The Urban Book Series

Małgorzata Hanzl · Anna Agata Kantarek · Artur Zaguła · Łukasz Musiaka · Tomasz Figlus *Editors*

Urban Morphology versus Urban Redevelopment and Revitalisation

Proceedings of the XXIX Conference of the International Seminar on Urban Form 2022

OPEN ACCESS

Springer

The Urban Book Series

Editorial Board

Margarita Angelidou, Aristotle University of Thessaloniki, Thessaloniki, Greece

Fatemeh Farnaz Arefian, The Bartlett Development Planning Unit, UCL, Silk Cities, London, UK

Michael Batty, Centre for Advanced Spatial Analysis, UCL, London, UK

Simin Davoudi, Planning & Landscape Department GURU, Newcastle University, Newcastle, UK

Geoffrey DeVerteuil, School of Planning and Geography, Cardiff University, Cardiff, UK

Jesús M. González Pérez, Department of Geography, University of the Balearic Islands, Palma (Mallorca), Spain

Daniel B. Hess, Department of Urban and Regional Planning, University at Buffalo, State University, Buffalo, USA

Paul Jones, School of Architecture, Planning and Policy Development, Institute of Technology Bandung University (ITB), Bandung, Indonesia

Andrew Karvonen, Lund University, Lund, Sweden

Andrew Kirby, New College, Arizona State University, Phoenix, USA

Karl Kropf, Department of Planning, Headington Campus, Oxford Brookes University, Oxford, UK

Karen Lucas, Institute for Transport Studies, University of Leeds, Leeds, UK

Marco Maretto, DICATeA, Department of Civil and Environmental Engineering, University of Parma, Parma, Italy

Ali Modarres, Tacoma Urban Studies, University of Washington Tacoma, Tacoma, USA

Fabian Neuhaus, Faculty of Environmental Design, University of Calgary, Calgary, Canada

Steffen Nijhuis, Architecture and the Built Environment, Delft University of Technology, Delft, The Netherlands

Vitor Manuel Aráujo de Oliveira, Porto University, Porto, Portugal

Christopher Silver, College of Design, University of Florida, Gainesville, USA

Giuseppe Strappa, Facoltà di Architettura, Sapienza University of Rome, Rome, Italy

Igor Vojnovic, Department of Geography, Michigan State University, East Lansing, USA

Claudia van der Laag Yamu, Oslo, Norway

Qunshan Zhao, School of Social and Political Sciences, University of Glasgow, Glasgow, UK

The Urban Book Series is a resource for urban studies and geography research worldwide. It provides a unique and innovative resource for the latest developments in the field, nurturing a comprehensive and encompassing publication venue for urban studies, urban geography, planning and regional development.

The series publishes peer-reviewed volumes related to urbanization, sustainability, urban environments, sustainable urbanism, governance, globalization, urban and sustainable development, spatial and area studies, urban management, transport systems, urban infrastructure, urban dynamics, green cities and urban landscapes. It also invites research which documents urbanization processes and urban dynamics on a national, regional and local level, welcoming case studies, as well as comparative and applied research.

The series will appeal to urbanists, geographers, planners, engineers, architects, policy makers, and to all of those interested in a wide-ranging overview of contemporary urban studies and innovations in the field. It accepts monographs, edited volumes and textbooks.

Indexed by Scopus.

Małgorzata Hanzl · Anna Agata Kantarek ·
Artur Zaguła · Łukasz Musiaka · Tomasz Figlus
Editors

Urban Morphology versus Urban Redevelopment and Revitalisation

Proceedings of the XXIX Conference of the International Seminar on Urban Form 2022

Springer

Editors
Małgorzata Hanzl
Lodz University of Technology
Lodz, Poland

Anna Agata Kantarek
Cracow University of Technology
Krakow, Poland

Artur Zaguła
Lodz University of Technology
Lodz, Poland

Łukasz Musiaka
University of Łódź
Lodz, Poland

Tomasz Figlus
University of Łódź
Lodz, Poland

ISSN 2365-757X ISSN 2365-7588 (electronic)
The Urban Book Series
ISBN 978-3-031-77751-6 ISBN 978-3-031-77752-3 (eBook)
https://doi.org/10.1007/978-3-031-77752-3

This volume's publication was supported by Polish state funds allocated by the Minister of Science and Higher Education. Task: "International Seminar on Urban Form 2022", Programme: Excellent Science, Contract No. DNK/SP/512952/2021.

© The Editor(s) (if applicable) and The Author(s) 2025. This book is an open access publication.

Open Access This book is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.
The images or other third party material in this book are included in the book's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the book's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

If disposing of this product, please recycle the paper.

Contents

1 Introduction. Urban Redevelopment and Revitalisation. A Multidisciplinary Perspective 1
Anna Agata Kantarek, Małgorzata Hanzl, Tomasz Figlus, Łukasz Musiaka, and Artur Zaguła

Part I Methods for Analysing the Transformation of Spatial Structures of Settlements

2 Morphogenesis and Urban Change in Newcastle upon Tyne: Context and Process 9
Michael Barke

3 Quantitative Analysis of Urban Form Through Urban Section: A Case Study of Nanjing, China 31
Ziyu Tong, Jingjing Dong, Lian Tang, and Zhichao Yu

4 Historical–Geographical and Procedural Typological Approach in Urban Renewal: As a Case Louroujina, Northern Cyprus 57
Nevter Zafer Cömert

5 Intellectual Heritage for Morphological Studies in Belgrade, Serbia: Understanding Spatial Transformations Through Review of Academic and Practical Thoughts and Actions from 1969 to 1981 73
Vladan Djokić, Milica P. Milojević, Aleksandra Milovanović, Aleksandra Djordjević, and Mladen Pešić

6 Quantity Versus Quality: Do Citizens in Denser Neighbourhoods Have Poorer Access to Urban Open Spaces? A Pilot Study in Stavanger, Norway 95
Todor Kesarovski and Fabio Hernández-Palacio

7 Reading for Rewriting Chinese Urban Form: The Dual Typo-Morphology of Nanshijie Block in Ganzhou 111
Laura Anna Pezzetti and Li Bao

8 From Maps to Diagrams. A Morphological Tool to Unravel Transitional Processes 147
Rossella Gugliotta

9 Typology and Morphology: The Gene of Chinese Traditional Town Form 167
Laura Anna Pezzetti and Wowo Ding

10 Typo-morphology in the Cognition of Traditional Landscape Region—Case Study of Urban Design Project in Changting Town, China 181
Yidan Liu, Lian Tang, and Wowo Ding

Part II Economic, Functional, Infrastructural Changes and Political, Legal, and Administrative Conditions for the Redevelopment and Renewal of the Urban Tissue

11 The New Urban Agenda in Urban Redevelopment: The Central Role of Public Space Networks 205
Michael W. Mehaffy

12 From Feudalism to Socialism: Socialization Process and Changes in Political Meaning of the Built Environment in Traditional City Central Areas 221
Xueqi Chen and Feng Song

13 Exploring the Interaction Between Urban Landscape and Regeneration Decision-Making Factors in the Context of Urban Regeneration, Exemplified by Liverpool Docklands 241
Junyuan Lu and Feng Song

14 The Impact of Plot Configuration on the Patterns of Spatial Change: A Diachronic Approach to the Urban Redevelopment Processes in New York, Melbourne and Barcelona 267
Onur Tümtürk

15 The Impact of Innovation Economy on Urban Form and Its Transformation: Taking Cases on Shenzhen 285
Zhenyuan Yang and Kai Xu

Part III Social and Cultural Determinants of Spatial Redevelopment and Regeneration

16 Urban Regions Under Stress: The Case of Madrid After the Lockdown 311
J. Barros-Guerton and J. M. Ezquiaga-Domínguez

17 Residential Community Renewal Performance Assessment Based on Social Network Analysis—Taking Jialingqiao Xicun Community, Chongqing Municipality, for Example 335
Simai Pang and Bo Yan

18 Urban Morphological Transformation in Modern Ningbo: Social Change and Street System 355
Panpan Jin and Naoto Nakajima

19 Chinatown's Key, Built Form Elements of Sense of Place: Findings from an Immersive Visual Survey 371
Francisco Alaniz Uribe, Nathan Stelfox, and Emily Kaing

Part IV Theoretical Concepts for Understanding the Redevelopment and Revitalisation of Spatial Structures and Directions of Changes in Historic Urban Structures

20 Christopher Alexander's Challenge for Implementation: Report from an ESRG Symposium 399
Michael W. Mehaffy

21 Urban Form and Sustainability. New Adaptive and Resilient Tools and Strategies for the Regeneration of Territories of Unauthorized Production 411
Francesco Crupi

22 Historic Neighborhoods' Preservation: Applicability of Morphological Regions as a Tool to Protect the Urban Memory and Urban Space of a Black Community Neighborhood in Uberlândia, Brazil 437
Glauco Cocozza

23 Multiscale and Multi-Temporal Simulation of Change of Urban Structures in the Subarctic East Siberian Metropolis of Yakutsk 455
Sébastien Gadal, Mounir Oukhattar, Jūratė Kamičaitytė, Moisei Zakharov, Walid Ouerghemmi, and Ismaguil Hanadé Houmma

24 The Invention of the Old City. A Didactic Experiment: Three Projects for Lübeck 477
Michele Caja and Pierfrancesco Sacerdoti

25 Adaptation to Climate Change—A Challenge for Small Towns 497
Bartłomiej Olczak and Małgorzata Hanzl

26 Public Open Spaces and Water: Urban Design in Response to Climate Change 521
Carlo Berizzi, Marta Mazurkiewicz, and Gaia Nerea Terlicher

27 Developments in Urban Design Practice in Kadıköy Region of Istanbul: A Morphological Perspective 545
Ayşe Sema Kubat, Şebnem Çebi, and Mehmet Ronael

Part V Practical Architectural and Urban Solutions

28 Invigorate Urban Public Vitality Based on Spatial Characteristic Analysis: A Case Study of Lujiazui Central District 569
Ying Yang, Kun Liu, Shuling Liao, and Yong Liu

29 Urban Form of Settlements on Water: A Morphometric Comparison Between Makoko and Venice 589
Alessandro Venerandi, Johan Mottelson, and Sergio Porta

30 Interface Regeneration and Place-Making Spatial Revitalisation of Shapowei Historical Environment in Xiamen 611
Biao Yin and Lijun Wang

31 Urban Form, Plans and Procedures in Serbia: Recent Transformations of Urban Tissue and Its Inherited Values 631
Ana Niković and Božidar Manić

32 Regenerative Learning Architecture. The School Campus of Vimercate as a Unit of Urban Morphology 657
Laura Anna Pezzetti and Helen Khanamiryan

33 Study on a Paradigm of Micro-Regeneration of Urban Community—Taking Three Cases of House Upgrading in Xiaoxihu Traditional Block, Nanjing 685
Li Bao, Yichang Sun, Han Wang, and Zixuan Liu

Chapter 1
Introduction. Urban Redevelopment and Revitalisation. A Multidisciplinary Perspective

Anna Agata Kantarek, Małgorzata Hanzl, Tomasz Figlus, Łukasz Musiaka, and Artur Zaguła

Abstract The XXIX ISUF conference book explores the multifaceted theme of urban redevelopment and revitalisation through the lens of urban morphology. It underscores the growing relevance of urban rehabilitation, particularly in light of the principles of urban metabolism and circular economy. It addresses the theoretical and methodological intersections between urban morphology and urban rehabilitation, advocating for a multidisciplinary approach to tackle the diverse challenges of urban renewal. Key themes include political, legal, and administrative conditions influencing urban transformations, and the social and cultural determinants affecting spatial redevelopment. The book also offers a comprehensive review of current theoretical and practical expertise, providing insights into economic, functional, infrastructural changes, and the impacts of climate change on urban strategies. It examines methodological advancements, ranging from traditional case studies to advanced digital tools like GIS and AI. The volume includes detailed analyses of political and economic systems' influence on urban renewal, case studies on social participation, and the impacts of migration and cultural diversity. Additionally, it discusses theoretical concepts linking urban morphology with urban renewal, exploring sustainability and climate change effects. Practical architectural and urban solutions are

A. A. Kantarek (✉)
Cracow University of Technology, Krakow, Poland
e-mail: anna.kantarek@pk.edu.pl

M. Hanzl · A. Zaguła
Lodz University of Technology, Lodz, Poland
e-mail: malgorzata.hanzl@p.lodz.pl

A. Zaguła
e-mail: artur.zagula@p.lodz.pl

T. Figlus · Ł. Musiaka
University of Lodz, Lodz, Poland
e-mail: tomasz.figlus@geo.uni.lodz.pl

Ł. Musiaka
e-mail: lukasz.musiaka@geo.uni.lodz.pl

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_1

highlighted, showcasing implementations from various countries to offer a global perspective on the morphological method in urban revitalisation.

Keywords Urban renewal · Urban revitalisation · Urban morphology · Multidisciplinary approach

The XXIX ISUF Proceedings book aims to present the broadly understood theme of redevelopment and revitalisation of spatial structures. Urban morphology research brings valuable knowledge to the theory and practice of urban rehabilitation. Studies on transformations of the urban fabric are at the core of both fields. Saverio Muratori (1959), one of the founding Fathers of urban morphology science, claimed the need for "storia operante" (operational history). Since the care to apply research on urban form in building and rebuilding cities became one of the principles of urban morphology, both the classical schools of urban morphology (Conzenian and Italian) deal with urban transformations and they perceive these processes either as the burgage cycle that we find in the works of MRG. Conzen (1960) and his followers, or as the territorial development cycle described by Caniggia and Maffei (1979).

Recently, urban rehabilitation has received more attention due to the growing interest in urban metabolism and the circular economy. As a result, the re-use of existing resources, including buildings and urban development, has become a core principle of "trias ecologica".

At a time when the global urban population is rapidly growing, and more than half of the world population lives in cities, there is no question that continuity and re-use are the only available strategies. The first two chapters of the current book cover these topics.

First, we propose to examine theoretical concepts that might arise at the boundaries of urban morphology studies and urban rehabilitation. Next, we look at the theoretical and methodological aspects of the emerging fields.

At the same time, the challenges that result from the re-use of existing urban environments are numerous and diverse. As a consequence, urban renewal processes require the concerted knowledge of several cooperating disciplines. The main themes presented cover the most significant areas of expertise to be considered. We look at the political, legal and administrative conditions of the redevelopment and renewal of urban fabric. These initial insights deal with decision-making factors and their impacts on the transformations of urban places. The following section revolves around the social and cultural determinants of spatial redevelopment and regeneration. As Rossi (1984) stated, cities are artefacts of the societies that built them; therefore, the two fields are inextricably linked and cannot be approached independently.

The book provides a comprehensive review of current theoretical and practical expertise at the confluence of urban morphology and urban rehabilitation. The holistic perspective leads a reader from theoretical explanations and approaches to the more practical experience in the design of urban places. The extensive methodological

section illustrates the progress of methodology. The following chapters offer insights from several perspectives: political, social and cultural to the economic. Each chapter examines the intersection with the field of morphological studies.

The book will explore the current state of evolving world urban morphology, encompassing the following chapters:

I. Methods for analysing the transformation of spatial structures of settlements.
II. Economic, functional, infrastructural changes and political, legal and administrative conditions for the redevelopment and renewal of the urban tissue.
III. Social and cultural determinants of spatial redevelopment and regeneration.
IV. Theoretical concepts for understanding the redevelopment and revitalisation of spatial structures and directions of changes in historic urban structures.
V. Practical architectural and urban solutions.

Before going on to describe the individual chapters, let's point out a few general observations about the publication. First, it is interesting to note the wide range of issues covered in the articles. The scale of topics ranges from regions, cities, districts to plots or individual buildings. There are threads related to both large agglomerations and small towns. Secondly, the variety of methods used by researchers from case studies to advanced digital methods and new theoretical postulates related to city morphology is also important. Another important fact is the wide geographical scope of the issues covered, testifying the global reach of morphological theory. Among the articles we find topics related to almost all continents. Although there is a definite predominance of European issues, there is also a large contribution from Asia (mainly China) but we will also find issues related to the Americas and even Australia and Africa. A very interesting phenomenon is the huge contribution of Chinese researchers and topics related to China. As many as 13 articles concern them, which shows the dynamic development of the morphological method in this country. One can see a clear trend in the interest in their own cultural heritage and their desire to reconstruct it. Finally, it is worth noting the increasing importance of issues related to climate change and the search for urban strategies seeking to minimize its effects.

Let's now briefly characterize the individual chapters that make up the publication. **The first** is entitled *Methods for analysing the transformation of spatial structures of settlements.* The chapter examines the transformation of spatial structures of human settlements from different methodological perspectives. The traditional dichotomy stemmed from the disciplinary provenance of the researchers involved. Thus, architects in the Muratorian School of urban morphology focus on a more detailed scale while the historical geography approach of the Conzenian School revolves around more general historical processes of land transformation. More recently, this catalogue has been enriched by the development of quantitative methods of urban morphometry, on the one hand, and a large amount of more specialized qualitative research that has been developed on the boundaries of other disciplines. The first group includes configurational analyses which include Space Syntax, and other more variegated methods based on the application of advanced computer tools, such as Geographic Information Systems. The latter covers various studies of public

space and its cultural aspects, environmental and landscape analysis and a range of methods that have developed internationally, grounded in local cultural contexts. All these methods and procedures yield valuable insights into the theory and practice of urban rehabilitation. The chapter proposes research methods useful in analysing the transformation of spatial structures, particularly concerning historic cities. Among propositions we can find: the rotational series sections method; an analysis that mixes GIS mapping and morphological drawings of small fragments of the city and its metropolitan area; a diagram that fills the gap between the traditional method and innovative AI tools; a stronger focus on the processes operating at a variety of scales; emphasize the importance of typo-morphology in delineating a traditional landscape region; and a shared taxonomy of urban fabric types (morphotypes) for the different case studies. The large number of articles considering methodological issues is significant. This means that the study of urban morphology continues to develop its own research idiom reaching out to new developments, especially digital technologies.

Chapter 2 examines the various factors influencing the transformation of the urban tissue, particularly in the context of renewal and revitalisation. The processes of redevelopment and renewal of the urban tissue, which take place both at the macroscale covering entire countries or administrative regions and also at the level of microscale units, such as individual cities, quarters, and housing estates are strongly dependent on political conditions. The forces for shaping the urban fabric derive to a great extent from political and economic systems. Different morphological changes and directions of spatial development can be observed whether they take place in the conditions of a free market or a central planning system. Administrative stimulants and barriers are also very important for the possibilities of urban redevelopment. Legal instruments (including acts, directives, and various local legal regulations) significantly affect the methods of implementation, spatial scope, dynamics, and intensity of revitalisation processes.

Economic, functional, and infrastructural factors have also a huge impact on shaping the renewal processes of cities. Among the other aspects, economic factors have led to the deindustrialization of western countries which, in search of higher profits, have relocated a large part of their production to countries with cheaper labour costs. Also in the post-communist countries, as a result of the socio-economic transformation of the 1990s, both entire economies and individual enterprises had to face the transition of their functioning by adapting to the requirements of the demanding capitalist market. The global factor of the changing economies and societies of a functional nature, which has a significant impact on renewal processes, can be described as the process of tertiarization, i.e. the gradual development of the service sector with the simultaneous reduction of the industrial sector. It accompanies the dynamic development of technology, transport, communication, and industrial infrastructure.

The chapter includes both articles relating to functional and infrastructural changes, e.g. the impact of plot configuration on the patterns of spatial change, as well as those relating to the broader political-economical spectrum. Of interest

are attempts to identify the impact of innovative economics and the development of network sciences on the form of the city and its transformation.

Chapter 3 presents social and cultural determinants of spatial redevelopment and regeneration. Spatial redevelopment and regeneration processes are deeply embedded in the social and cultural environment. Cities are considered artefacts of the societies that built them. The social context both determines and is affected by the physical context in mutual processes of interaction and interplay. Therefore, to fully grasp the complexity of interactions between built structures and the social phenomena that they accommodate, this theme welcomes articles on a range of topics that connect these two fields: sociology and cultural studies, on the one hand, and urban morphology and form studies, on the other. The field seems broad since it extends from social participation and those conflicts that affect urban redevelopment and go beyond structural changes. The focus is on how social forces and processes affect physical structures. There are numerous contemporary societal challenges related to these topics, such as migrations and the impacts of cultural diversity on the built environment or the redevelopment processes of informal settlements. The quest for healthy environments that support well-being and a high quality of life complete the picture. Examples from China and Brazil illustrate progressive social change and its impact on changes in urban space. Interesting issue to consider is also the correlation between the evolution of COVID-19 and changes in social dynamics.

Chapter 4 presents a series of articles that address theoretical concepts covered by the field of morphology. They feature a number of both classical and innovative constructs. This theory section reveals the connections between established morphological theories and urban renewal. It explores established ideas in both fields and their overlaps. The epistemology of urban renewal and urban morphology together contributes to developing practical recommendations for the future re-use of the urban fabric. Theoretical concepts of urban renewal and revitalisation together with the directions of change of transformational processes can help answer the question: How to ensure effective protection of historic urban structures? They can be a train of thought that in the future will allow effective changes in design practice and ultimately lead to the protection of heritage while maintaining the vitality of the urban organism. One of such trial was research work which led to design proposals for Lübeck aimed at replacing out-of-scale or poor-quality buildings from the post-war reconstruction period. However, to develop the practice from theory is not an easy task, as evidenced by the problem with the implementation of Ch. Alexander's thought, one of the most influential figures of late twentieth century urban and architectural theory. Another important theoretical issue that we currently have to consider is sustainability and climate change and their impact on the renewal and revitalisation of the urban tissue. These topics are raised in articles, both in relation to large urban centres and small towns.

Chapter 5 presents practical architectural and urban solutions. Urban renewal and revitalisation, in its broadest sense, refers to the social and economic spheres of the city. Spatial actions are understood as a resultant. However, the assumption of the internal strength of the logic of an urban form shows us that it is the form (in line with the life requirements of a specific community) through its shape which

is generative. Thus, specific solutions at the planning, urban, or architectural scale are the basis for well-understood revitalisation. The presentation or comparison of individual cases, by showing the relationship in the design process between the law and its application, features of local culture, agents of change, and the use of space, as well as the functional and spatial solutions used at various scales, are another scope for research carried out as part of urban morphology. The articles present examples of implementations from different countries and cities, which can become a reference for developing further activities in the use of the morphological method in renewal and revitalisation.

We hope that the volume handed over to you on urban morphology in the context of urban renewal and revitalisation will meet with interest on the part of the reader and at the same time contribute to expanding the research field in this topic.

References

Caniggia G, Maffei GL (1979) Composizione architettonica e tipologia edilizia 1. Lettura dell'edilizia dibase, Marsilio Editore, Venezia

Conzen MRG (1960) Alnwick, Northumberland: a study in town-plan analysis. Institute of British Geographers Publication 27, London

Muratori S (1959) Studi per una operante storia urbana di Venezia. Istituto Poligrafico dello Stato, Rome

Rossi A (1984) The Architecture of the City, The MIT Press, Cambridge, Massachusetts, London

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Part I
Methods for Analysing the Transformation of Spatial Structures of Settlements

Chapter 2
Morphogenesis and Urban Change in Newcastle upon Tyne: Context and Process

Michael Barke

Abstract This paper will argue that the study of morphological processes has lagged behind the identification and classification of morphological patterns. Examples from Newcastle upon Tyne will be used to illustrate this argument, ranging from mediaeval burgage plots, through a typology of nineteenth-century working-class terraced housing that emerged in the west end of the city, and more recent twentieth-century social housing. It is concluded that a deeper understanding of urban forms is dependent on a stronger focus on the processes operating at a variety of scales.

Keywords Morphogenesis · Newcastle upon Tyne · Working-class housing · Morphological legacy · Housing policy

2.1 Introduction

The principal theme of this paper is concerned with morphological processes and, perhaps contentiously, with what the author regards as their relative neglect. It is important to clarify that the word 'process' is used here in the broadest sense and is concerned with the transmission of ideas as well as tangible physical outcomes. The study is mainly concerned with the west end of the city of Newcastle upon Tyne and in terms of its academic provenance it is based firmly in the historico-geographical tradition in urban morphology. Urban morphologists will need no reminder that Newcastle upon Tyne was the location of seminal morphological research by Conzen and Whitehand and therefore the comments made here should resonate in a variety of ways.

M. Barke (✉)
Department of Geography and Environmental Sciences, Northumbria University, Newcastle Upon Tyne, UK
e-mail: mikebarke46@hotmail.co.uk

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_2

2.2 Morphogenesis

In the context of a study of process, it is useful to start with one word—morphogenesis. Curiously, this is a word that is familiar to all urban morphologists but which on further analysis seems to be remarkably underused. For example, a simple content analysis of the titles and keywords in main papers and viewpoint articles in the journal *Urban Morphology* from 1997 to 2021 (49 issues in total; 183 main articles, and 203 viewpoints) shows limited usage (Table 22.1). This is an arguably imperfect measure but the relative paucity of occurrence of the word in this volume of titles and keywords is both surprising and informative.

The specific concern about this relative absence is that the words 'morphogenesis' and 'morphogenetic' are essentially about process. The central message of this paper is to make a plea for a more direct consideration of 'process' in the field of urban morphology. By 'process' I mean something that causes certain phenomena to come about and/or to change. Urban morphology is very good at pattern recognition and, indeed, there exists a quite sophisticated 'tool kit' (or several 'tool kits') to recognise and describe morphological patterns and morphological components but it is possible to argue that less direct overt attention has been given to process. The argument developed here is that we need more studies of process understood as a dynamic set of forces—things that explain why things happen or happened in a specific way. Of course, the word 'process' does appear in many studies but sometimes what is presented as process is simply a description of a sequence of patterns at different stages, or sometimes little more than an account of the context within which change takes place.

A widely cited example concerns Conzen's work on mediaeval Newcastle upon Tyne (1962) but what follows is a small but important extension of this. It concerns the area of East Pilgrim Street where Conzen exemplified the burgage cycle (Fig. 2.1).

Table 2.1 'Morphogenesis'—a forgotten word? (word/term occurrence)

Word/term	UM main articles	UM main articles + viewpoints
	Key words	Titles
Urban morphology	39	91
Urban form	30	60
Typological process/process typology	4	9
Typology	10	3
Urban tissue	5	2
Planning	26	22
Urban design	24	17
Landscape	10	9
Space syntax	11	2
Morphogenesis/morphogenetic	3	3

Source Author's survey

However, an important issue concerns the process under which this burgage series emerged, something that Conzen didn't really consider. However, the eminent urban historian Maurice Beresford (1967) was in no doubt—'the basic street pattern north of the Castle (i.e. including this area of Pilgrim Street) bears evidence of Norman 'new borough' planning'. In other words, the 'process' was effectively a central planning directive. But, on closer examination, this seems unlikely. In fact, it is possible to identify four phases of development (from the eleventh century to the thirteenth century) in this burgage series (Fig. 2.2). The identification is based on a combination of form (morphological) detail and archaeological evidence (Graves and Heslop 2013, p. 132). The burgage plots shown as A-B developed first, there was then a later extension northwards of nine plots, wider and deeper than the first; plots C-D were clearly much narrower and had a slightly different alignment; finally, plots D-E were much narrower and shorter.

Conzen's purpose was much more concerned with what happened to the burgage plots after their formation (that is, the burgage cycle) and, understandably, he didn't really consider the process of their formation. But the latter is important and the distinction between a 'planned' series and an organically emerging one is fundamental. The process here was not the one, single decision to lay out an overall template for this part of Newcastle upon Tyne, it was a much more piecemeal set of decisions made over the course of a couple of hundred years, that is, a process of organic growth.

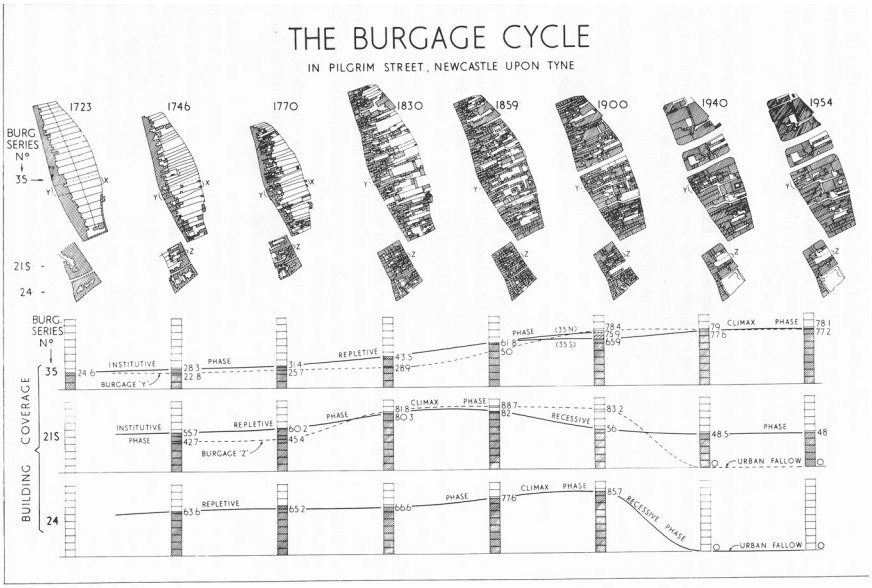


Fig. 2.1 Conzen's burgage cycle, east Pilgrim street

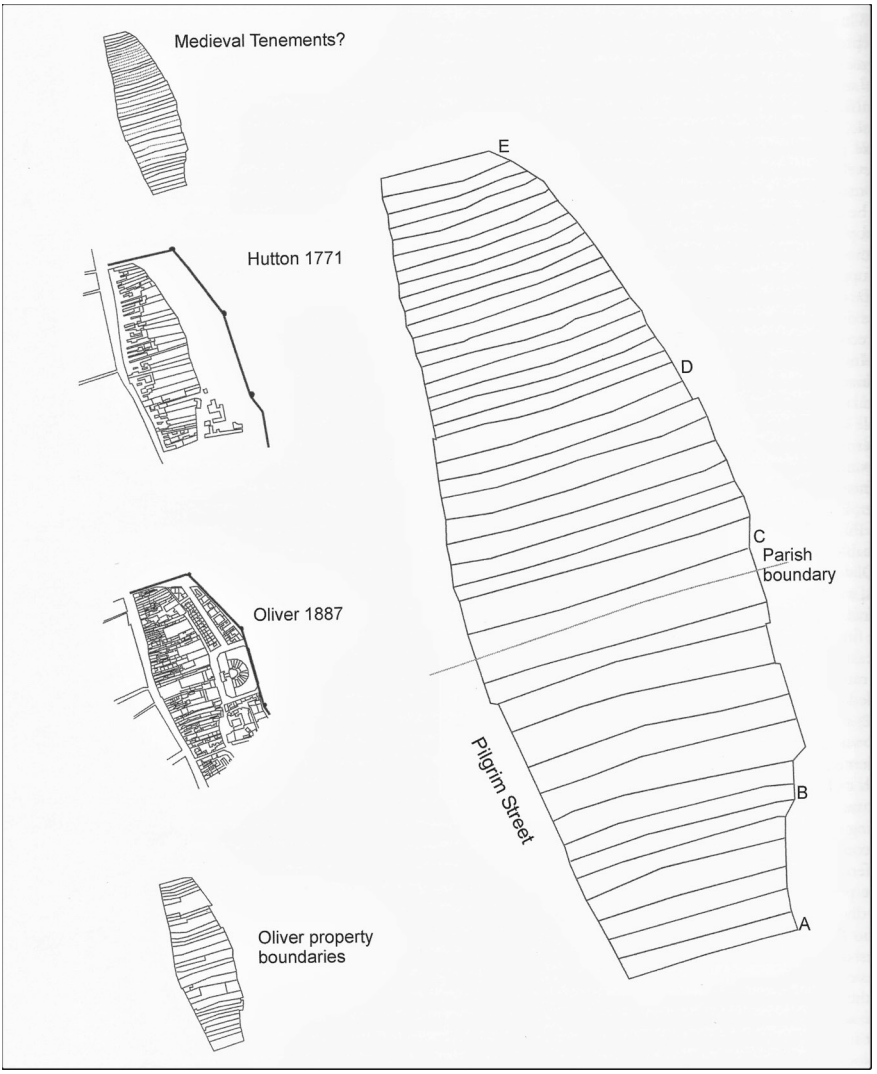


Fig. 2.2 East Pilgrim street burgage plots

2.3 Recent Developments in Newcastle upon Tyne

Some recent developments in Newcastle upon Tyne have reinforced the importance of considering the processes of morphological change and how, in contemporary urban areas, these may relate also to the challenges of a neo-liberal era (or possibly a post neo-liberal era) when traditional conceptions, terminology and categorisations are less appropriate than formerly (especially in this context of 'process').

Intriguingly, the developments that have stimulated this concern and, more broadly, some disquiet about how we approach 'process' in urban morphology are concerned with two iconic sites in Newcastle, frequently cited as representative of 'classical' urban morphological phenomena. One we have looked at already and concerns the series of burgage plots on Pilgrim St. in the city centre. The second concerns a segment of the Outer Fringe Belt in the north of the city (Fig. 2.3). The former was studied by Conzen (1962) and the latter by Whitehand (1967). But what is of considerable interest in this context of contemporary processes is that these two sites have become linked.

The East Pilgrim Street burgage plots have clearly passed through their full cycle (Fig. 2.4), reaching the phase of urban fallow, and are now in the process of wholescale development. The photograph is taken looking at the back of East Pilgrim St. which runs across the top of the photograph and the burgage plots ran from left to right, down the slope. It is immediately apparent that a significant component of Newcastle upon Tyne's mediaeval morphological heritage is being lost at the present time. Indeed, it has been calculated that only 8% of Newcastle's historic burgage plots actually remain (Graves and Heslop 2013). It is the case that, in terms of commercial viability, East Pilgrim Street has been problematic for many years, with a lengthening history of poor property maintenance and a growing volume of empty property, apparently signalling to many that the area was ripe for clearance. However, in terms of what is

Fig. 2.3 North Newcastle outer fringe belt

happening in this area now, that is, the contemporary process—this site is now linked to a significant section of Newcastle's northern Outer Fringe Belt (Fig. 2.3). This area developed south of the fixation line of the railway to the coast, consisting of a series of institutional and sport-related land uses including a convent with associated school, a golf course, the Freeman Hospital site and, more significantly, a very large area of Government Department offices, known locally as the 'Ministry'. Although initiated in the 1930s this Outer Fringe Belt area consolidated mainly in the post Second World War period. In the late twentieth and early twenty-first centuries, the 'Ministry' and Freeman Hospital have progressively intensified investment and buildings on their sites.

However, in accelerating pursuit of a neo-liberal agenda, successive Governments have been keen to reduce costs and/or increase revenue from their assets. The principal way of doing this in such sites is, of course, to capitalise on the value of land—a process that famously began in the Thatcher years with schools being encouraged to sell off their playing fields and health institutions their green open spaces. This process has been accelerated by recent Governments with sites increasingly colonised for residential developments (Fig. 2.5). Indeed, the 'nibbling away' at such sites has been replaced by 'gobbling'! Institutions and government departments have for some time been engaged in re-appraising the use value of their 'estate', that is, the land they own and, in the context of declining support from Central Government funds, have sought to use their land to generate finance. But this, of course, is a 'one off'

Fig. 2.4 Rear of east Pilgrim street former burgage plots

Fig. 2.5 Recent house building on ministry site

source of income generation. In fact, this 'Ministry' site is to be closed and sold off to residential developers, a process that is already under way. However, the linkage to the East Pilgrim Street site described earlier is that, to justify the comprehensive redevelopment of the city centre site, the functions of the Government Departments, formerly located on the Outer Fringe Belt site, are to be transferred to East Pilgrim Street, to the site of the previous burgage series.

This example of abrupt morphological transformation, and a more detailed historical example to be discussed shortly, relates to observations made by Larkham (1999) on the concept of 'evolution' in urban morphological studies. The article identifies important differences (in outcomes but also in terms of process) between the traditional, 'gradualist' view of evolution and a situation where long periods of only minor change are followed by short bursts of extremely rapid change. The case of East Pilgrim Street and the northern Outer Fringe Belt is clearly an example of the latter case of rapid change. The key question, of course, is what causes this rapid change? In similar vein, amongst other things, Kropf (2001) in a paper on 'conceptions of change' pointed out the significance of 'agency' as a process—'Changes do not occur of their own accord. Building types do not just change, people change them' (pp. 33–4). However, the example discussed above shows that it is not just 'people' as individuals who have agency, so do organisations.

An extensive reading of the literature, together with the empirical evidence on the paucity with which terms such as morphogenesis are used only reinforces the view

that the consideration of causative processes in urban morphology lags somewhat behind the consideration of form. In the conviction that process can often be more clearly discerned in the examination of historical examples, attention will now be turned to the morphological development and change in the west end of Newcastle upon Tyne. In this examination, a further theme will be developed, namely, the conviction that the study of the processes of morphological change requires the examination of the impact of previous forms upon subsequent ones but also the existence of ideas and concepts of how urban form should be shaped at a particular period of time in a particular place will also impact on subsequent ideas and concepts.

2.4 Newcastle's West End

Given their significance in terms of scale and their overall contribution to the urban landscape, there are remarkably few morphological studies of industrial landscapes although exceptions include Conzen (1978) and Mortimore (1969). Local urban histories provide useful information but are usually divorced from a conceptual framework that would facilitate more general comparisons. Perhaps it is no surprise therefore that, historically, and in the recent past, the west end of Newcastle upon Tyne has been perceived as an archetypical industrial suburb (Fig. 2.6). Like similar areas, most accounts of the development of the area follow a fairly simple sequence. For example, Smailes (1960) observes 'Since most of the new employment that was responsible for crowding workers on Tyneside was provided alongside the river itself, the spread of housing to north and south was limited compared to lateral extension…' and, significantly, Middlebrook (1950) notes '…the vast expansion of the suburbs most impressed contemporaries. The overspill westwards into Elswick and Westgate … was mainly by artisans who **had to** (*my emphasis*) live near the shipyards and engineering shops along the river…'. The implied sequence therefore is that industry grew westwards along the river, creating substantial employment. The workers clearly demanded housing accommodation which was readily supplied. The reality was not like this at all. In fact, for a large part of the later nineteenth century there was a considerable mismatch of employment growth and housing provision (Benwell Community Development Project, 1978c). Table 2.2 shows the expansion of employment at Armstrong's massive Elswick works, by far the largest employer in the area. Particular noteworthy is the growth of employment between 1851 and 1863, a period in which there was hardly any house building in the locality. The major spurt in house building was in the 1880s by which time over 12,000 people worked at Armstrong's Elswick works.

The conventional accounts of the development of Newcastle's western industrial suburbs do not therefore relate to the actual sequence of events. In particular, the timing of residential growth actually related to a complex of factors, other than the simple demand for worker's housing. Foremost amongst these was a growing concern about labour relations. Whilst it may seem slightly odd to give prominence to the topic of industrial relations in an article concerned with morphogenetic processes, this

Fig. 2.6 Elswick and Benwell 1904

Table 2.2 Nineteenth-century employment at Armstrong's works, West Newcastle

Date	Number employed
1847	26
1851	400
1863	4,000
1886	12,000
1892	13.000
1906	23,000

Source Various

factor does relate directly to the context and process of development of Newcastle's west end. An event that was central to this was the so-called Engineer's Strike of 1871 (Allen et al. 1971), ostensibly principally about securing a 9-h working day. Employers, led by Armstrong, opposed this, but after a bitter confrontation, lasting 20 weeks, eventually gave way, perhaps the most significant victory for organised labour on Tyneside up to this point. It is no coincidence that, subsequently through the 1870s, a series of charitable bequests from industrialists in the building of schools,

public baths, libraries, public parks and—for some—better housing (Barke 1977; Benwell Community Development Project 1978a) took place. Such social concessions represented an attempt to mollify the new-found militancy and confidence of organised labour within the region. The large-scale development and built form of the west end of Newcastle was significantly affected by these processes.

However, we need to dig a little deeper in search of a comprehensive account of the development of this area. The fortunes of the west end had also been profoundly impacted by the failure of an earlier and entirely different development scheme, one initiated by the entrepreneur and developer Richard Grainger (Green 2016). In fact, this proved to be a significant factor in the delay in provision of working-class accommodation in the area, despite an unquestionable demand.

It is important to understand that Grainger was the person principally responsible for the much-lauded large-scale development of Newcastle's city centre in the later 1830s (Wilkes and Dodds 1964). It was on the basis of this work that he turned attention to the West End. In January 1839, he purchased the Elswick Estate from John Hodgson Hinde for the then considerable sum of £114,100. It appears that he borrowed virtually all of this sum from various banks and creditors. He saw this as 'yet another opportunity to acquire building ground' (Wilkes and Dodds 1964: 104). In effect, his intentions were to carry on with large-scale development, but this time creating a residential area in the northern section and a riverside industrial and commercial zone. Grainger moved into Elswick Hall and development started in the early 1840s. Amongst the first projects was the elegant terrace of Graingerville South and he clearly intended to create a middle-class villa suburb (Fig. 2.7) in the north of the area. Negotiations with the Tyneside Natural History Society, seeking to develop Botanical and Zoological Gardens at this time, held out the prospect of the creation of a positive externality function for the area. But Grainger also recognised that industrial and commercial development would be profitable, especially along the riverside southern section of the Estate. Accordingly, a serious proposal was made to create Newcastle's main line railway station there, connecting north to Edinburgh, west to Carlisle and east to Tynemouth.

Although some of these developments were started, and some remain, Grainger had over-stretched himself. He was declared bankrupt and was forced to leave Elswick Hall and abandon his plans. The management of his affairs fell to his associate, the remarkable John Clayton, Newcastle's Town Clerk and it was Clayton who subsequently managed the development of the area in the interests of servicing Grainger's debts. This involved a very different type of development—and one that played into many of the social objectives of the 'ruling class' relating to how to respond to the emergence of more militant working-class movements. This process took place over a lengthy period as Clayton's decisions, especially their timing, were designed to maximise profitability—parts of the Estate were sold off piecemeal (e.g. Fig. 2.8) to builders/developers, often under quite specific covenants relating to the form of development. The morphology of the emerging area thus owed a huge amount to the decision-making of this one individual—this was the process by which the area took on its form. A very similar role with similar objectives was played by W.G. Armstrong in the development of parts of the Benwell Estate immediately to

Fig. 2.7 Incipient villa suburbs

the west. For example, the area marked as number 1 on Fig. 2.9 had been inherited by Buddle Atkinson (a minor) but with Armstrong and a colleague as guarantors. Although Armstrong didn't actually own the land, he therefore had the power to determine when and how development took place. The strategy was the same as that employed by John Clayton in his management of the Elswick Estate, with a process of sub-division and sale to small building firms for building development

(Fig. 2.9). Significantly, there is no doubt that this involved a clear process of social engineering, linking morphology and social outcomes. Daunton (1983) has demonstrated that, in the second half of the nineteenth century, a new form of working-class housing emerged, one that had quite specific social objectives and outcomes:

> …the private domain of the house moved from a promiscuous sharing of facilities to an encapsulated or self-contained residential style. Secondly, the public domain of the city lost a cellular quality which had entailed an ambiguous semi-public and semi-private use of space, and took on a much more open texture. The third change is implied in these comments in the developments in the private and public domains. The boundary or threshold between the two became less ambiguous and more definite, less penetrable and more impermeable. (p. 12)

Furthermore, the development of Elswick and, especially, Benwell meant that they were effectively new towns. They had the effect of separating skilled manual workers from the unskilled. The former were pulled out of high density, tenemented residential areas in the central city and quayside whilst the latter remained in such localities. Additionally, in the detailed development of the Benwell estate, for example, certain streets were designated for rather superior housing, aimed at clerical and supervisory grade of workers (Barke 1977). This had the result of associating the skilled manual workers with those who supervised them at work in their residential environment, a process of conscious social engineering.

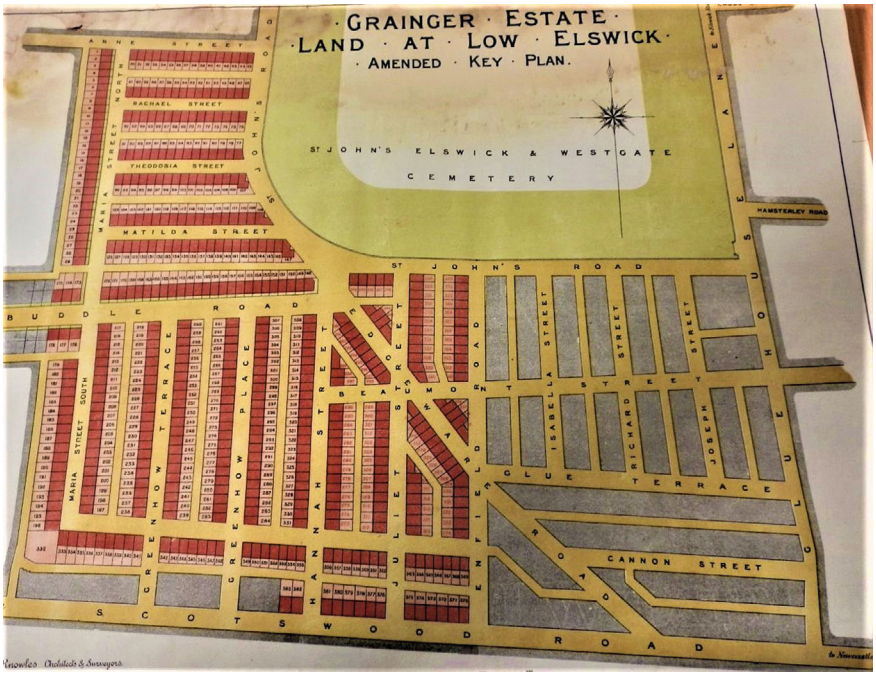


Fig. 2.8 Layout of low Elswick sub-division

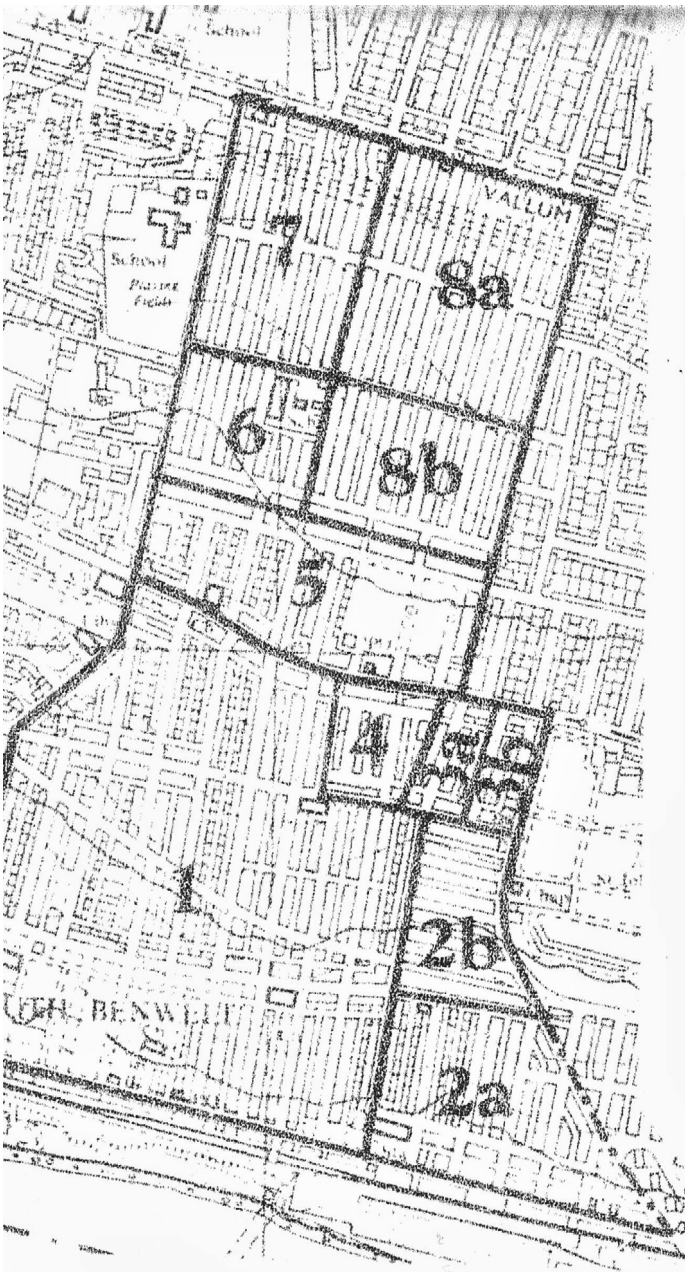


Fig. 2.9 West Benwell estate sub-divisions

The form and character of such 'respectable' working-class areas in the second half of the nineteenth century is usually interpreted through the imposition of local bye-laws, relating to minimum standards and building requirements (Daunton 1983; Muthesius 1982). These were introduced by national level public health legislation. But, in fact, the detail of such bye-laws was powerfully influenced by local interests and subject to manipulation. This is one reason why regional 'types' of working-class housing emerged in Britain, some with quite specific form characteristics, including on Tyneside (Lancaster 1994) as will be demonstrated below.

Therefore, contrary to Richard Grainger's intentions, what was built in Elswick and Benwell was a working-class suburb, a visually apparent morphological region that is usually characterised as a coherent unit. However, as already implied, there were important internal variations within the area and this raises important questions about the scale of resolution in determining a distinctive morphological region. At what level or scale should the defining characteristics be identified—and for what purpose? Such questions remain the topics of a rather different analysis but, for the present purpose, it is clear that the processes we have examined produced a morphologically distinct residential area (Fig. 2.6) but within this we can identify a typology of high-density terraced housing with subtle differentiations (Fig. 2.10 1–5) which related very closely to social categorisations within the inhabitants.

The area actually consisted of a hierarchy of terraced residential housing types. At the apex of this hierarchy was the two-storey house with a small private front garden and its own back yard (10.1), catering mainly for lower grade white-collar workers such as clerks and office workers. A slightly different arrangement housing similar households was the pedestrian-walkway street (10.2). Both these categories often demonstrated decorative details around doors and windows. Distinctly lower in the social hierarchy was the 'Tyneside flat' (Lancaster 1994; Pearce 1994) but this category also exhibited its own subtle social hierarchy. The basic 'Tyneside flat' form consists of a series of two-storey terraces with each storey containing a self-contained flat, normally of two bedrooms. The flats have adjacent entrance doors, one of which leads directly to a staircase to the upper flat. At the rear is an annexe containing a small scullery and the upper flat has an external staircase down to a small back yard containing an outside toilet and coal storage space. The lower flat has a rear door opening directly into this yard. The slightly superior 'Tyneside flat' possesses a small front garden and bay windows (10.3) whilst a notch lower in the typology is the version with a token small external front space but with no bay window and no or very limited decoration of door and window frames (10.4). In the basic form of this typology, the front door opens directly onto the street (10.5).

These detailed variations that emerged through a process of conscious segregation of workers were subsequently to have a fundamental impact on the morphology of policy intervention in this area, particularly in the period after the Second World War.

Fig. 2.10 1. Terrace typology, Self-contained houses, Adelaide Terrace. 2. Terrace typology. Self-contained housing for clerical and supervisory grades. 3. Terrace typology. Superior Tyneside flats with bay windows and small front garden. 4. Terrace typology. Tyneside flats with small front space. 5. Terrace housing typology. Tyneside flats, no front garden

2.5 Housing Policy and Morphogenesis

What was experienced in the west end of Newcastle was a set of morphological processes that visually transformed this morphological region and which were largely driven by public policy. The area experienced a succession of policy phases in social housing (see Hanley 2007). Yet, the morphological outcomes of these policies were related directly to the hierarchical division within the original working-class housing provision identified above.

British housing policy has passed through a series of distinctive phases (Mullins and Murie 2017) each with their own distinctive morphological outcomes (see Barke 2010) but, clearly, not all of these will apply to every locality. In our study of the west end of Newcastle, the nature of its development meant that substantial parts of the area could be classified as slum property. The area was therefore not directly impacted upon by earlier twentieth-century policies designed to expand the numerical volume of housing (general needs) the main outcomes of which, initially at least, were strongly influenced by the garden city movement. Such housing was largely conventional, two-storey, semi-detached with gardens front and back built at a relatively low density of around 12 houses to the acre (Hanley 2007). But the fate of west Newcastle was different (CDP 1976). Influenced by the 1930 Housing Act and the subsequent reduction in subsidy levels due to the financial crash of 1931, slum clearance housing became the only form of provision for older industrial areas. In the later 1930s, therefore, sections of Elswick and Benwell were scheduled for slum clearance (Fig. 2.11), although the outbreak of the Second World War delayed implementation of the policy.

The massive housing shortage after the war gave additional impetus to policies to improve housing overall. Accordingly, a much larger area of Benwell and Elswick was scheduled for demolition and redevelopment (Fig. 2.12). The predominant residential accommodation in the areas shown for clearance in Fig. 2.12 was precisely the types at the bottom of the terraced housing typology identified above. However, the replacement housing, mostly built between 1956 and 1960, was highly problematic, consisting of badly designed blocks of three- or five-storey flats built to minimum standards (CDP 1976; Benwell Community Project 1978b). If the previous generation of housing was bad, their replacement was not a great deal better, especially in the light of mid-twentieth-century expectations. In other words, the worst contemporary housing was simply being reproduced in the same area. By 1976 this ‘new’ housing was itself condemned and scheduled for demolition, largely due to the pressure from local activists.

In the later 1960s, a further significant shift in national housing policy took place. This was an abandonment of large-scale slum clearance, with its demolition of vast areas and a switch to prolonging the life of older properties. In reality, the ‘worst’ of the nineteenth-century terraced housing stock had mostly been demolished. This new policy impacted mainly on the rather higher levels of the nineteenth-century terraced housing typology. Such housing was modernised through the availability of improvement grants for new bathrooms and kitchens, repairing or replacing roofs,

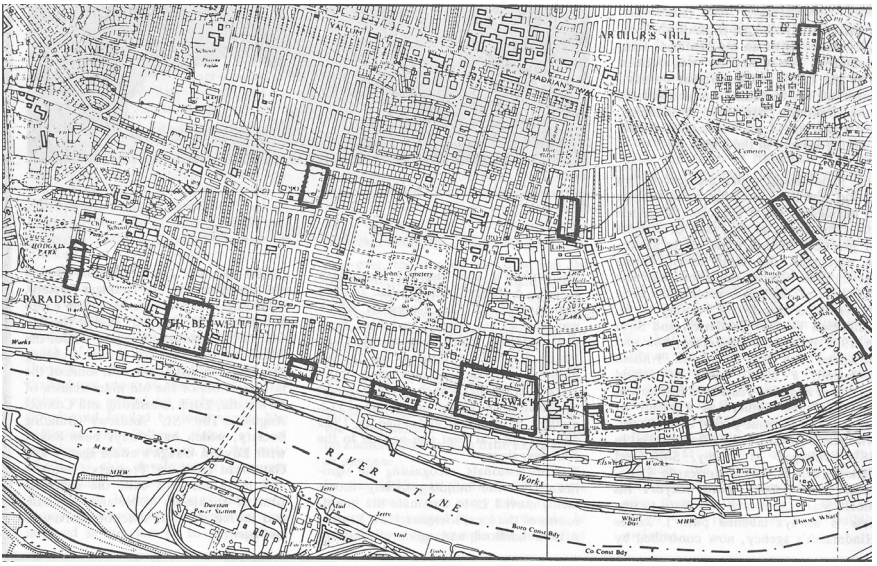


Fig. 2.11 Proposed 1930s clearance areas

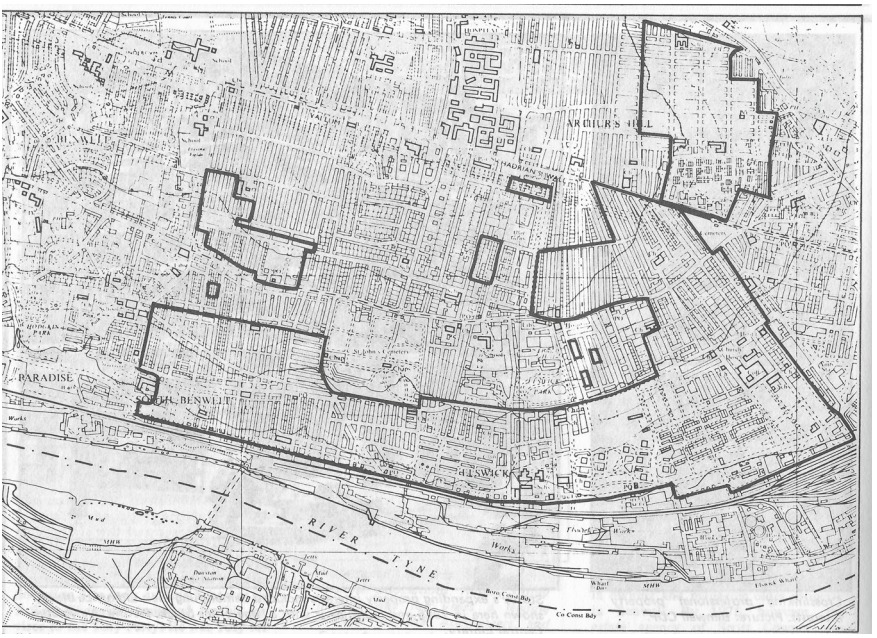


Fig. 2.12 Post-war slum clearance areas

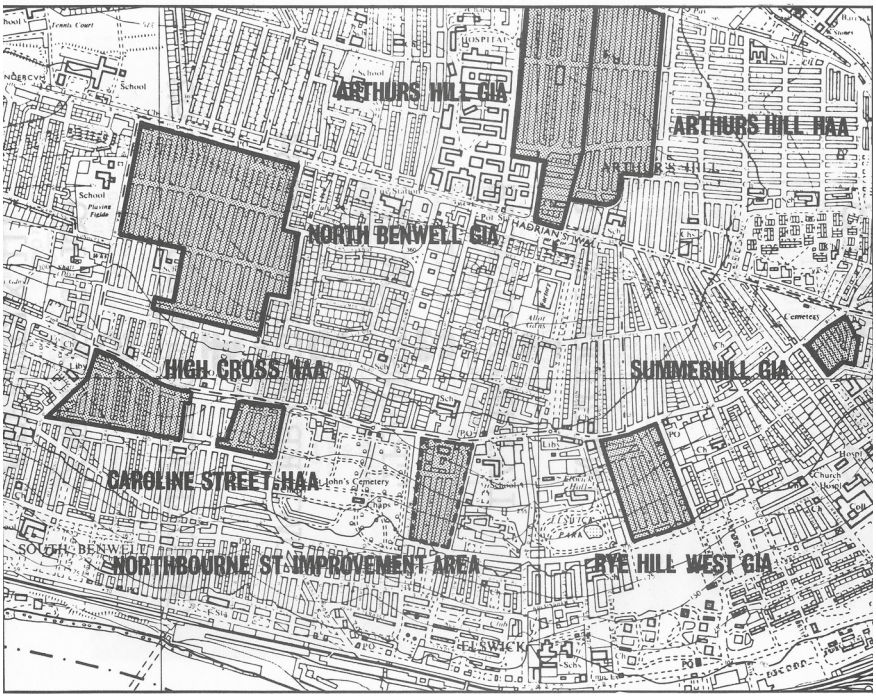


Fig. 2.13 Proposed improvement areas

damp proofing, etc. But this policy was spatially targeted (Fig. 2.13) meaning that the chief beneficiaries were the descendants of those 'clerical and supervisory' grade of workers who had inhabited such superior terraced housing from the beginning of the area's development.

In another major switch of policy, reflecting the inflexible ideological commitment of the Conservative right wing government of Margaret Thatcher, it was determined that local authority (council) housing should be taken out of their control and as much as possible be sold off. The 'right to buy' of tenants was introduced with extremely generous subsidies to encourage the purchase of their houses. The morphological impact of this was twofold. Inevitably, the 'best' of the remaining local authority housing stock was the most attractive for purchase, producing enclaves of new owner-occupied dwellings in Newcastle's west end. The second impact was the residualisation of the remaining stock for which there was no market appeal (for example, the high-rise blocks of flats at Cruddas Park, Elswick) or where tenants could not afford to buy, even at heavily subsidised prices. Inevitably therefore, as the corollary of the emergence of new enclaves of owner-occupation, were the pockets of socially deprived and residualised housing stock (Barke 1997).

In the latter part of the twentieth century, the policy arena in terms of social housing moved to an emphasis on what was termed regeneration, manifest in the 1986

Housing and Planning Act. Superficially, the thrust of policy was still to maintain and 'rejuvenate' the older stock. But, crucially, this was conditional on transferring its management to housing associations or Registered Social Landlords (RSLs). Central Government effectively took away control of social housing from Local Government. Social rented housing thus became even more clearly simply a safety net for vulnerable households but the reality is that social housing was effectively being sold off faster than it was being replaced. In areas where this has appeared to be impossible, where there appeared to be no market demand (although homelessness increased significantly), the policy response has often been clearance. Somewhat ironically, the 'vision' for the west end for 2020 under the label 'Going for Growth' involved the demolition of 3,000 dwellings (Newcastle City Council 1999). The intention was to build new housing but only a limited number of developments have taken place, leaving substantial swathes of open land. At the same time, where such new developments have occurred, their form and layout marks a significant change from the linear terraces of the nineteenth century (Fig. 2.14) with pockets of small owner-occupied dwellings in cul-de-sacs, named 'Gardens' or 'Close' replacing the former geometric morphology (Newcastle City Council 2021). Hanley (2007) summarises the public sector intervention in the provision of working-class housing thus:

> What began as a nineteenth-century crusade to house the urban poor…eventually turned into just another industry, co-opted by large building firms who received state subsidies to build quickly and carelessly, and encouraged by the short-term thinking of governments whose votes relied on quick solutions to visible problems. (Hanley 2007, pp. 50–51)

In morphological terms, what has emerged in the west end of Newcastle is a highly fragmented palimpsest of housing types and characteristics. Nevertheless, the processes that produced the initial development of the West End of Newcastle have reverberated onwards and have influenced subsequent policy processes and outcomes. The visual link between late nineteenth-century terraced housing in the

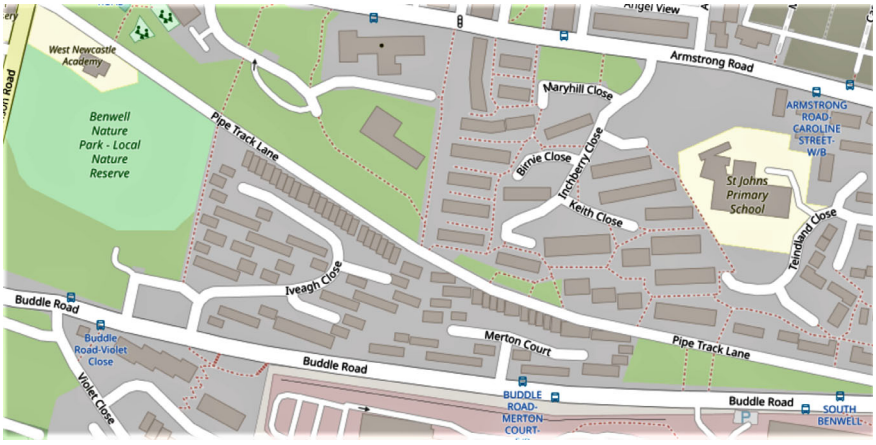


Fig. 2.14 Modern housing layout

West End and twentieth-century housing styles may, at first sight, appear to be limited but the processes that have produced the latter are firmly embedded in the experience of the former.

2.6 Final Comments

Anglo-European urban morphology has had an understandable tendency to focus on particular kinds of urban environment. For example, the type of areas that figure prominently include the elegance and beauty of Italian and other Renaissance cities, the seductive romantic appeal of small mediaeval towns and the discrete charm of middle-class suburbs. However, areas sometimes dismissively characterised as former industrial slums deserve more attention, are certainly challenging for urban morphology, and possess many features worthy of exploration.

In terms of the overall argument, what has been presented here is not about any fundamental change. But it is a request for a slight swing of the pendulum in urban morphological research and a plea for a more overt consideration of causative processes and to see more studies where 'process' is made explicit rather than being implied. In short, I believe it is necessary to think more about that word 'morphogenesis' and to ask more closely 'what actually is going on here' and 'what are the transformative processes'? We have many excellent studies that describe the morphological results of various processes. What our discipline needs is more studies of the morphological processes themselves. One direction that this inevitably takes us in is a deeper look at decision-making, and that isn't just decision-making by key individuals but by corporate and administrative bodies as well.

In terms of academic provenance, the example of west Newcastle also speaks to one of the significant debates on the process of urban growth, particularly in the nineteenth century, a debate that Jeremy Whitehand was centrally involved in (Whitehand 1972, 1975, 1978; Daunton 1978; Cannadine 1977; Rodger 1979). On the one hand, the argument (mainly from the urban historian, Daunton 1978) was that decision-making by landowners was the key factor in the timing and form of development. On the other hand (partly represented by Whitehand) was the argument that the timing of development and, to some extent, the form of development was powerfully influenced by the land market and/or bid rent processes. Our historical example from West Newcastle suggests that these are not necessarily polar opposites, but are actually part of the same set of processes. Whilst a key factor was the decision-making by landowners (or controlling agents), those decisions were almost always made in the light of maximising profitability. Quite clearly, decision-takers, whether it was John Clayton or Armstrong, were influenced predominantly by economic factors, especially in terms of the timing of development and its form in terms of type and density.

However, a problem with the deeper quest for investigation of the processes of change is that by definition, it represents a focus on the idiographic. The danger with such an exclusive emphasis is that, potentially, we could end up with a mass

of unrelated case studies. The answer of course is that there should not be such an entirely exclusive emphasis, just a greater weight attached to the investigation of process. Nevertheless, within the historiography of urban morphology there is something of an inbuilt contradiction on this issue. We have to ask ourselves, as urban morphologists, how the justified criticism of an idiographic approach squares with urban morphology's 'holy grail' of the *genius loci* or 'spirit of place'. By definition the latter forces us to focus on that which is specific to a particular locality. The fundamental answer to the apparent contradiction involved here depends entirely on the purpose of the study. Surely, within the broad scope of the study of urban morphology there is room for both deeper studies of the processes operating in particular cases and the search for generalities that may be applicable in many cases?

References

Allen E, Clarke JF, McCord N, Rowe DJ (1971) The north-east engineer's strike of 1871. Frank Graham, Newcastle upon Tyne

Barke M (2010) Urban transformation in an inner city area: morphological processes in shieldfield, Newcastle upon Tyne, UK. In: Tian Y, Kai G, Tao W (eds) Urban morphology. Science Press, Beijing, Architectural Typology and Cities in Transition, pp 56–78

Barke M (1977) Social change in Benwell, Benwell community development project. Newcastle upon Tyne

Barke M (1997) The 'right to buy' revisited. An empirical assessment in the Tyne & Wear area. North Econ Rev 68–85

Benwell Community Development Project (1978a) Private housing and the working class Benwell community development project, Final Report Series, No. 3, Newcastle upon Tyne

Benwell Community Development Project (1978b) Slums on the drawing board Benwell community development project, Final Report Series, No. 4, Newcastle upon Tyne

Benwell Community Development Project (1978c) The making of a ruling class, Benwell community development project, Final Report Series, No. 6, Newcastle upon Tyne

Beresford MW (1967) New towns of the middle ages. Lutterworth Press, London

Cannadine D (1977) Victorian cities: how different? Soc Hist 4:477

CDP (1976) Whatever happened to council housing? CDP Information and Intelligence Unit, London

Conzen MRG (1962) The plan analysis of an English city centre. In: Norborg K (ed) Proceedings of the IGU symposium in urban geography, Lund 1960, Lund, pp 383–414

Conzen MRG (1978) The morphology of towns in Britain in the industrial era. In: Jager H (ed) Probleme des Stadtewesens im industriellen Zeitalter, Cologne, pp 1–48

Daunton MJ (1978) The building cycle and the urban fringe in Victorian cities: a comment. J Hist Geogr 4:175–181

Daunton MJ (1983) House and home in the Victorian city. Arnold, London

Graves CP, Heslop DH (2013) Newcastle upon Tyne. An Archaeological Assessment, Oxbow Books, Oxford, The Eye of the North

Green J (2016) What Richard Grainger did next. Tyne & Tweed 70:46–54

Hanley L (2007) Estates: an intimate history. Granta Books, London

Kropf KS (2001) Conceptions of change in the built environment. Urban Morphol 5:29–46

Lancaster B (ed) (1994) Working class housing on Tyneside, 1850–1939. Bewick Press, Newcastle upon Tyne

Larkham PJ (1999) Organicism, evolution and urban form: on the problems of borrowing from other disciplines. Urban Morphol 3:49–51
Middlebrook S (1950) Newcastle upon Tyne: its growth and achievement. Newcastle Journal, Newcastle upon Tyne
Mortimore MJ (1969) Landownership and urban growth in Bradford and its environs in the West Riding conurbation, 1850–1950. Trans Inst Br Geogr 105–119
Mullins D, Murie A (2017) Housing policy in the UK. Bloomsbury Publishing, London
Muthesius S (1982) The English terraced house. Yale University Press, New Haven
Newcastle City Council (1999) Going for growth: a green paper. Newcastle upon Tyne
Newcastle City Council (2021) Regeneration plan–West end. Newcastle upon Tyne
Pearce K (1994) Newcastle's Tyneside flats 1830–1900. By-law housing or cultural phenomenon? In: Lancaster (ed.) Working class housing on tyneside, 1850–1939, Bewick Press, Whitley Bay, pp 39–85
Rodger RG (1979) The building cycle and the urban fringe in Victorian cities: another comment. J Hist Geogr 5:72–78
Smailes AE (1960) North England, Nelson, London and Edinburgh
Whitehand JWR (1967) Fringe belts: a neglected aspect of urban geography. Trans Inst Br Geogr 41:223–233
Whitehand JWR (1972) Building cycles and the spatial pattern of urban growth. Trans Inst Br Geogr 56:39–55
Whitehand JWR (1975) Building activity and the intensity of development at the urban fringe: the case of a London suburb in the nineteenth century. J Hist Geogr 1:211–224
Whitehand JWR (1978) The building cycle and the urban fringe in Victorian cities: a reply. J Hist Geogr 4:181–191
Wilkes L, Dodds G (1964) Tyneside classical. John Murray, London

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 3
Quantitative Analysis of Urban Form Through Urban Section: A Case Study of Nanjing, China

Ziyu Tong, Jingjing Dong, Lian Tang, and Zhichao Yu

Abstract A more comprehensive and in-depth understanding of the urban form has been a long-term interest of urban morphology. Compared to a plan view, urban section helps to understand the three-dimensional shape of a city from a transection. As a linear graph, the section can be quantified with some indicators easily and accurately. However, a single section cannot adequately describe the entire urban form, and a series of sections are needed to construct a representation of it. In this research, we test two different series of sections: parallel series and rotational series. In the former, all sections are distributed in parallel at a certain spacing, while in the latter, all sections are rotated around a center point. Taking four different districts of Nanjing, China, as the cases, two series of sections are applied to implement the quantitative analysis of urban form. The different parameters are also analyzed by comparison to determine reasonable values. The results show that the both series are effective in representing the urban morphological characteristics with reasonable parameters. In addition, the rotational series section method has unique advantages in expressing the urban form in different directions.

Keywords Urban form · Urban section · Quantitative analysis

Z. Tong (✉) · L. Tang · Z. Yu
School of Architecture and Urban Planning, Nanjing University, Nanjing, China
e-mail: tzy@nju.edu.cn

L. Tang
e-mail: tanglian@nju.edu.cn

Z. Yu
e-mail: yzc@smail.nju.edu.cn

Z. Tong · L. Tang
Key Laboratory of Urban AI and Green Built Environment of Provincial Higher Education Institutes, Nanjing University, Nanjing, China

J. Dong
Institute of Architecture Design and Planning Co., Ltd., Nanjing University, Nanjing, China
e-mail: bbjjhappy@126.com

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_3

3.1 Introduction

A more comprehensive and in-depth understanding of the urban form has been a long-term interest of urban morphology. Scientific cognition of urban form can help summarize the urban patterns and explore the morphological problems (Martin 1972). Quantitative cognition turns the patterns into describable and replicable indicators, which are meaningful for relevance studies and urban form control (Oliveira and Medeiros 2016). The quantification of urban morphology at the micro-level mainly revolves around capacity and geometric attributes, including indicators such as floor area ratio (FAR), building density, open space ratio, and building height (Yoshida and Omae 2005; Pont and Haupt 2007; Steadman 2014; Çalışkan et al. 2022). By combining these indicators, different types of fabrics and characterize form can be represented. However, most of these indicators are calculated based on the plan of urban form, lacking effective expression of the complexity of urban form in three-dimensional space.

Here, the section is a potential answer to this disadvantage (Mantho 2015). Sections are commonly used in architectural drawings to express the complex spatial variations within a building. A similar concept in city is the transect, which expresses environmental change from natural-to-rural-to urban areas by categorizing built environments along a cross section (Welter 2002; Andres 2002). Transect theory has also been used in urban design and has developed into the theory of transect urbanism (Bohl and Plater-Zyberk 2006). However, the transect is an abstract and typological expression of urban form, and cannot detail specific urban form. Combining the characteristics of architectural section and urban transect, urban section focuses directly on specific city block buildings, and helps to understand the buildings' heights and the spaces between buildings through a polyline (Tong 2019). As a linear graph, the section can be quantified with some indicators easily and accurately. Through a series of continuous vertical urban slices, city texture can be transformed into planar linear information to represent the urban form (Gu et al. 2021). However, in the series of sections, the settings of relevant parameters such as section orientation and density can affect the representation of urban form and the final indicator calculation results.

In this research, we test two different series of sections, namely, parallel series sections and rotational series sections, and explore the reasonable values of the relevant parameters by analyzing the section indicators obtained from different sectioning methods.

The paper is organized as follows. First, it presents the calculation of quantitative indicators for urban sections and two different transect methods to obtain a series of sections. Then, it takes four districts of Nanjing City as case studies to apply the transecting methods, and calculates corresponding indices. Finally, by comparing those indicators, reasonable transecting parameters are proposed, and the urban form is analyzed.

3.2 Methodology

3.2.1 Calculation of Quantitative Indicators for Urban Sections

The urban section is a derivation of the architectural section. A sectional path is created in a certain direction in an urban area. And the spatial relationship of buildings on the section is observed. The urban section not only visually expresses the height of buildings, but also focuses on the spaces between buildings. In addition to the visual information presented by the section shape, it can be quantified to accurately represent its morphological characteristics.

Figure 3.1 presents an urban section prototype and corresponding dimensions, where L is the length of the whole section, H is the maximum height of the section, *l1-ln* represent the lengths of every segment of the section, *A1-An* represent the areas of every building section, *w1-wn* are the widths of every building section, *ws1-wsn* are the widths of the open spaces between buildings, and *h1-hn* are the heights of every building.

Based on the prototype, several indices are proposed to represent the morphological characteristics. The length ratio (*LR*) is the ratio of the sum of l to L, representing the tortuosity of the urban section line. The area ratio (*AR*) is the ratio of the sum of A to L, which could be regarded as the average buildings volume of the entire section extent, or the *FAR*. The average height (*AH*) is the average height of all buildings. The width ratio (*WR*) is the ratio of the sum of w to L, which can be regarded as the building density. In addition, the open space ratio (*OSR*) is the ratio of the sum of the width between buildings to L, which could be used to present the open spaces of the section. The formulas for calculating these indicators are as follows:

$$\mathrm{LR} = \sum l_n / L \tag{3.1}$$

$$\mathrm{AR} = \sum A_n / L \tag{3.2}$$

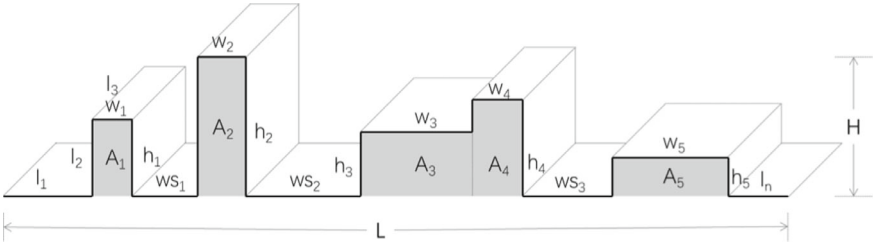


Fig. 3.1 An urban section prototype and corresponding dimensions (Source: created by the authors)

$$\mathrm{AH} = \sum h_n / n \tag{3.3}$$

$$\mathrm{WR} = \sum w_n / L \tag{3.4}$$

$$\mathrm{OSR} = \sum ws_n / L \tag{3.5}$$

To make *OSR* more capable of expressing the advantages of open space in terms of environmental performance, we also set a special rule for the calculation. In the study of isolated roughness flow in street canyon, Oke found that when the height-to-width ratio of the street section is <0.33, buildings on both sides do not significantly affect each other's wind fields, and the wind flow remains relatively smooth without the appearance of large turbulence and vortexes (Oke 1988). Ashihara also found that space with a height-to-width ratio of <0.33 was open and discrete, with a poor sense of enclosure (Ashihara 1984). Therefore, we define that only open spaces with a height-to-width ratios less than 0.33 will have its *ws* included in the calculation of *OSR*.

Considering that much of the urban form data is planar, it is not easy to draw the sections and calculate the indicators manually. It is even more time-consuming when series of sections are required. Therefore, we have developed a program based on Processing (https://www.processing.org). By importing building plans with height information and setting the direction and density of the cutting, the program can automatically generate all the sections and calculate all the indicators.

3.2.2 Two Types of Cutting Methods

A section is just a cutting of an object and can only reflect its local features. Even in architectural drawings, multiple sections are required to represent the interior spaces of the building. Due to the complexity of urban form, a single section cannot fully depict its morphological characteristics. To create a comprehensive representation, a series of sections can be generated by cutting the urban area at a certain density. There are two types of cutting methods: parallel series cutting (Gu et al. 2021) and rotational series cutting (Kaya and Mutlu 2017; Tong et al. 2020).

Parallel series cutting involves drawing a series of evenly spaced parallel transect lines across an urban area to create a set of parallel sections (Fig. 3.2). This method is similar to a CT (Computed Tomography) scan, where each section corresponds to a scanned image of a CT. By associating all slices, a relatively complete reconstruction of the 3D object is possible. By adjusting the density of the sections, a more detailed representation of the urban form can be achieved. In China, due to the demand for sunlight, most buildings face south to get the maximum amount of sunlight (Li et al. 2018). Therefore, the parallel transect line is set to be east–west, which runs through

Fig. 3.2 Parallel series cutting method (satellite image source: https://www.google.com/maps Imagery©2024 CNES/Airbus, Landsat/Copernicus, Maxar Technologies. Others: created by the authors)

the long side of the buildings and presents the degree of curvature of the building contour line.

In the case of a rotational section, a fixed point is selected within a certain urban area, and a series of sections are obtained by rotating transect lines around this fixed point at a set angle (Fig. 3.3). In comparison to parallel series cutting, rotational cutting does not need to consider the direction of the transect line. However, to ensure consistent L-values when calculating the indicators, the study range is circular. Moreover, the transect lines have a distinct ray character, their distribution is dense at the center and sparse at the periphery, and the representation of the morphological characteristics of the city is closely related to the position of the center.

Both cutting methods result in a series of sections, which in turn allow the calculation of the corresponding indicators. Figure 3.4 shows the series of sections for the parallel cutting method and the five indicators for each section. Figure 3.5 shows the series of sections for the rotational cutting method and the five indicators for each section. Despite targeting the same area, there are significant differences in the results obtained by the two methods, both in terms of section images and the quantitative indicators.

Fig. 3.3 Rotational series cutting method (satellite images source: https://www.google.com/maps Imagery©2024 CNES/Airbus, Landsat/Copernicus, Maxar Technologies. Others: created by the authors)

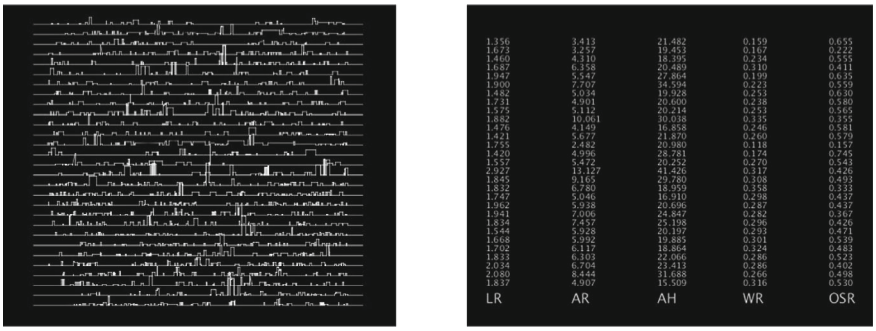


Fig. 3.4 The series of sections for the parallel cutting method and the five indicators for each section (*Source* Created by the authors)

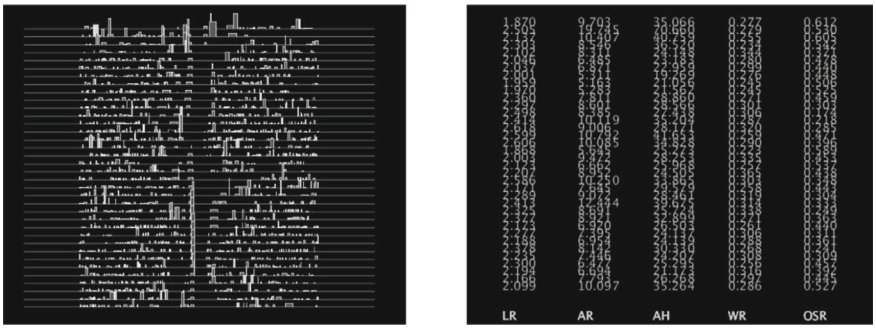


Fig. 3.5 The series of sections for the rotational cutting method and the five indicators for each section (*Source* Created by the authors)

Two cutting methods involve the setting of some parameters. Both methods need to set the section range. In addition, the parallel cutting method needs to determine the density of the transect lines, and the rotational cutting method needs to set the rotational angle of the transect lines.

3.3 Case Study

Nanjing is a representative city in China with an urban fabric of different periods. This study selected four morphologically diverse areas in Nanjing: Xinjiekou, the traditional central business district; Hexi, the new central business district; Chengnan, which retains the traditional historical pattern; and Jiangning, a suburban area with a large number of new modern residences and inadequate public facilities (Fig. 3.6).

Xinjiekou has a high concentration of high-rise buildings, commercial offices, and a high degree of mixed building functions. Hexi is full of large public buildings,

Fig. 3.6 Four study areas of Nanjing City (*Source* https://www.google.com/maps Imagery©2024 CNES/ Airbus, Landsat/Copernicus, Maxar Technologies)

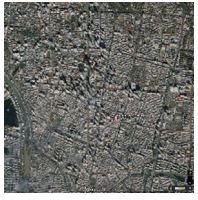
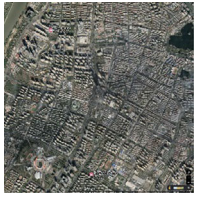
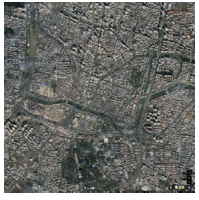
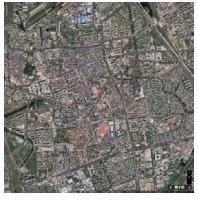
with a large building scale, low building density, sparse distribution, wide roads, more open external space, and a higher average building height. As a representative of the old city, Chengnan has a smaller building scale, lower average building height, higher building density, more varied building forms, and high building coverage. Jiangning is located in the suburban area of Nanjing, where the plots are not regular, the buildings are residential, the average height is high, the coverage rate is more balanced, and the plan is more regular. Table 3.1 shows the satellite images and building plans. The form of each districts is distinct, which provides a good research sample for the study of urban sections.

3.3.1 Parallel Cutting with Different Parameters

To investigate the best scale at which the series of urban sections could reflect the morphological characteristics of the area, the center points of the four study areas were selected as reference points, and based on these points, square areas with side lengths of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, and 4.0 km were selected as our study areas (Table 3.2).

The density of the transect lines also affects the section shape and indicator calculation. In this study, the section spacing is set as the parameter to adjust the section density. We apply 2, 5, 8, 10, 12, 15, and 18 as the values of section spacing. The smaller the spacing, the greater the density of the sections. Parallel cuttings of different densities were performed separately for each scope in each district, yielding

Table 3.1 Images of the current state of four cases

	Xinjiekou	Hexi	Chengnan	Jiangning
Satellite image				
Buildings plan				

Satellite Image Source https://www.google.com/maps Imagery©2024 CNES/Airbus, Maxar Technologies. Others: created by the authors

Table 3.2 Study scopes of the four districts with different side lengths

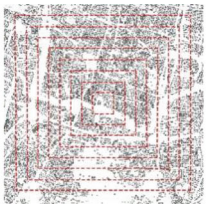
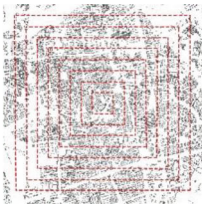
Xinjiekou	Hexi	Chengnan	Jiangning
			

Image Source Created by the authors

seven separate sets of data, each with five indicator data, *LR*, *AR*, *AH*, *WR*, and *OSR*. As shown in Table 3.3, taking the 3.0 km range of Xinjiekou as an example, the sections were obtained from seven density cuttings.

3.3.2 Rotational Cutting with Different Parameters

Similar to parallel cutting, the size of the section range is the first parameter to be considered. Circles with diameters of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, and 4.0 km were used as the scope of the study (Table 3.4).

In rotational cutting, the section angular spacing affects the section density. Values of 5°, 10°, and 15° are used for the section angular spacing. As shown in Table 3.5, taking the 3.0 km range of Xinjiekou as an example, the sections were obtained from three density rotational cuttings.

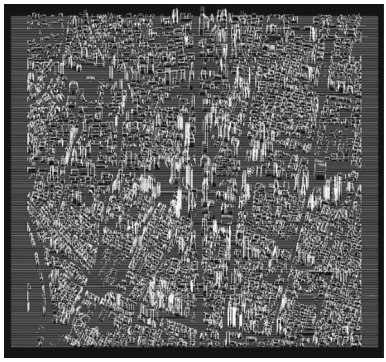
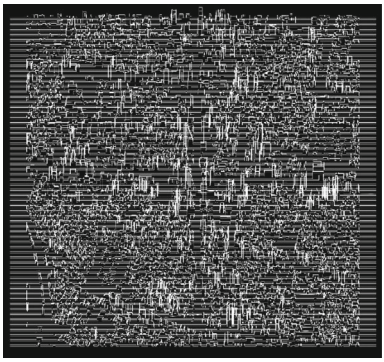
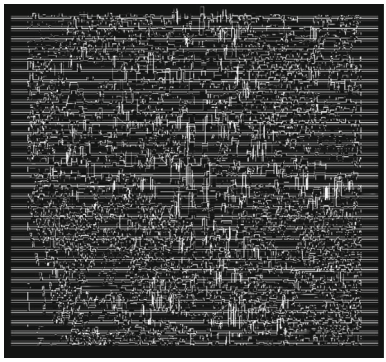
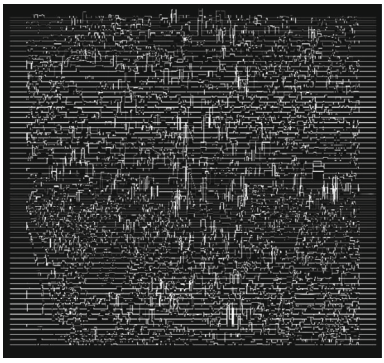
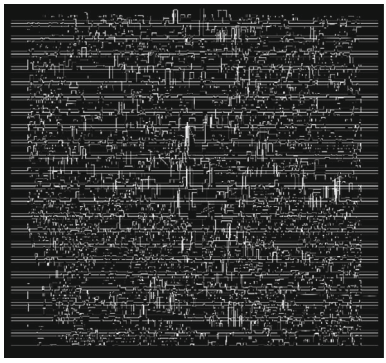
To conveniently analyze the variation in the magnitude of the section indicators in each direction, radar plots were selected for data analysis. As shown in the first graph in Fig. 3.7, there is only one value on each section. All data are mirrored center-symmetrically around the center of the circle to obtain the second graph in Fig. 3.7, which makes it easy to observe the values and changes in the direction. In the third graph, the orange circle represents the average value of all data.

3.4 Result Analysis

3.4.1 Analysis of the Parallel Series Sections

For the same area, we take the average of the indicator value obtained under seven different density sections and put them in the same coordinate system for statistics. In the following figures, the horizontal coordinates represent the scale range 0.5–4.0 km, the vertical coordinates represent the size of the indicator value, and the

Table 3.3 The parallel sections were obtained from seven density cuttings

Study scope	Section spacing 2
	
Section spacing 5	Section spacing 8
	
Section spacing 10	Section spacing 12
	

(continued)

Table 3.3 (continued)

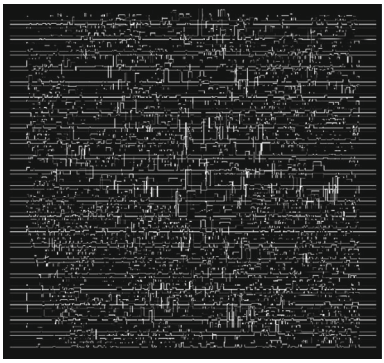
Study scope	Section spacing 2
Section spacing 15	Section spacing 18
	

Image Source Created by the authors

Table 3.4 Study scopes of the four districts with different diameters

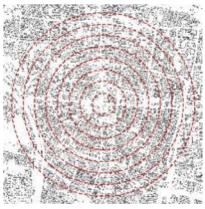
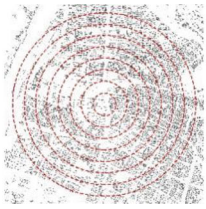
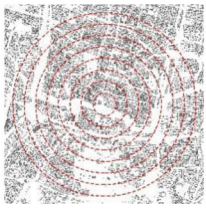
Xinjiekou	Hexi	Chengnan	Jiangning
			

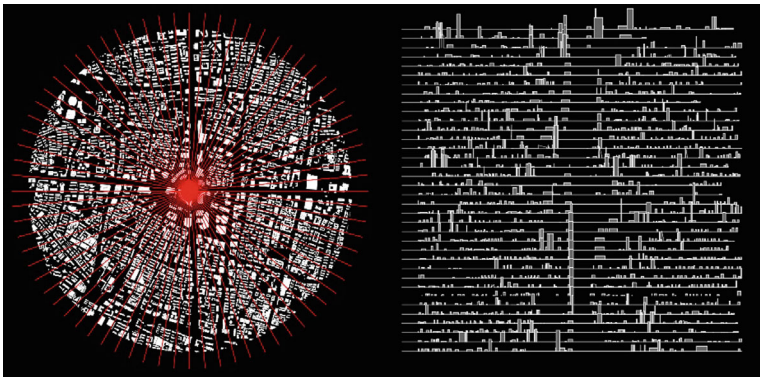
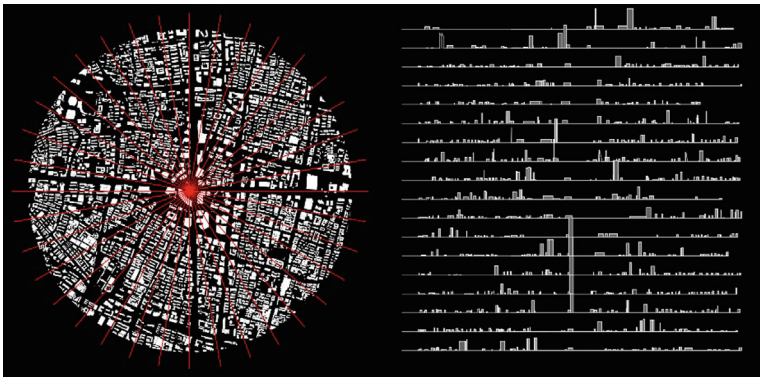
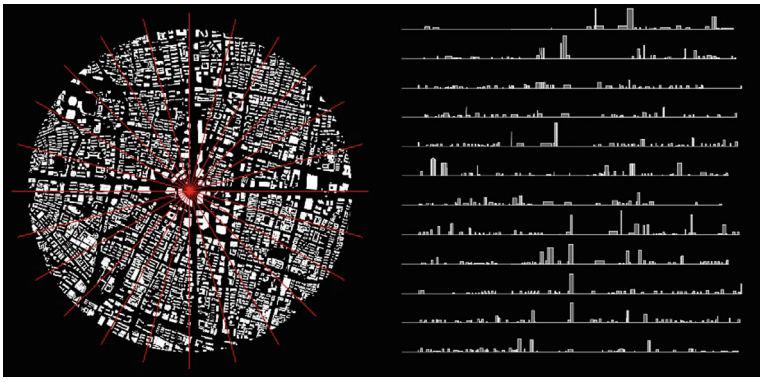
Image Source Created by the authors

line of the seven sets of data represents the change in each indicator as the range increases.

Taking Xinjiekou as an example, which is shown in Fig. 3.8, *LR* is distributed between 1.6 and 2.2, *AR* is distributed between 6 and 12, *AH* is between 20 and 50 m, *WR* is between 0.25 and 0.3, and *OSR* is concentrated between 0.4 and 0.5. From the changing trend, the *LR*, *AR*, and *AH* of Xinjiekou gradually descend, and the *AR* and *AH* descend in a consistent trend. The *WR* rises first, then descends rapidly at 2.5–3.0 km, and then falls back after a basic stabilization at 3.0–3.5 km. The *OSR* descends rapidly at 0.5–1.0 km, and rises to 4.0 km after falling back to 2.5 km.

There is a certain commonality in the interpretation of the indicator values and trends of the four districts. There is a large positive correlation between the indicators *LR*, *AR*, and *AH*, and the change trends are similar, while there is an opposite change trend between *WR* and *OSR*. When the range is less than 2.5 km, the value of each indicator changes considerably, and at 2.5–4.0 km, the value tends to stabilize. This

Table 3.5 Sections and indicators at different angular spacings (image source: created by the authors)

Section angular spacing	Rotational series sections and indicators
5°	
10°	
15°	

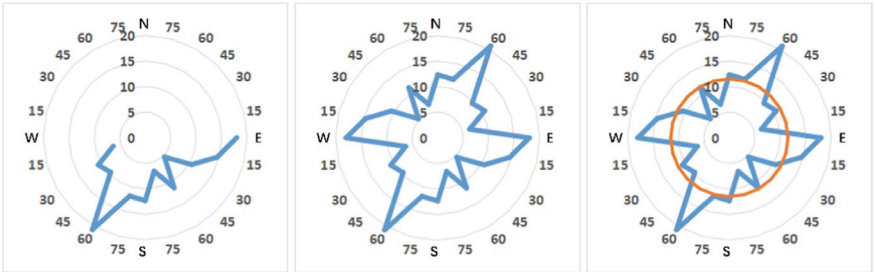


Fig. 3.7 Method of drawing the radar plot of indicator values of rotational sections (*Source* Created by the authors)

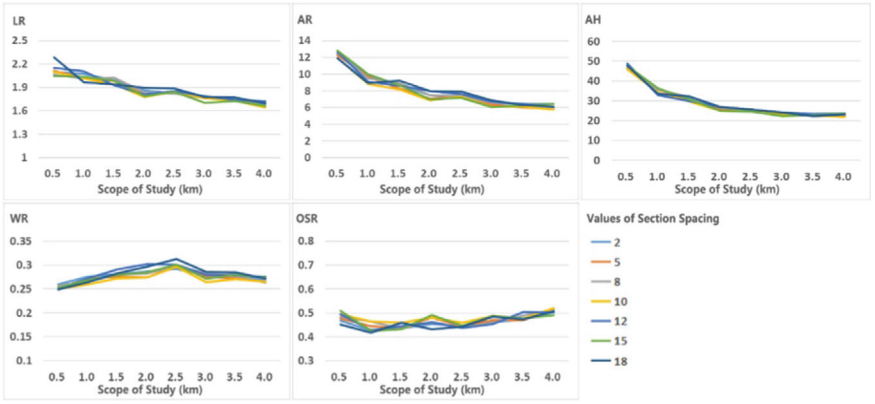


Fig. 3.8 The plot of indicator values of parallel sections of Xinjiekou (*Source* Created by the authors)

characteristic is more evident in the trends of *LR*, *AR*, and *AH*. In order to better compare the similarity between each district, seven sets of data for each indicator value of the above four districts were averaged at different scales (Fig. 3.9).

As Fig. 3.9 illustrates, the values of Xinjiekou are higher than those of the other three districts in *LR*, *AR*, and *AH*, and the *OSR* values of Xinjiekou are the lowest. The *LR* and *AR* values of Chengnan, Hexi, and Jiangning are closer, and the three variables tend to be consistent after 2.0 km. The *WR* values of Xinjiekou and Chengnan are closer, and the overall *OSR* values of Jiangning and Chengnan are closer. The *AH* values of Xinjiekou and Hexi are higher than those of Chengnan and Jiangning, but all four districts tend to be consistent with the increase in the section scope range. From the perspective of change trends in general, Jiangning and Chengnan are closer in change trends, while Xinjiekou and Hexi are more similar.

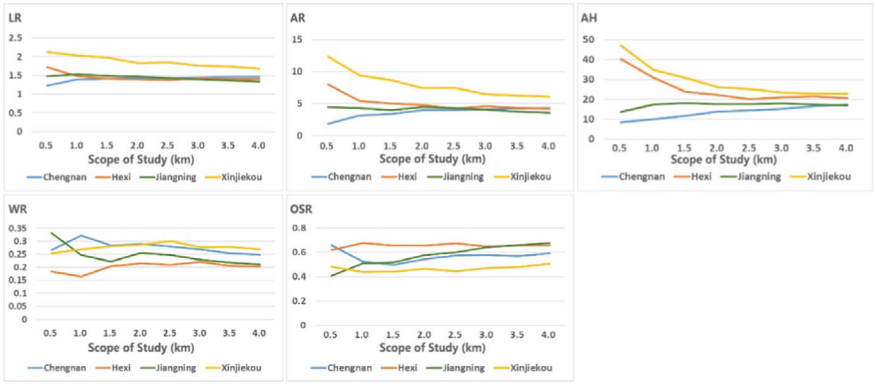


Fig. 3.9 Comparison of parallel section indicator values across the four districts (*Source* Created by the authors)

3.4.2 Evaluation of the Parameters of the Parallel Series Cutting

Both the scope and density of the parallel series cutting affect the indicator values. Reasonable parameter thresholds are key to conducting urban section studies. In this research, we introduce relevant urban planning indicators as reference values. By comparing these section indicator values and the urban planning indicator values of the same scope, we can evaluate the reasonableness of the parameters for parallel series cutting.

The indicators directly linked to specific forms in urban planning are mainly the *FAR*, building density, and building height. The *FAR* is the ratio of the total building area to the block area. When the buildings tend to be homogeneous and reach a state of uniform distribution, the series sections are basically the same. If the buildings are horizontally compressed to the two-dimensional state, each floor area is the width of each building, and the land area is equivalent to *L* in Fig. 3.1. The difference between the *AR* and *FAR* is the average floor height, so the *AR* can be compared with the *FAR* to judge the urban morphological characteristics reflected by the *AR* value. In the two-dimensional vertical state, the building density is equal to the ratio of the sum of the widths of the buildings to the range *L*. The calculation method is the same as that of *WR* in the section, so we can equate the building density to *WR*. The average building height in this paper is the ratio of the height of all buildings to the number of buildings in a certain range. The average building height is calculated in the same way as *AH*, so we can equate it to *AH* directly. When the urban buildings are in the two-dimensional vertical state, i.e., the same state as the urban building section, we consider the *FAR*, density, and average building height in the three-dimensional state to be equivalent to the section indicators *AR*, *WR*, and *AH*. The higher the degree of matching of the indicator values, the better the section parameters express the characteristics of the urban form of the area. Even

when buildings are non-homogeneous, the average values of the series of sections will converge to the corresponding planning indicators.

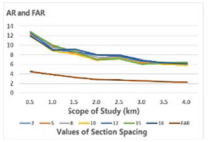
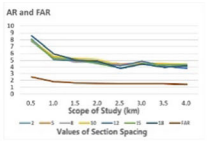
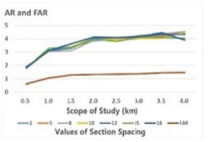
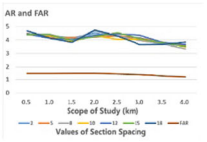
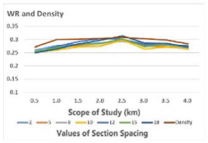
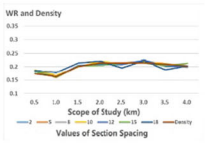
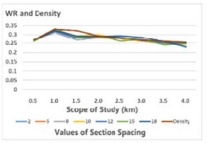
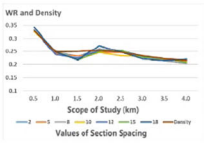
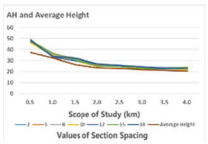
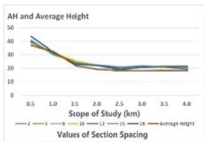
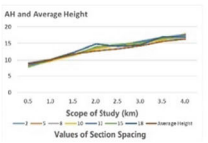
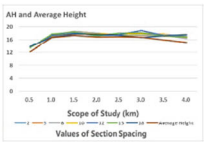
Therefore, we can use the above-obtained section indicators *AR*, *WR*, and *AH* in Xinjiekou, Hexi, Chengnan, and Jiangning with different scopes and transect densities, and compare them with the *FAR*, density, and average height in the same areas for fitting analysis, as shown in Table 3.6.

Graphically, with the increase in transect spacing, *AH* and *WR* seem to be closer to the corresponding urban planning indicators and fit better, but it is hard to see the specific degree of data fit from the graph. To better compare the deviation of the section index data with the actual situation at different scales, according to the previous discussion, we compare the sum of the deviation of the section indicators and the urban planning indicators in each area. For a more accurate analysis, we measure the deviation of the section indicators from the urban planning indicators by the degree of deviation.

Since *FAR* and *AR*, density and *WR*, and average height and *AH* are not at the same scale level or order of magnitude, direct comparisons cannot be made. The deviation values were first standardized, and then the deviation values of *AR*, *WR*, and *AH* values were summed and compared to obtain the smallest sum of deviation values, which best reflected the real urban morphological characteristics.

Figure 3.10 presents the sum of the degrees of deviation of the three indicators *AR*, *WR*, and *AH* for each district at different section densities and scopes. The sum of deviations is relatively close, and all show some idiosyncrasies at a different scope, but do not affect the overall trend. The sum of deviations in Chengnan and Jiangning decreases after rising to the scope of 1.5 km, and the value fluctuation gradually

Table 3.6 Comparison of section indicators and planning indicators in different parameters

Xinjiekou	Hexi	Chengnan	Jiangning
			
			
			

Images Source Created by the authors

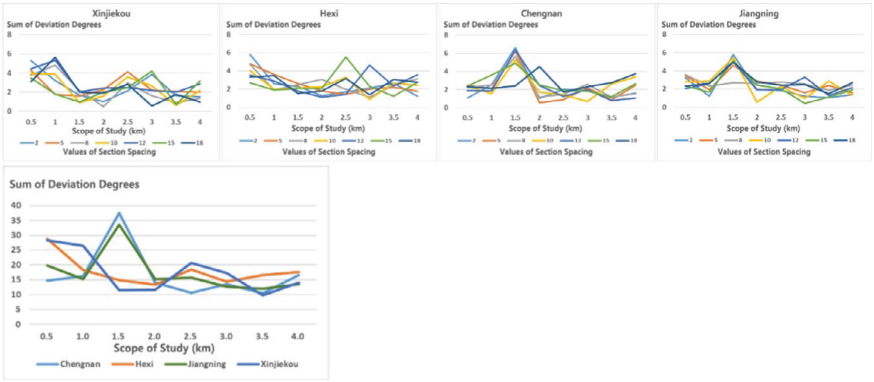


Fig. 3.10 Deviation of the standardized indicators in the four districts with different cutting densities and scopes (*Source* Created by the authors)

decreases. The overall deviation values are close together in Hexi, with an overall decrease followed by an increase, but do not show significant specificity. The value of Xinjiekou drops sharply after 1.0 km, and fluctuates slightly as the scope becomes larger, with a slightly stronger degree of fluctuation than that of Hexi. The last graph in Fig. 3.10 represents the sum of the deviations of all indicators. On the whole, the sum of deviation is the largest in Chengnan and Jiangning at 1.5 km, and the trend of deviation is very close as the scope becomes larger. The trend lines of Xinjiekou and Hexi are very similar, both continue to fall to 1.5 and 2.0 km, and there is a clear trend of rising and falling at the 2.0–3.0, 2.0–3.5 km ranges.

With the comparison result shown in Fig. 3.10, we believe that scope 2.0–3.5 km best reflects the urban morphological characteristics of each district. When the scope is set to 2.0 km, the sum of the deviations of the four districts is the smallest, and the deviations of each district are also small.

Furthermore, with a scope of 2.0 km, the deviations at different cutting densities are statistically analyzed. Figure 3.11 presents the result. The left graph shows the deviations of the eight densities from 2 to 18 in different districts at a scope of 2.0 km, and the right graph shows the sum of the deviations of all four districts.

As shown in Fig. 3.11, when the cutting density is 2, the sum of the deviation of all districts is the smallest, the deviation of each district is between 1 and 2, and the data distribution is more concentrated. Therefore, the cutting scope is 2 km and the cutting density is 2 (spacing of transect line is 12 m), which are the more reasonable parameter thresholds for parallel series cutting, and the sections obtained better reflect the morphological characteristics of the city.

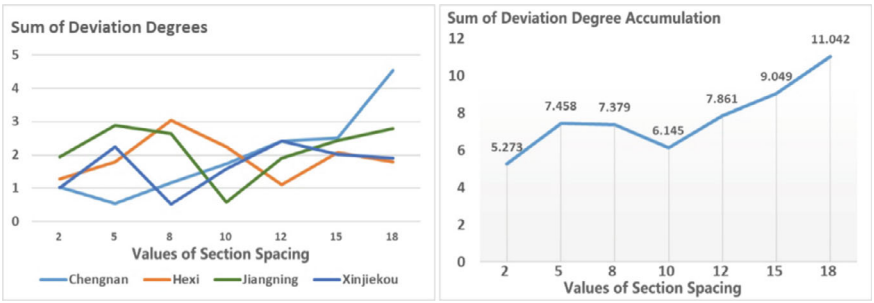


Fig. 3.11 Deviation of the standardized indicators with different cutting densities at scope 2.0 km. The left shows the separate statistical chart for each district, and the right shows the statistical chart for the sum of all districts (*Source* Created by the authors)

3.4.3 Analysis of the Rotational Series Sections

Previously, we determined the cutting scope and cutting angular spacing for rotational series cutting. The cutting scopes are from 0.5 to 4.0 km, and the cutting angular spacing is 15°. The indicators at different angular spacings at the same scope are represented in the form of radar plots. Each district obtains five sets of radar maps, namely, *LR*, *AR*, *AH*, *WR*, and *OSR*, and each indicator has a total of 8 radar plots under different cutting scopes.

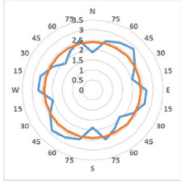
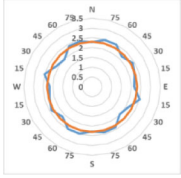
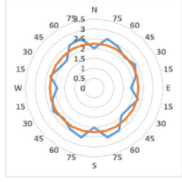
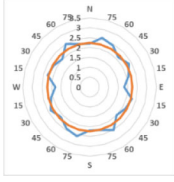
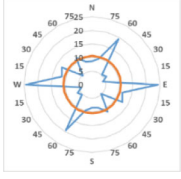
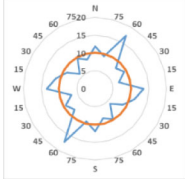
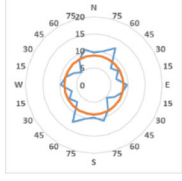
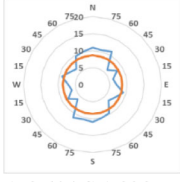
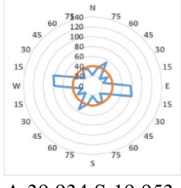
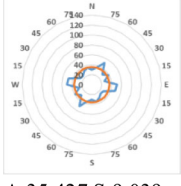
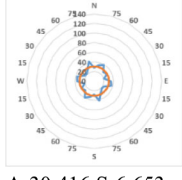
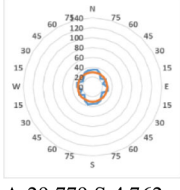
Taking Xinjiekou as an example, Table 3.7 shows some radar plots of the rotational series sections. In the table, *A* represents the mean value of the corresponding section indicators, and *S* represents the standard variance. A larger value of *S* represents greater volatility of the radar plot values.

Comparing the radar plots of the rotational sections of Xinjiekou in Table 3.7, the differences in the directions of the *AR* and *AH* are relatively similar, both change from the specificity presented in the east–west and southwest 60° section directions to the specificity in the north–south direction, and the average values gradually decrease with increasing scope. The *WR* presents the difference in the north–south direction, and the *OSR* mainly presents the difference in the southeast 30° section direction. The values of *WR* gradually increased with increasing scope, and the mean values of *OSR* did not change much.

3.4.4 Evaluation of the Parameters of the Rotational Series Cutting

As in the case of parallel series cutting, the degree of deviation between the rotational section indicators of each district and the urban planning indicators is used to evaluate the reasonableness of the cutting parameters. Table 3.8 shows the comparison

Table 3.7 Radar plots of indicator values of rotational sections of Xinjiekou

Indicator	1.0 km	2.0 km	3.0 km	4.0 km
LR	 A:2.395 S:0.319	 A:2.302 S:0.160	 A:2.252 S:0.238	 A:2.234 S:0.207
AR	 A:10.555 S:5.811	 A:10.096 S:2.928	 A:8.625 S:1.936	 A:8.604 S:1.828
AH	 A:39.934 S:19.953	 A:35.427 S:9.039	 A:30.416 S:6.653	 A:29.779 S:4.762

(continued)

Table 3.7 (continued)

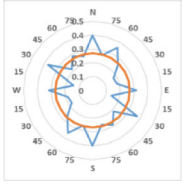
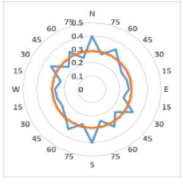
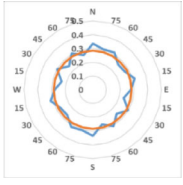
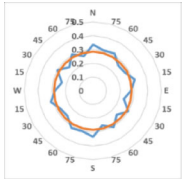
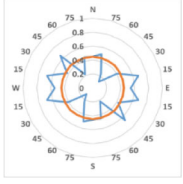
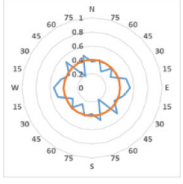
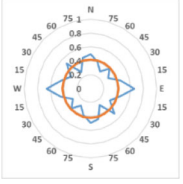
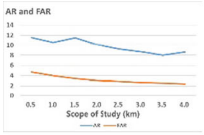
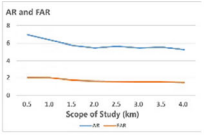
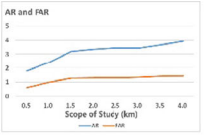
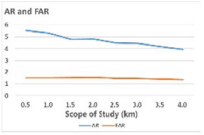
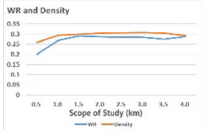
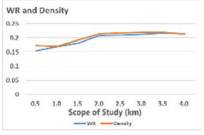
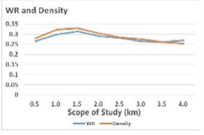
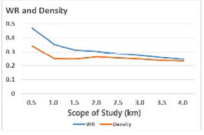
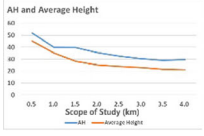
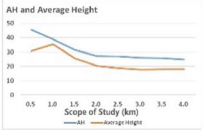
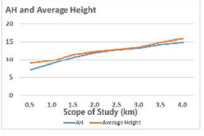
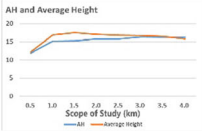
Indicator	1.0 km	2.0 km	3.0 km	4.0 km
WR	 A:0.269 S:0.078	 A:0.287 S:0.050	 A:0.285 S:0.030	 A:0.285 S:0.030
OSR	 A:0.448 S:0.174	 A:0.402 S:0.102	A:0.414 S:0.120	 A:0.421 S:0.105

Image Source Created by the authors

of section indicators and planning indicators in different parameters of rotational cuttings.

Similarly, the deviation values were standardized and then summed, and the three indicators were combined to evaluate the fit with the urban planning indicators at each scope. The standardized deviation values of the three indicators in the same scope of each district are summed together, and the result is graphically represented as shown in Fig. 3.12 on the left. The smaller the value is, the better the fit of the data, and the more it reflects the specificity of the morphological characteristics of the city. The deviations in all four districts show an upward trend at the 0.5–1.5 km scope after a rapid decrease in deviation and a more moderate increase at 3.0 km. The deviations of indicators in the range of 1.5–3.0 km are all low. The sums of the deviation of indicators of all districts are shown in Fig. 3.12 on the right. When the scope is set as 2.0 km, the sum of the deviations of the four districts is the smallest, and the deviations of each district are very close. Therefore, we conclude that the most suitable scope for the rotational section is 2.0 km, which is the same as the optimum value taken for the parallel section.

Table 3.8 Comparison of section indicators and planning indicators for different parameters of rotational cuttings

Xinjiekou	Hexi	Chengnan	Jiangning
			
			
			

Images Source Created by the authors

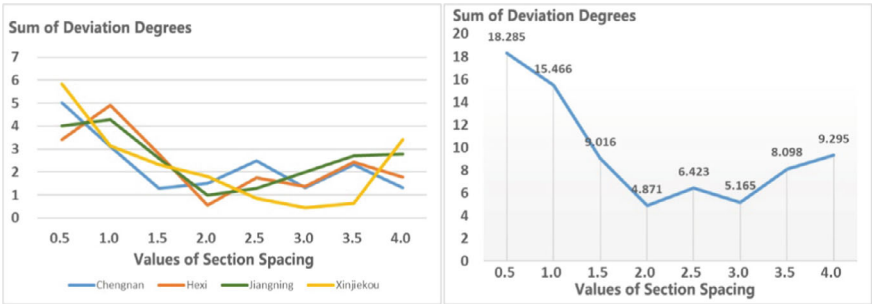


Fig. 3.12 Deviation of the standardized indicators with different cutting scopes. The left shows the separate statistical chart for each district, the right shows the statistical chart for the sum of all districts (*Source* Created by the authors)

3.5 Application of Reasonable Cutting Parameters and Urban Form Analysis

After obtaining adequate cutting parameters, we performed parallel and rotational cutting for each of the four cases and calculated the indicators for the sections, which are then compared to analyze the differences in their morphological characteristics.

3.5.1 Parallel Series Sections

Through the above study, the adequate parameters for parallel series cutting are a scope of 2.0 km and a density of 2. Figure 3.13 presents the comparative analysis of the indicators in four districts. It can be seen that *LR*, *AR*, *AH*, and *WR* are the largest in Xinjiekou, which represents the highest building form, complexity, and functional mix in this district. As a new CBD, Hexi has the largest *OSR*, as well as a larger *AR* and *AH*, which is different from the crowdedness of Xinjiekou and pays more attention to spatial quality. The overall building coverage in Chengnan is high, the *OSR* is low, and the complexity of building functions is high; however, because it is an old city, the *AR* and *AH* are the smallest. Jiangning has more residential houses and is an area to be developed, and the public building facilities are insufficient. The indicators in all aspects of Jiangning are close to Chengnan.

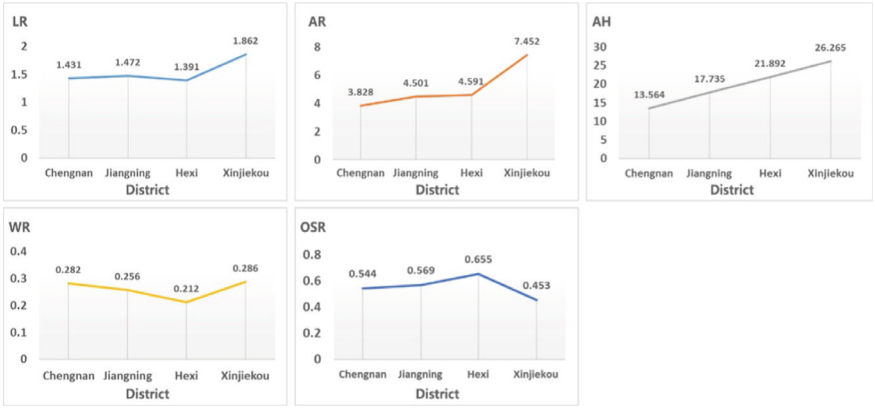
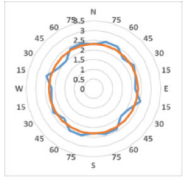
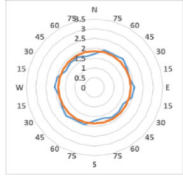
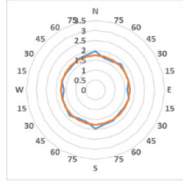
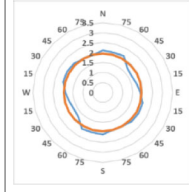
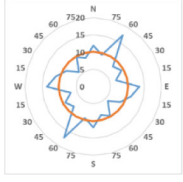
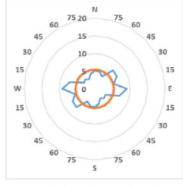
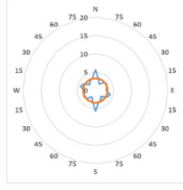
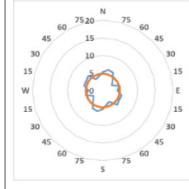


Fig. 3.13 Comparative analysis of indicators of parallel series sections in four districts (*Source* Created by the authors)

3.5.2 Rotational Series Sections

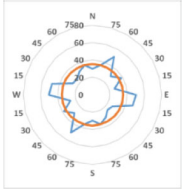
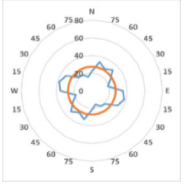
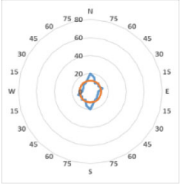
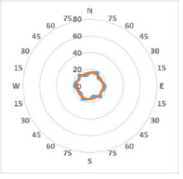
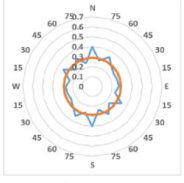
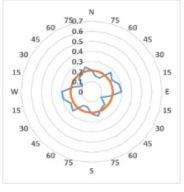
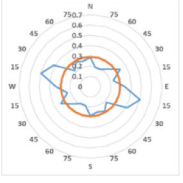
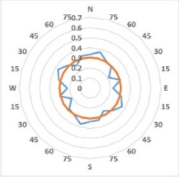
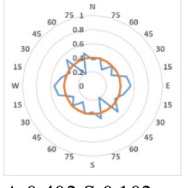
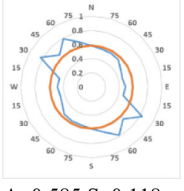
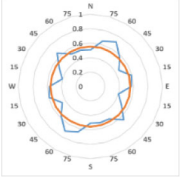
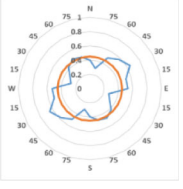
The above study indicates that the adequate scope for the rotational series cutting is 2.0 km. Table 3.9 presents the comparative analysis of the indicators in four districts. In a comprehensive view, the radar plots of each district show certain similarities and specificities in some places. The values on the radar plots of the *LR* indicators of each district in all directions are relatively balanced, all tend to be circular, and do not exhibit obvious directional specificity. The directions showing variability in *AR* and *AH* for Xinjiekou, Hexi, and Chengnan are very similar. This indicates that the building capacity size of these three districts in the same direction is closely related to the average building height in that direction, and the building capacity size of Jiangning is closely related to the building coverage in that direction. The *AR* and AH of Chengnan show variability in the direction of the north–south section, the *AR* and *AH* of Hexi show variability in the direction of the southwest and east–west sections, and the *AR* and *AH* of Xinjiekou show variability in the direction of the north–south sections. The *AR* and *WR* of Jiangning are more balanced, showing variability in the direction of the sections 30° southeast and 75° southwest. The *OSR* of Chengnan and Jiangning both show directional specificity of values in the southwest section.

Table 3.9 Comparative analysis of indicators of rotational series sections in four districts

Indicator	Xinjiekou	Hexi	Chengnan	Jiangning
LR	 A:2.302 S:0.160	 A:1.857 S:0.139	 A:1.747 S:0.088	 A:1.949 S:0.152
AR	 A:10.096 S:2.928	 A:5.461 S:1.810	 A:3.353 S:0.885	 A: 4.808 S:0.948

(continued)

Table 3.9 (continued)

Indicator	Xinjiekou	Hexi	Chengnan	Jiangning
AH	 A: 35.427 S:9.039	 A: 27.094 S:7.250	 A:12.074 S:3.240	 A:15.806 S:1.929
WR	 A: 0.287 S:0.050	 A:0.208 S:0.063	 A: 0.290 S:0.089	 A: 0.304 S:0.047
OSR	 A:0.402 S:0.102	 A: 0.585 S:0.118	 A: 0.554 S:0.085	 A: 0.451 S:0.110

Images Source Created by the authors

3.6 Conclusion

For the study of urban form, the urban section helps to understand the characteristics of building heights and the spaces between buildings compared to the traditional plan view. Moreover, as a two-dimensional polyline, the urban section is easy to use indicators for quantitative analysis. Parallel and rotational series cutting methods further provide different approaches to creating sections, offering more space for imagining the potential value of urban sections.

In the case study of the four districts of Nanjing, it is also clear that the relevant parameters of the cutting method have a direct impact on the results of the sections. Using traditional urban planning indicators as a reference, we compared the results obtained from different cutting parameters with the planning indicators to find the group with the smallest deviation, thus providing a benchmark for setting a reasonable threshold for the parameters. After many comparisons, we finally determined that a cutting scope of 2.0 km was the most reasonable. On this basis, a density of 12 m was adopted for parallel series sections.

Applying reasonable cutting parameters, four districts in Nanjing were analyzed for their respective quantitative indicators. By comparison, we can see that the urban section indicators reflect the different morphological characteristics of these cases well. In particular, the use of radar maps with rotational series sections provides an intuitive visualization of the morphological differences in different directions.

Certainly, despite the advantages of urban sections for the representation of urban form, a single section can only reflect local urban form and cannot express the entire morphological characteristics of the city. The parallel series cutting method can visually show the three-dimensional form of the city, but the results are directly influenced by parameters such as the direction and density of the cut. The rotational series cutting method avoids the interference of the cutting parameters, but the results depend on the choice of the center point and cannot intuitively express the urban form. In contrast, Gu et al. (2021) provided a new idea by using two perpendicular directions to perform parallel series cutting. However, the difference in calculated indicator values between the two directions is too great, and how to interpret the difference remains to be studied.

In this study, although multiple cases and parameters were tested, the scope was limited to square or circle. In practical applications, the shape of the block or neighborhood is not like this, and even irregular. At this point, no matter which series of cutting method is used, the length of each section may be different. Using the average value as the quantitative result of the urban form actually obscures the complexity of the boundary shape. Therefore, the application of cutting methods needs to be approached with caution and careful consideration of the limitations.

While the study of the urban section is still relatively preliminary, its quantitative representation of urban form can assist in a better understanding of urban morphology. The urban section has good potential for applications in urban design and urban construction control.

References

Andres D (2002) Introduction to the special issue: the transect. J Urban Des 7(3):251–260 (2002)
Ashihara Y (1984) The aesthetic townscape. MIT Press, Cambridge
Bohl CC, Plater-Zyberk E (2006) Building community across the rural-to-urban transect [The Transect]. Places 18(1):4–17
Çalışkan O, Mashhoodi B, Akay M (2022) Morphological indicators of the building fabric: towards a metric typomorphology. J Urbanism: Int Res Placemaking Urban Sustain 1–30 (2022)
Gu X, Tian S, Zhang B, Tong Z, Gan J (2021) SECTIONMATRIX: mapping of urban form through urban section. In: Proceedings of the 26th international conference of the association for computer-aided architectural design research in Asia (CAADRIA), vol 2, pp 599–608
Kaya HS, Mutlu H (2017) Modelling 3D spatial enclosure of urban open spaces. J Urban des 22(1):96–115
Li RY, Tang L, Ding WW (2018) Evaluation of generating mechanism of residential building patterns in contemporary cities. Case study on Xi'an and Nanjing. In: 24th ISUF international conference: city and territory in the globalization age, pp 331–341
Mantho R (2015) The urban section: an analytical tool for cities and streets. Routledge, New York
Martin L, March L (eds) (1972) Urban space and structures. Cambridge University Press, New York
Oke TR (1988) Street design and urban Canopy layer. Energy Build 11(1–3):103–113
Oliveira V, Medeiros V (2016) Morpho: combining morphological measures. Environ Plann B Plann des 43(5):805–825
Pont MB, Haupt P (2007) The relation between urban form and density. Urban Morphology 11(1):62
Steadman P (2014) Density and built form: integrating 'Spacemate' with the work of Martin and March. Environ Plann B Plann des 41(2):341–358
Tong Z (2019) Mapping and quantification of urban form through urban section. In: ISUF 2019 XXVI international seminar on urban form: cities as assemblages
Tong Z, Yang H, Liu C, Xu T, Xu S (2020) Quantification of the openness of urban external space through urban section. Geo-Spat Inform Sci 23(4):316–326
Welter VM (2002) Biopolis: patrick geddes and the city of life. MIT Press, Cambridge
Yoshida H, Omae M (2005) An approach for analysis of urban morphology: Methods to derive morphological properties of city blocks by using an urban landscape model and their interpretations. Comput Environ Urban Syst 29(2):223–247

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 4
Historical–Geographical and Procedural Typological Approach in Urban Renewal: As a Case Louroujina, Northern Cyprus

Nevter Zafer Cömert

Abstract The city is observed and shaped by the development and transformation of its dynamics during the process. Urban morphologies research; analyze the transformation and formation of physical forms of cities in the historical process and transformation. Morphological studies are examined from different perspectives in many countries in a wide range and are spreading to different geographies day by day. English School, one of the pioneers of these studies, MRG Conzen examines morphology through historical–geographical perspective, while Italian school S. Muratori evaluates morphology through typological processes point of view. MRG Conzen, who started to examine morphology at macro-scale in planning processes, and JWR Whitehand, MP Conzen, and M. Bark, who had a great influence on the development of these theories, examined urban morphology in the context of (a) town plan, (b) townscape, and (c) fringe belts by the means of planning level. On the other hand, S. Muratori and his continuation G.F. Cannigia, who examine micro-scale morphology from an architectural point of view, advance urban morphology within the scope of (a) buildings, (b) urban tissue, and (c) urban organism. The studies created by these two schools also have an important place in the discussion of rehabilitation and protection plans on theory. Suggestions and solutions for the practical application of theory, which is being discussed today, are actually examples of the practical analysis of these studies. In this context, the aim of this study is to examine and put into practice the morphological analysis methods, which are considered together with the architectural scale theories and practices, starting from historical–geographical approach within the scope of planning scale and typological procedural approach on rehabilitation and renewal projects. While doing all this, it is to examine the role of local users, NGOs, governmental bodies, and municipalities (local bodies) at every stage of these projects and the place of their inclusion in the project in practice. The results of this research will lead both the planners and architects in rehabilitation and renovation projects, by creating a basis for the method, and how the method will be analyzed in terms of morphology in future studies and its reflections on practice.

N. Z. Cömert (✉)
Faculty of Architecture, Eastern Mediterranean University, Famagusta, Northern Cyprus
e-mail: nevter.zafer@emu.edu.tr

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_4

Keywords Urban form · Procedural typology · Historical–geographical approach · Renewal · Rehabilitation

4.1 Introduction

The study of urban form is a field that embraces different professions and researchers within different languages and disciplines such as geography, architecture, planning, anthropology, sociology, and cultural studies. M.R.G Conzen (1981) puts forward a theoretical basis for urban conservation grounded in the functional development of the urban landscape and based on the recognition of townscape. According to Conzen (1969), the town plan is a combination of three distinct but integral plan elements; they are the streets and their street system, the plots and their plot pattern, and the building arrangement within these patterns. In addition to this he explained the present structure of a town plan by examining its historical development. Within this context he puts forward a theoretical basis for townscape in the functional development of the urban landscape, which is plan unit, land utilization, and building utilization. Later, Whitehand (2021) developed his ideas not only in the field of urban conservation grounded based but also the socio-economic development of the industrial and post-industrial towns by the means of understanding the transformation of urban form. While historical–geographical approaches are discussing on planning level, Italian School which have been started with Mouratori and later continuing with Cannigia continues their studies on the typological process on the Latin towns by discussing procedural typological approach. As Cataldi (2003) addressed that, Mouratori typological classification is not a right attempt to understand the urban form, for him historical building process was based on the spontaneous type plan the outgrowth of a particular cultural context. He added that Muratori Venice experiences that push him to single out not only the typological persistence of single building, but also the capacity of the dwelling to be aggregated serially to form within building tissue, the real backbone of the urban organism. Then Caniggia starting point is utilizing the building type applying it to the tissue and developing Muratoris' concept of elementary cell, pertinent areas, and strips. Then he was setting up the method of "procedural typology" including the concepts of substratum type, leading type, synchronic variant and diachronic transformation and typological yield from medieval up to today. While two scholars assessing the urban form with different point of view and different levels, both theories and findings have not been applied for the new proposed projects especially by considering urban rehabilitation, urban renewal, and urban conservation projects. They were tested their theories on selected sites but the question is would it be possible to applied in practices?

In line with two theories, this study is to discuss the historical–geographical and procedural typological approach to turn to the practices at one of the traditional town's renewal by conserving the form of the Louroujina in Northern Cyprus. This entails to see the finding within the concepts of town plan, building procedural transformation and typological character into practices. Other aim of this study is to determine the

methods by interacting with NGOs' and stakeholders and locals while carrying out such conservation and rehabilitation practices.

4.2 Procedural Typology and Historical–Geographical Approach in Renewal Projects

As mentioned above, procedural typological and historical–geographical approaches have been discussed since the beginning of nineteenth century by pioneers in this field, MRG Conzen, JWR Whitehand, M. Barke, P. Larkham MP. Conzen, K. Gu, Mouratori S. GF. Caniggia, G. Strappa, M. Matteo, G. Cataldi, and M. Maretto. The physical form of cities structured of many forms in urban context and these elements combined into distinct patterns in different places of the city. Additionally, different agents and process of change continuously change these forms. Within this framework the activities of urban design and architecture have significant impact on these elements. However that could be acceptable that this action on physical form of cities could be linked to the knowledge that continues to be produced in the universities, but actually it is not.

Oliveira and Monteiro (2021) firstly starts to discuss how those theories have been carried to practices? Morphological research in planning, urban design, and architecture book edited by Oliveira (2021) is the first example of discussing the relation between scientific research and professional practice on the urban landscape. It tried to address linkage between morphological research and practice on planning, urban design, and architecture. He tries to understand if in different fields of knowledge from architecture to urban morphology, how this gap was common for the other fields of knowledge such as health education law and economics on one hand. The other focuses of him are to understand the wide gap between research and practices, even the practices are not a whole thing there are incredible differences between architect, urban designer, and planner.

Jeremy Whitehand (2021) explores the applicability of the historical–geographical approach into planning practice, especially he focuses on how the morphological regions has been take into consideration as a base for the conservation plans, he stated that In subsequent work on Kuling, the Peking University Urban Morphology Research Group drew attention to drawbacks of the UNESCO Historic Urban Landscape approach in the conservation of this type of heritage in China and the importance of taking into account academic research on urban landscapes. JWR Whiteand, S. Whitehand and Gu (2014) town plan analysis on Chinese cities especially on Pingayo and Guangzhou area has opened a new discussion on town plan analysis within three integral components—town plan, building form, and land use—based on comparative studies. Such studies show that the processes of the cities on certain period lead the people to take historical background into consideration for conserving or renewing the towns upon the scientific data. Larkham and Morton (2021) and Kropf (2021) explore the urban morphology practices in conservation plans and creating a

policies on Stratford Upon Avon by the means of morphological regions for defining the character areas at planning level. While UNESCO put an emphasize to put how the create a basis to analyzing and proposing cultural heritages by using Historic Urban Landscape as a tool (Larkam and Northon 2011) studied signifies how the contribution and collaboration with local authority are important in practices. Also this study is one of the significant examples that showing how the local authority and theoretician had been collaborated in conservation plans to put the planning policy strategies in UK. While morphological issues have been take into consideration by UNESCO and also they create a guide in planning policies and strategies at planning level on one hand. On the other hand, those studies carried out by Samuels (2021) on urban design level that examines two planning tools; appointing planning officials and making preparations that include approaches from the spectrum of urban morphology. This brought the basis for improving the spatial quality of master plans in UK. With coding system the unit and proximity of the spaces carried the their local identity. This study is benefits of the linking of academic work together with local authority in practices that found the barriers incorporation with urban economical consideration on conservation and rehabilitation level.

In fact, the most practice-oriented studies in morphological studies are seen in urban rehabilitation and renovation projects within the scope of typomorphological approach in line with procedural typological studies. Muratorian School has put on the theory within this field. Cannigia had found an opportunity to discuss all of the theoretical bases basically in Como and other Italian cities but it is a questioning how it will be in practice in the future. While Strappa (2021) assesses the relationship between the morphological reading of the built environment and the architectural design by considering the typological characterization of the organism, architectural values of the existing tissues and new proposed forms have been put a systematic way of understanding on typomorphological studies both in theory and practices, also it shows an evidence for further studies. Later Moretti (2021) puts an emphasis on how the transformation of typological process of the cities by considering the Mouratiorian theories into practice both an analysis tool for understanding the urban form over all and also put the relation with relevant authority during the process in order to define the guidelines of urban rehabilitation and renewal. He indicates that the analysis of urban and typological process is possible with cartography, and at the same time it makes it possible to highlight the layers of formation and transformation of the urban fabric, which remains a process for contemporary projects. This also brings another discussion on how relatively new urban forms may link between the cultural and social context that produced them is more evident. Moreover, this perspective opens the view to a “sensitive morphology” in which the contemporary project establishes a relation between the cultural heritage sites, urban conservation areas, or new architectural proposal with the aspirations of its inhabitants. While typomorphological studies spread in Europe by considering Mouratiorian School approaches both in theory and practice, Wowo Ding used similar practices to rehabilitate the small villages in China. She addresses how design can be considered base on research and conclude on the meaning of using morphological research in practice, debating why practice needs research, how it works, and in which ways it

can be done. This achievement opens a new discussion among architects who are in academy and who practice in order to understand the systematic way of understanding. Parallel to Ding et al. (2021) point out how the integration of planning and architectural point of view take into consideration on morphological approach that had tested on design of a nineteenth-century house. In here the fundamental question of the relationship between the analysis and design of the urban landscape is what to preserve and what to change?

As a result, within the scope of cultural heritage, conservation, rehabilitation, or renewal projects in morphological studies, studies made by shedding light on strategic planning and spatial planning in cooperation with local authorities at the planning level, and also the transformation of typomorphological elements at street scale were discussed directly or indirectly by many theorists with applicable or applied examples.

4.3 Louroujina as a Case for Rehabilitation and Renewal by Conserving the Form of the Town

The most important feature in the selection of Louroujina is that the morphological region in the planning scale is also considered as criteria in this process and applied by the local authorities, although it is not in any strategic plan or schedule. The town is one of the frontier vernacular towns that has survived to the present, despite all kinds of changes and migration, and is one of the unique examples of vernacular Mediterranean identity. The town during the post-conflict period in Cyprus, town population has been decreased from 5000 to 500. One of the reasons is the proximity to the border and distances from the closest cities. Because of the two reasons there is a rapid place displacement to closing towns. Afterward, town has become smaller and processing physical decay has emptied most of the houses. In line with this in 2006 Louroujina municipality applied to rehabilitation of the town in order to achieve physical, functional, and social revitalisation at the town. United Nations Development Project (UNDP) founded the Lourinina by the means of physical rehabilitation and functional revitalisation.

Putting to design the stages of the process has started the rehabilitation process. As seen in Fig. 4.1, first stage of the project has been started on planning level in order to understand the urban form by the means of historical–geographical perspective. On this stage, morphological characteristics of the town analyzed by defining the morphological regions. In second stage, rehabilitation and restitution of the buildings has been figured out by using procedural typological perspective. In here, rehabilitation and restitution of street characteristics, plot head characteristics, and buildings have been analyzed by means of understanding the characteristics of typological process of existing structures. Last stage covers the implementation and practices of

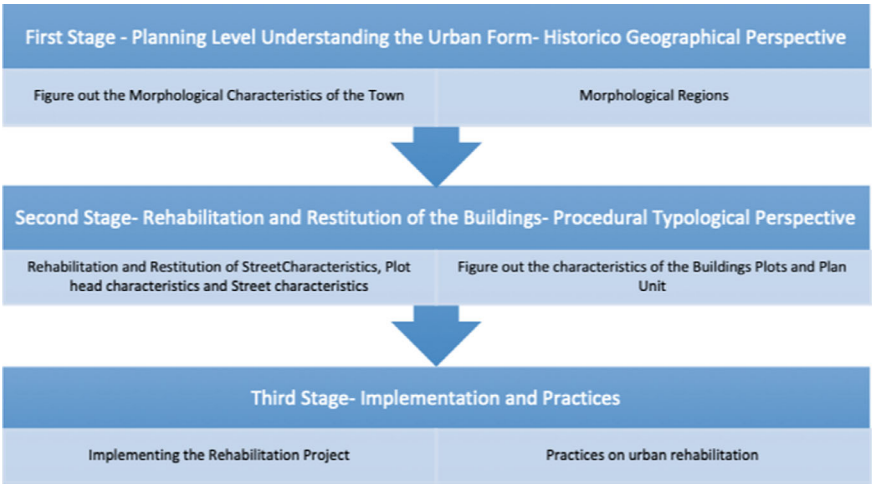


Fig. 4.1 Method of the study process (*Source* Developed by author)

the project into practice by using the historical–geographical and procedural typological processes by consulting the governmental bodies, owners of the buildings, and project authority.

In the scope of the **first stage** at planning level, Louroujina municipality applied to UNDP for the identification and rehabilitation of these priority areas, a budget was determined in the process. Within the scope of the budget, a group of urban designers, engineers, and architects determined the morphological regions by doing research for 2 months according to land use, building typology, and plan units throughout the whole town. Afterward, the city planning department was contacted and informed about how the method and the process would work, it was discussed that such methods should be added to the planning criteria and should be handled while making spatial planning, and as a result of the discussions, these were added to the criteria in this field. Subsequently, an application was made to the land registry office for 40% unused buildings and land ownership research. One reason for this was to get permission from the landowners and the other was to reach the land owners and become a stakeholder in this project. After the land ownership inventories taken from the land registry office, all the owners were contacted one by one, and their permission was obtained, provided that they were informed at every stage about the rehabilitation of their buildings in a possible application. Also the functional revitalisation information has been given to them upon their approval. After all the processes were completed, the planning and design team started working to determine the priority areas within the budget by defining the morphological regions. Morphological regions have been figured out by analyzing the plan unit, land utilization (Fig. 4.3), and building type (Fig. 4.4). Upon the morphological regions' study, first rank of the area has been selected for façade rehabilitation and functional revitalisation (Fig. 4.2) by approving the city planning department, UNDP monitoring committee, and landowners. Within the scope of

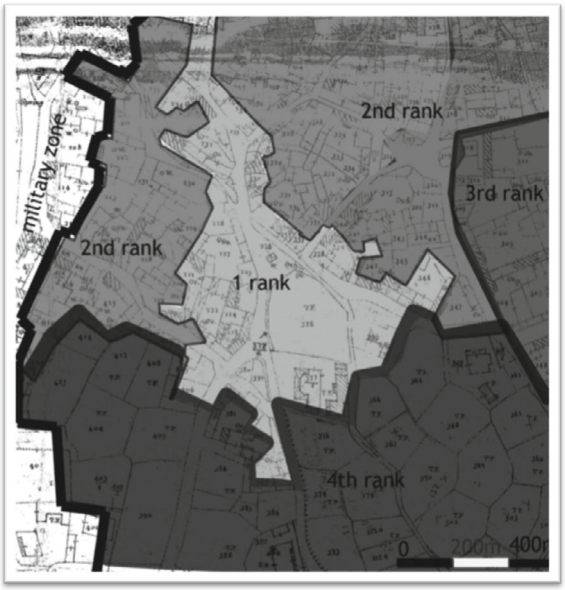


Fig. 4.2 Morphological regions of Louroujina (*Source* Developed by Author based on City Planning Department, Northern Cyprus Cadastral Maps)

the budget, it was decided to rehabilitate morphologically the first rank regions, and to give new functions to some buildings by the approval of firstly landowners, then planning department and land survey department as a governmental authority, municipality as a local government who provide a common discussion ground for all relevant bodies, and local NGOs and UNDP monitoring committee who are financing the project.

When the morphological characteristics of the town have been defined, building types, plan units, and their pertinent characteristics on the street level have been studied in stage 2.

As seen in Fig. 4.5, detailed research on building and their plot characteristics together with pertinent street characteristics has been analyzed in order to putting existing situation of the tissues on one hand. The archive studies for understanding the transformation of the town have been done both at national archive and also the land survey department.

As a result of the research, morphological transformation was observed as a result of the overlapping of the maps and photographs of the 1900s with the current situation. In this study, the maps showed that the street formation did not change and preserved its original structure. Only in 224 and 336 parcels, the structure does not appear on the 1900 map. Instead, the continuation of the building in plot 224 used as an extension of the khan on plot 223. It was observed that this place was demolished in the 1940s and the coffeehouse of today was built, and the research showed that coffee house has set back from the street where coffee house terraces align on street. Morphologically, withdrawing from the street line after this formation shaped the coffee houses, and this resulted in the differentiation of the plan unit. With the studies,

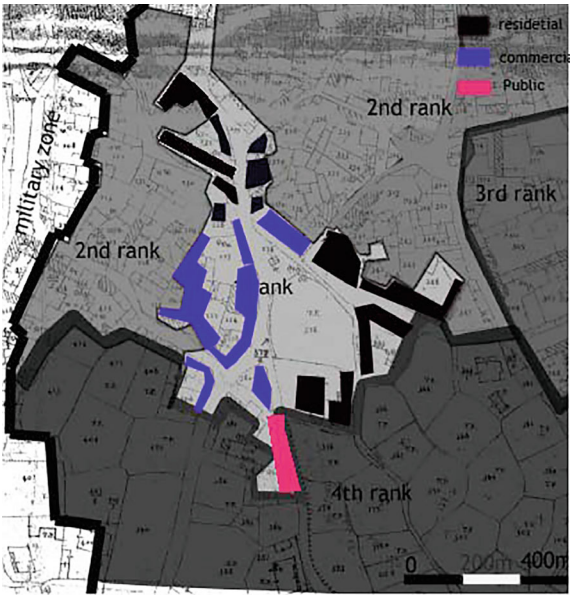


Fig. 4.3 Land utilization map in first rank (*Source* Developed by Author based on City Planning Department, Northern Cyprus Cadastral Maps)

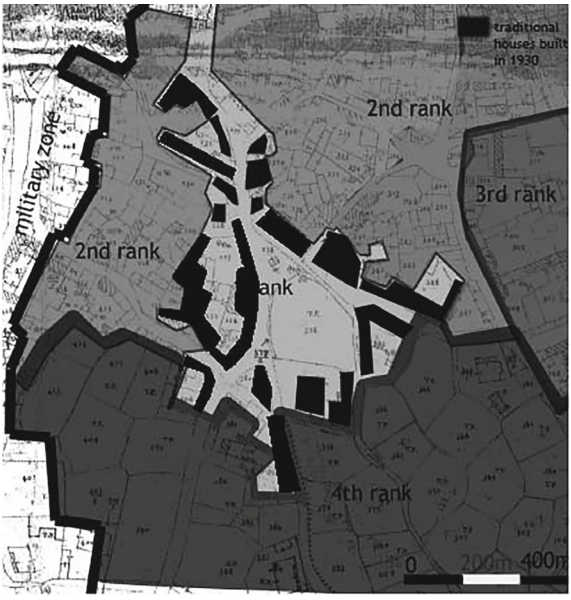


Fig. 4.4 Building type in first rank (*Source* Developed by Author based on City Planning Department, Northern Cyprus Cadastral Maps)

Fig. 4.5 Street and square design proposal by considering existing form (*Source* Comert Zafer et al. 2007)

the current situation has been preserved, but the walls and structures that define the street in terms of defining the street as a morphological element and creating a border have been added to the street and morphological continuity has been ensured.

In order to figure out the existing situation, measuring the existing façade, streets, and square with total station and photogrammetry method has been followed during the restitution and rehabilitation process by tracing the previous tissue that has been researched. In the archival study, the area, which is currently the current road, was used as a village square in the 1900s, and kebab was made in the big ovens in this square every weekend and on national days, and it was started to be used as a gathering place for the people in the whole village. Morphologically, the location of the ovens was determined as a determining element in the village. In addition, due to the structure of the village, these ovens can be observed in many different small squares. In the design process, it has been suggested that these elements will be brought back to the village, both to continue the cultural habits and to continue the plan unit. In addition, the texture was maintained by interpreting the proportions of the stones connected with the old street by making use of the form of the square and its relations with the buildings. In line with surface material and texture, all solid

and void relations along the street level were also took into consideration as a design guideline. One of the significant elements on public open spaces is the community oven (Fig. 4.10), which has been observed at all the public open spaces. They are a morphological element together with façade element.

As seen in Fig. 4.6, existing facade has been explored both with archive data and facade traces along pertinent street characteristics. During the analysis, windows proportion, material types, windows, door, porticos, shutters, stairs, entrance position—elevated, depressed or same level—on street and their relations has been deeply investigate in order to find out general morphogloical characterisitics of street plan unit. Addition to those roof types, structures and material have been defined. Moreover, interview with the former owner and current owner gave the designer a great opportunity to figure out the existing morphology of the houses, plots on the pertinent characteristics of the street especially defining the overall morphology from their own photograph archives and old title deed. In order to understand the characterisitcs of morphologial regions in the first rank, series of systematic methodology has been applied for restitution and rehabilitation. Morphologically, it helps to preserve the existing morphology and providing a new proposal by considering the current situation. After the design process was completed, the designers gathered in the area again with all the stakeholders and exchanged ideas on how this area was designed in the process, what was taken into account, and how archival work was done? These sessions were held five times before the completion of the project and were completed after being revised as a result of the feedback received.

Design proposal on street level has been done according to the existing morphology on pertinent strip typological transformation on building level by interpreting all façade elements (window, door, stair, roof, arches, shutters, etc.) with proposing materials, proportional division, solid void relations, and structure characteristics by considering typological process since the construction of the buildings (Figs. 4.7 and 4.8). The design process was resolved in line with the comments, experiences, and suggestions of all relevant stakeholders, governmental bodies, and NGO, after considering the morphological transformation, by adhering to the plan units, if it

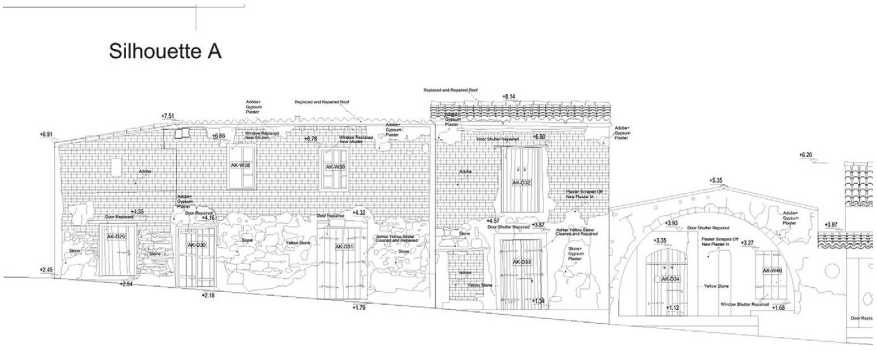


Fig. 4.6 Existing façade on street level (*Source* Comert Zafer et al. 2007)

is possible to complete it, by taking the old traces in this context, taking into account the plot and building relations, and considering the relations with the neighboring plots on street level, and suggestions were created. In this area, attention has been paid to ensure that cultural continuity is not disrupted on the one hand, and that it is handled in an integrated manner without losing its morphological character on the other. This idea has been developed throughout the town, before implementing the project firstly consultation with all partners (UNDP monitoring committee, municipality, antiquities department, owners, habitants) as a last decision at the end. This approach has been applied at all the streets which has been morphologically in first rank of the region.

During the implementing the project, procedural typology of the building has been the primary concern but also structure, material, and volumes have been searched during the process. The new proposal for façade rehabilitation by the means of physical revitalisation has been implemented on site especially monitoring by UNDP collaboration with the owners of the land, stakeholders, and governmental bodies.

During the implementation phase, the cycle of the typological processes of the buildings and the transformations in the process were among the main objectives of the project. In this process, all analyses and findings were systematically researched before the implementation was started, and then, after sharing with the stakeholders, the production of the implementation projects and the tender process started. The company, which won the tender in the process, started by questioning the appropriateness of some decisions, since this project was not only a rehabilitation project, but also a part of the process and transformation. In particular, the adoption of the project by the owners and the fact that the buildings are more livable by using the cultural clues as the texture allows, starting from the building construction details during the construction phase, was created at this stage. For example, the design agreements and on-site solutions of the bakeries in the streets and their immediate surroundings have been realized by the transformation of the form in the cultural context. At the same time, during the implementation phase, the local people contributed to the problems that could not be resolved on a local scale, especially about adobe, by making their own production, and started to use one of the rehabilitated buildings as a workshop

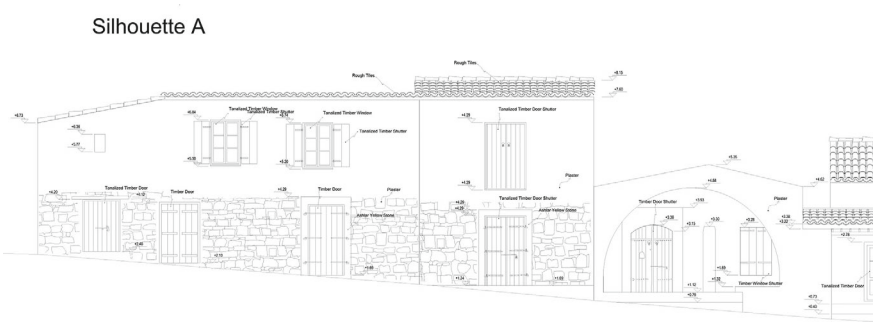


Fig. 4.7 Façade proposal on street level (*Source* Comert Zafer et al. 2007)

Fig. 4.8 Restitution and rehabilitation of the buildings and streets (*Source* Comert Zafer et al. 2007)

in this area. After the implementation not only physical rehabilitation and renewal is enough, afterward functional revitalisation has been necessity for actively using the town not only for residence but also tourist and other people all around the Cyprus. Within this scope some local shops in (Fig. 4.9) have been structured and convinced the locals to open it and create the continuation of the function. Additional local authorities support the villagers to organizing a local festival to attract the people all from the island.

Fig. 4.9 General view after the rehabilitation and functional revitalisation (Left: URL1, from the INTABU Cyprus Archive, Right: By author, Cömert Zafer 2022)

Fig. 4.10 Oven is the morphological element at public open spaces (By Author, Cömert Zafer 2022)

4.4 Conclusion

The findings give a systematic methodology for assessing the vernacular town by the means of historical–geographical and procedural typological approaches on vernacular towns with the collaboration of the stakeholders, governmental bodies, and owners on one hand. On the other hand, it gives a common ground for discussing and assessing the urban revitalisation and rehabilitation project in practices by applying and legalizing those systematic way of assessment on town plan rehabilitation and renewal approved by governmental bodies and local authorities. Within this scope Rehabilitation and Revitalisation Projects in practice need to be tending to deep analysis of the townscape and the inputs of the existing surrounding not only analyze and understand the façade and surface but also analyze the townscape on planning level by considering plan units, land use, and building types through the process. In line with such studies, if there will be an other morphological elements has been founded during the research, other morphological methodologies may considered on the research by analyzing them. In the scope of this study, public oven is one of the important elements that needs to be taken into consideration as a morphological element.

Additionally, the research findings give a systematic methodology for assessing the traditional urban form rehabilitation in practices for further studies as a holistic way. Within this scope, historical–geographical and procedural typological processes would be followed together in order to achieve a better solution on overall morphology of the cities or towns in implementation on practices by considering all relevant stakeholders. Such a study not only archive research but also narratives help to figure out the existing structure of urban morphology throughout the process and transformation. Only the physical rehabilitation and revitalisation is not enough to implement but also functional revitalisation could be proposed in order to create

the livable environment especially by analyzing the land use patterns in the past and observe their transformation. This study shows that especially in functional renewal project all relevant bodies need to be taken into consideration in order to create a liveable environment.

Note: The ZNO architecture office at Northern Cyprus leads the project and drew all drawings in the article. The project members of the team are Nevter Zafer Comert, Burak Tursoy, Erkal Şahoğlu, and Seran Aysal and this team carried out this project under the supervision of UNDP.

References

Cataldi G (2003) From Mouratori to Cannigia. J Urban Morphlogy 7(1):19–34

Comert Zafer N, Tursoy B, Şahoğlu E, Aysal S (2007) UNDP, villages rehabilitation project as a case of Louroujina, Northern Cyprus

Cömert Zafer N (2022) Personal photo archive

Conzen MRG (1969) Alnwick, Northumberland: a study in town-plan analysis. Institute of British Geographers, London

Conzen MRG (1981) Geography and townscape conservation. In: Whitehand JWR (ed) The urban landscape: historical development and management. Academic Press, London, pp 81–105

Ding W (2021) Morphology and typology: a village as a cultural and environmental process. In: Oliveira V (ed) Morphological research in planning, urban design and architecture. Springer. ISSN 2365-7588. https://doi.org/10.1007/978-3-030-66460-2

Kropf K (2021) Is there a normative science of the built environment? In: Oliveira V (ed) Morphological research in planning, urban design and architecture. Springer. ISSN 2365-7588. https://doi.org/10.1007/978-3-030-66460-2

Larkham PJ, Morton N (2011) Drawing lines on maps: morphological regions and planning practices. Urban Morphol 15:133–162

Larkham PJ, Morton N (2021) Conservation and (sub)urban form: reviewing policy in Stratford Upon Avon, 2004–2019. In: Oliveira V (ed) Morphological research in planning, urban design and architecture. Springer. ISSN 2365-7588.https://doi.org/10.1007/978-3-030-66460-2

Moretti G (2021) Contemporary architectural projects as interpretation of urban and social contexts. In: Oliveira V (ed) Morphological research in planning, urban design and architecture. Springer. ISSN 2365-7588. https://doi.org/10.1007/978-3-030-66460-2

Oliveira V (ed) (2021) Morphological research in planning, urban design and architecture. ISSN 2365-7588. https://doi.org/10.1007/978-3-030-66460-2

Oliverira V, Monteiro C (2021) On a morphologically-based method for architectural practice: the Lindo vale house. In: Oliveira V (ed) Morphological research in planning, urban design and architecture. Springer. ISSN 2365-7588. https://doi.org/10.1007/978-3-030-66460-2

Samuel I (2021) Towards an eclectic urban morphology. In: Oliveira V (eds) Morphological research in planning, urban design and architecture. Springer. ISSN 2365-7588. https://doi.org/10.1007/978-3-030-66460-2

Strappa G (2021) The Terni cemetery—considerations on the relationship between reading and design. In: Oliveira V (ed) Morphological research in planning, urban design and architecture. Springer. ISSN 2365-7588. https://doi.org/10.1007/978-3-030-66460-2

URL1:INTBAU Cyprus intagram page:https://www.instagram.com/intbaucyprus/ Acessed 7 Nov 2023

Whitehand JWR (2021) Conzenian research in practice. In: Oliveira V (ed) Morphological research in planning, urban design and architecture. Springer. ISSN 2365-7588. https://doi.org/10.1007/978-3-030-66460-2

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 5
Intellectual Heritage for Morphological Studies in Belgrade, Serbia: Understanding Spatial Transformations Through Review of Academic and Practical Thoughts and Actions from 1969 to 1981

Vladan Djokić, Milica P. Milojević, Aleksandra Milovanović, Aleksandra Djordjević, and Mladen Pešić

Abstract If heritage is about continuity, then intellectual heritage is about continuity of knowledge, ideas and thoughts that allows us to learn from the past and make informed decisions in the future. Accordingly, the paper strives to establish review of academic and practical thoughts and actions within the scope of urban morphology in Belgrade starting from the period after World War II until the beginning of 1980s. Therefore, the two research questions were (a) what kind of theoretical and methodological approaches have emerged in local context over this period and (b) on which manner these approaches reflect, confirm, or deny emerging interpretations around global research landscape in spatial transformation? The research engages the literature review method through three steps: (1) analysis of relevant bibliographic units from magazine Urbanism of Belgrade dating from the most influential planning period (1969–1981), (2) content analysis of selected units and (3) deriving key notions and actions. These sources provide background for tracing the intellectual progression for the field on local level—key authorities and precedents. The paper results—over the timeline—in the evolution of theoretical and practical reflection on morphological studies in a local context, and provides a new theoretical perspective for understanding intellectual heritage and for guiding future actions, contributing to critical visions and disciplinary discussion within Serbian Network of Urban Morphology (SNUM). The research has both practical and theoretical impetus and is based on the assumption that research on locally specific approaches on the renewal processes is an important puzzle in understanding the global research agenda in the subject area and accordingly seeks to show the roots and precedents in the context of Serbia.

V. Djokić · M. P. Milojević · A. Milovanović · A. Djordjević (✉) · M. Pešić
Faculty of Architecture, University of Belgrade, 11000 Belgrade, Serbia
e-mail: aleksandra.dj@arh.bg.ac.rs

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_5

Keywords UM regional networks · Urban morphology legacy · Spatial transformations · Magazine urbanism of Belgrade

5.1 Introduction

This research aims to highlight the place and importance of local studies in building a joint global agenda for urban morphology. ISUF Regional Networks related to countries or language areas have potential to become leading bearers of knowledge directed towards building discipline, fostering academic debate and disseminating results. Each of the network is built on a historically rooted intellectual heritage that developed at the intersection and through the synthesis of science, practice and education. The impetus for morphological studies were most often influenced by contextual factors that came from the institutional, planning and theoretical-methodological framework which is why the importance of their understanding is extremely important for further development of the urban morphology discourse. In this sense, the research has both practical and theoretical impetus and is based on the belief that research on locally specific approaches is an important piece of the puzzle in understanding the global research agenda in the subject area and accordingly seeks to show the roots in the Serbian context. The overarching objective of the paper tends to present contextual stimulus for morphological studies in Serbia, and for understanding wider background of Serbian network of Urban Morphology (SNUM), established in 2016 with focus on the evolution of urban form from the more general viewpoint. Paper relates to SNUM endeavours to strengthen relations between research, practice and teaching of urban morphology in academia by involving researchers and practitioners from fields of architecture, urban planning, transport engineering and conservation. For its further improvement, the closer insight into the academic tradition was presented within 5th ISUF Italy International Conference (Djokic et al. 2020a), while here, more comprehensive analysis of the practical thoughts and actions was conducted.

The paper consists of four parts. In the first part, the research methodology is explained through the elaboration of the conceptualization of the research and rationale behind selecting Belgrade as the main research subject area, and then the elaboration of the individual steps related to the identification of magazine Urbanism of Belgrade (in Serbian Urbanizam Beograda) as relevant source followed by classification of recognized bibliographic units, and decoding and mapping of key notions and actions (two analysis tracks—notion track and scale track). In the second part, a detailed analysis of the context is provided through closer insight into (a) developmental features of professional context and importance of Urban Planning Institute of Belgrade and (b) periodicals as a system of knowledge focussing on Magazine Urbanism of Belgrade (67 issues published in the period from 1969 to 1981). In the third part, a presentation of the results is given followed by a discussion in two research directions: (1) an explanation and description of the choice of sources and

their classification in relation to the criteria and (2) the results of the two-track analysis. Finally, in the fourth part, concluding considerations and perspectives for further research are given.

5.2 Methodology

5.2.1 Research Conceptualization

In order to identify contextual factors, as well as the research and professional context of the development of urban morphology in the context of Serbia, the research engages (1) a context-based approach—by identifying the contextual framework in which the professional and research practice of urban planning and design develops and (2) evidence-based approach–by systematically identifying and mapping previous research and roots and based on them draws conclusions about influential factors in contemporary action. The development of professional practice and action in the context of Serbia arose immediately after the Second World War, in the socialist conditions of the Yugoslav Country with Belgrade as a central figure in the development of intellectual heritage. In that context, Belgrade was not only the capital, but also a unique urban laboratory where new approaches were developed and modern principles of planning and construction were tested, but where there was also a very productive and continuous publishing activity in the form of periodicals in the domain of architecture and urban planning. On these grounds, the subject research engages Belgrade as a role model and spatial framework for decoding approaches that have emerged in local context over time. This research is conceptualized in a form of the case study analysed through several research phases as follows: (1) identification of relevant sources/bibliographic units that witness about the urban development and spatial transformation of Belgrade over time, (2) sorting and classification of recognized sources, and (3) decoding and mapping of key notions and actions relevant to the urban morphology scope.

5.2.2 Identification of Relevant Sources

Identification and selection of relevant sources affiliated with the urban development and spatial transformation of Belgrade over time are based on the following criteria: (1) continuity in publishing activity, (2) publishing activity related to the institutional framework, and (3) inclusion of presentation of practical achievements in correlation with research thought. In this criteria framework, the magazine Urbanism of Belgrade (Orig. in Serbian: Urbanizam Beograda) is recognized as a relevant primary source of research that can be characterized as a specific source that is equally Scholarly Periodical and Trade Periodical. Selected magazine has (1) continuity in publishing activity,

Table 5.1 Sorting the bibliographic units (authors)

Thematic grouping	Description
Planning framework	New plans, reconstruction plans, programming
Research framework	Studies and research, spatial planning challenges, architectural, urban design and planning competitions, architectural projects, the experiences of European cities
Theoretical and methodological framework	Theoretical concepts, methods and approaches to planning
Institutional framework	Urban planning activities, institutional framework and public participation in planning
Realizations and implementations	Realizations
Events and awards	Events, awards

particularly in the period of intensive urban development, institutional consolidation, and planning articulation of Belgrade (1969–1981); (2) publishing activity is affiliated with Urban Planning Institute of Belgrade as a leading institution for research and practical application of ideas at the time in question; and (3) practical achievements (planning framework and realizations) are discussed in line with the research thought (theoretical-methodological framework and experiences of other cities).

5.2.3 Classification of Recognized Bibliographic Units

Sorting and classification of recognized sources were carried out through the following steps: (1) creation of a chronological review of articles (by principle: year, issue number, author, title), (2) analysis of articles by title and keywords, and (3) sorting and thematic grouping of the articles. A total of 489 articles published in 67 issues in the period from 1969 to 1981 were identified which are grouped in following classes/frameworks (Table 5.1).

5.2.4 Decoding and Mapping of Key Notions and Actions

Based on the identified primary sources and the conducted classification of articles, the third step of the study is the decoding and mapping of key notions and actions. This analysis is primarily content based and aims to identify key conceptual precedents and approaches that had an impact on the domain of urban morphology both indirectly and directly. The analysis is carried out through two tracks—notions track and scale track. Notions Track analysis implies observation of (1) Research Framework (studies and research, the experiences of European cities, challenges of spatial planning), (2) Theoretical and Methodological Framework (theoretical concepts, methods and

approaches to planning) and (3) Institutional Framework (urban planning activities, institutional framework and public participation in planning). Scale Track analysis implies observation of (1) Conceptual Framework (architectural, urban design and planning competitions, architectural projects (designs), and urban projects) and (2) Realization Framework (realizations, as well as adopted new plans, reconstruction plans, programming). While the notions track tends to identify leading precedents and umbrella themes that shaped the contextual framework of the development of urban practice, the Scale Track tends to identify engagement in relation to different spatial levels.

5.3 Context

To understand discussion, it is necessary to start from the explanation of the contextual framework that encouraged the development of professional activity in the form of the Urban Planning Institute of Belgrade, as well as through the presentation of relevant sources through the identification of the magazine Urbanism of Belgrade (Orig. in Serbian: Urbanizam Beograda). Accordingly, the research identifies periodicals as a system of knowledge and decodes their content. In the second part, the presentation of the results follows the results of two analysis tracks—notions track and scale track.

5.3.1 Developmental Features of Professional Context: Urban Planning Institute of Belgrade

Activities that lead to the establishment of Urban Planning Institute of Belgrade began immediately after the end of the Second World War with the establishment of the Urban Planning Institute of the People's Republic of Serbia and the Office of the Chief/Main Architect of Belgrade with Nikola Dobrović as its lead figure. These activities were part of the substantial post-war reconstruction plans and expected urban development of Belgrade, as a capitol city of the newly established state. After several institutional reforms and changes, Urban Planning Institute of Belgrade was founded, as a part of the Urban Design Administration, in 1948 with main task to develop the first post-war Master Plan of Belgrade (adopted in 1950) that envisioned extensive planned and organized construction of the city itself. In its 70 years history, Urban Planning institute was reformed on number of occasions that were lined up with decisions to reorganize the city's urban planning services and shape specialized institutions that will, on behalf of the city, organize the planning and construction of the city (Gligorijević and Graovac 2018). History of the Institute and its endeavours within Belgrade urban development is observed through five periods: (1) 1948–1958: The Beginning; (2) 1958–1974: Fast Development; (3) 1974–1985: Re-examining the Visions; (4) 1985–2000: The Period of Uncertainty and (5) 2000–2018: New

Enthusiasm (Gligorijević and Graovac 2018). Historical role of the institute as a specialized, expert planning institution and part of the city administration that was responsible for all tasks of urban planning, development and implementation of plans since 1950s until 1980s, and its present role as professional consulting company whose main activity is still intricately linked with urban and spatial planning of Belgrade and past and present activities of the institute are clearly visible in Belgrade urban fabric/tissue. Constant transformation of ideas, conceptual frameworks along with theoretical and practical aspects of planning within the institute and its staff members was influenced by global and local social, political, cultural and economical changes (Gligorijević and Graovac 2018, p. 6). It is within this context that Urban Planning Institute in Belgrade is one of the few constants in dynamic process of Belgrade spatial development that could be used as testing ground for discovering locally specific approaches, hidden narratives, chronologies and trajectories within the scope of urban morphology while seeking roots and precedents in the Serbian context.

5.3.2 Periodicals as a System of Knowledge: Urbanism of Belgrade (Orig. In Serbian: Urbanizam Beograda)

Along with its central tasks, within the institute, a system of research and educational units for urban planning and architecture was organized and they had a significant role in the professional upgrade of the institute profile. Following professional and research activities within the institute vivid publishing activity was developed engaging permanently in presentation and promotion of urban practice and education among professional and general public. Especially important was a professional magazine entitled Urbanizam Beograda (Urbanism of Belgrade/Belgrade urbanism), launched in 1969, and regularly published five times a year until 1982 (Fig. 5.1). In 67 numbers, Urbanizam Beograda portrayed expert studies, views and topics important for research and understanding of urban and spatial planning and their complementary areas (Gligorijević and Graovac 2018, p. 36). From present perspective, this magazine is kind of chronicle of the golden age of urban planning in Yugoslavia and could be used for quantitative, qualitative analysis and critical interpretations of protagonists, themes, textual and graphic contents, in establishing movements, trends and debates over the selected period (Gligorijević and Graovac 2018, p. 36). In the first issues of the magazine, the most important plans and decisions of the 1960s are summarized and information is given on ongoing activities and current topics in the field of urban planning. Debates about ideas, proposals and achievements, as well as weaknesses and problems in practice of urbanization and planning of complex spatial, social and economic development as multidisciplinary activities marked the issues from 70 s. At the same time, Urbanizam Beograda offered insights in other topics regarding current regional and global trends and events in the domain of urban planning and architecture through initiation of permanent thematic sections about

Belgrade's urban history and its builders, public spaces and their improvement, city's cultural identity and review of other publications. In the 80 and 90s, magazine has lost the rhythm of publishing due to political and economic changes in Yugoslavia (Serbia) that lead to overall crisis that also challenged planning system and harden the priorities of urban development.

Publishing within the Institute was renewed in 2003 through a newsletter titled Info, in which the most important topics and plans from the domain of city planning were presented to professionals and the general public through three sections—Theme of the issue through which the current task of the Institute was presented, Research, Travelogues and Reports (Gligorijević and Graovac 2018, p. 100). Over the following years this publication offered reports and discussions about plans and studies carried out by the Institute, and covered wide range of themes regarding public spaces, sustainable development, GIS, illegal construction within the city, environmental protection, etc.

By acknowledging the role and influence of the Urban Planning Institute and its position within the planning system of Belgrade along with its periodicals in the

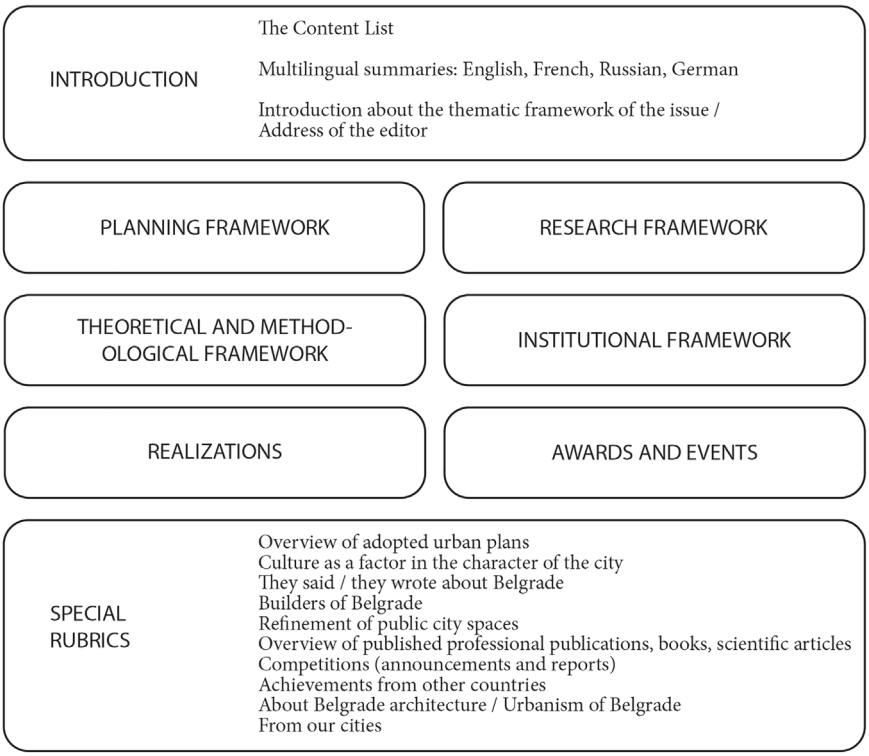


Fig. 5.1 Structure of content—urbanism of Belgrade magazine (authors)

form of testimonials of overall activities it is possible to map the operations, identify and analyse both professional and tacit narratives of urban morphology within the context of Serbia. Both magazines that were published within Institute undertakings to broaden the scope of professional activities and improve the production of built environment can be examined as primary sources and as a complex document consisting of databases, images, expert views and testimonies of collaborations between local practices and foreign experts to trace circulation of this specific knowledge within the local context.

In the address of the editorial office of the Urban Planning Institute of the City of Belgrade (1969) on the occasion of the release of the first issue in January 1969, the key objectives for the launch of the publishing activity in the form of the magazine Urbanism of Belgrade as a permanent periodical were highlighted:

1. *Recognition of urban development problems*: As a result of the increasingly intense and accelerated process of urban development, both in Belgrade and in other cities, an increasing number of problems appear that are the subject of intensive mastering, solving or at least mitigating through practice, especially from the point of view of socio-economic development.
2. *Preparation of the new general plan*: The general urban plan, which was drawn up at that moment almost two decades ago, was recognized that despite its significant qualities, it is becoming outdated in some of its settings and is at the end of its time span.
3. *Strengthening the cooperation of the urban planning institute, experts and institutions*: The Institute, in addition to its professional staff, must gather eminent individuals, groups and institutions outside its composition in a complex form of cooperation and synchronization of the highest degree.
4. *Involving citizens in the city planning debate*: Despite the demographic forms by which all major urban decisions gain their vitality only after the opinion of a wide range of citizens and professional public has been previously heard, the Urban Institute considered that it would be beneficial to discuss important urban plans, projects and problems, as well as the realization of those plans and projects to the general public.
5. *Report on the work and achievements of the urban planning institute*: The publication is intended for city and other bodies and institutions, work, social and other organizations, as well as for the wider professional and other public, including the press and other means of information, with the aim of timely and better gain the best possible insight into the work and achievements of the Urban Institute.
6. *Criticism and debate*: The publication should provide an opportunity to evaluate the functional and aesthetic values of individual projects and achievements, as well as the results of individual authors.
7. *Systematization of the planning of Belgrade*: To serve other cities in their planning and construction, as well as to present a systematic documentation on the planning and construction of Belgrade.

5.4 Results and Discussion

This part presents the results of decoding and mapping of key notions and actions through two-track analysis–notions track and scale track. Notions Track will present the observation of (1) Research Framework, (2) Theoretical and Methodological Framework and (3) Institutional Framework, while Scale Track analysis will present the observation of (1) Conceptual Framework and (2) Realization Framework through multiscale perspective. Notions Track will be presented through a table that has thematic and chronological nature, hence highlighting the time when specific topic was addressed in local context. On the other hand, Scale Track will be presented through a diagram of a scalar nature that consists of two axes: a time axis with the years of publication and a scalar axis with spatial levels, and with indexes that indicate the elements of the study (projects, plans, competitions, programmes, realization, etc.).

5.4.1 Notions Track

Research Framework. By identifying the articles that contribute to the research framework, it is also possible to recognize the specificity of practice and action within the Urban Planning Institute of Belgrade, which are based on continuous monitoring of contemporary approaches and experiences of other European cities, such as Budapest, Copenhagen, Vienna, Munich, Paris, Prague and Hamburg, but also on planning experiences from the USA and Canada. In this sense, the research framework is built in constant dialogue and exchange of experiences with other cities and multidisciplinary dialogue with experts from other disciplines. In this framework, 10 groups of aspects have been identified (presented on Table 5.2). The central group of aspects is occupied by housing, which can be marked as the leading pattern of development of the territory of the city of Belgrade, which is why its research preoccupation is not surprising. The research framework begins with the consideration of illegal housing construction (Đurović 1969), followed by residential construction in planning process (Jovanović 1975), housing policy (Popović 1975), indicators of housing construction (Veljković 1975a) and general characteristics of the construction of new settlements (Martinković 1975). In addition to the above, in the context of the theory of needs and the growth of studies on future users, there are also studies examining modes of residence (Bjelikov 1977) and emotional and psychological aspects of housing (Lukić 1979). When it comes to the aspect of urban form, research dealing with urban anatomy (Perović 1979) could be singled out. This study is based on the theory of modern analytical procedures in the study of large urban systems, where it is considered that economic development, social changes, as well as political and institutional trends are equally important as physical and technological factors. Accordingly, the study monitors several variables that have an impact on the development of the urban system and urban form guided by the belief that the

multivariate character of the city cannot be simply explained by one representative parameter. According to the time orientation, the research framework can be characterized in two ways: (1) orientation towards the past (aspects of history and heritage) through the review of historical plans (Škalamera 1974; Kovačević 1975), geography of culture (Kolarić 1971), introducing the theme of heritage protection in the context of spatial planning (Lukić 1975b; Đurović 1978) and (2) orientation towards the future (aspects which concern future of the planning and city) through the analysis of demographic development and future growth (Rašević 1969). Within the group of aspects related to planning and design methodology following studies were identified: study dealing with basic elements and concepts of planning (Karamata 1969), study of documentation of urban development of the city (Đurić Zamolo 1971), as well as two spatial possibility studies—study on possibilities of programmatic and functional organization (Petrović 1977), and study on possibilities for urban reconstruction (Đurić Zamolo 1979). In correlation with the tendencies in the theoretical and methodological framework, the research framework is also occupied by environmental aspects that open the academic and practical debate on environmental pollution (Kovačević 1973), urban hygiene (Mišić 1969), and environmental protection of private property (Šimić 1980). Also, the involvement of a group of aspects related to aesthetics is recognized, through which the aesthetic-ambient values of space (Matičević 1977) are considered. Finally, aspects of spatial planning and evaluation involve analytical studies related to gravity zone analysis (Fatić 1969), and the influence of the rural area on the city (Papić 1973). In its nature, the research framework is followed and strengthened by the domain of critical-reflective thinking, which is developed through a series of articles about criticism and critics of construction (Šegvić, 1978).

Theoretical and Methodological Framework. Through the decoding of the content of the magazine Urbanism of Belgrade, it was recognized that in the practice of urban development in Belgrade, there is continuity in the shaping of the theoretical and methodological framework, which enabled the continuous improvement of both the substantive and thematic aspects of the design and planning process, as well as the procedural aspect that refers to the elements of stages of the design and planning process. In this framework, 11 groups of aspects have been identified (presented on Table 5.3). Within the group of Sociological and Economic aspects, first of all, the general consideration of the relationship between the practice of urban planning and knowledge in the field of sociology (Djurović 1969) and economics (Rajić 1969) is recognized, while from the mid-70s, through the growth and influence of environmental-behavioural studies (Stojanović 1969; Pešić 1969), questions of rational housing construction (Mendelson 1975) and specifically study of relation in between human and the space in line with the paradigm of humanization of the city was considered (Matičević 1978, 1979, 1980). These determinants were also reflected in the environmental aspects group, whose central themes are the question of protection of the human environment by urbanism (Stojanović 1975), relation of climatology and urbanism (Milosavljević 1977), and urban environment factors and measures (Stojkov 1980). The previous groups of aspects were mostly considered in

Table 5.2 Thematical and chronological overview of research framework

Aspect groups	Description	No. of texts
1. Environmental aspect	Environmental pollution (Kovačević 1973), urban hygiene (Mišić 1969), environmental protection and private property (Šimić 1980)	3
2. Aesthetic	Aesthetic-ambient values of specific space–Obrenovac (Stojkov 1974), ambient values of Belgrade (Matićević (1977)	2
3. Urban form	Urban anatomy (Perović 1979)	1
4. Planning and design methodology	Basic elements and concepts of planning (Karamata 1969), study of documentation of urban development of the city (Đurić Zamolo 1971), possibilities of programmatic and functional organization (Petrović 1977), urban reconstruction (Đurić Zamolo 1979)	4
5. Future of the planning and the city	Demographic development and future growth (Rašević 1969)	1
6. Spatial planning	Gravity zones analysis (Fatić 1969)	1
7. Evaluation/assessment	The influence of the rural area on the city (Papić 1973)	1
8. Critical-reflective thinking	About criticism and critics of construction (Šegvić, 1978)	1
9. Housing	Illegal housing construction (Đurović 1969), residential construction in planning process (Jovanović 1975), housing policy (Popović 1975), indicators of housing construction (Veljković 1975a), general characteristics of the construction of new settlements (Martinković 1975), modes of residence (Bjelikov 1977), emotional and psychological aspects of housing (Lukić 1979)	7
10. History, culture and heritage	Geography of culture (Kolarić 1971), historical plans-overview (Škalamera 1974; Kovačević 1975), heritage protection and spatial planning (Lukić 1975a), the place and function of historical ambient units in cultural life (Đurović 1978)	5

relation to housing, which was the leading determinant for the expansion of the territory of Belgrade in relation to demographic changes and factors of industrialization. Such was the case with the aspect of aesthetics, which was considered at the level of the city's physiognomy in the search for an aesthetic synthesis (Stojanović 1969). Within this framework, aspects of urban form occupy a special position through the following topics and studies: (1) the physical structure of the city as a subject of urban analysis (Radović 1969) and (2) theses on architectural composition in urban planning (Kostić 1977). The innovative approach is the application of mathematical models in the analysis of megalopolis structure (Perović 1973), which is built in an academic and practical dialogue between the study of urban form and the improvement of planning and design methodology. In the context of the improvement of the

methodology, the central position is occupied by the orientation towards the improvement of the methodology of creating plans of different levels (Bojović 1976; Vasić 1980), with a special focus on the general urban plan of the city (Stojkov 1974). The special value of the theoretical and methodological framework is recognized in its focus on the future through (1) the aspect of future planning of the city through the examination of the relationship between futurology and the city (Lukić 1972), as well as the thesis of the city that maintains and changes itself (Bojović 1978); (2) the aspect of education through the consideration of permanent education in the function of strengthening and continuous building of the profession in contemporary society (Bogosavljević 1975) and (3) aspect of evaluation and assessment of existing urban conditions (Lukić 1975b). Finally, the aspect of culture and heritage stands out as a specific group of identified aspects through which themes of urban culture (David 1978), notion of reconstruction through decentralization and restructuring of the city (Tomić 1978), reconstruction as a process of constant improvement of urban living conditions (Glavički 1978), as well as study on impact of urban solutions on the preservation (Zakić 1978), were introduced at the end of the 70s.

Institutional Framework. The institutional framework of the identified contents was created as a natural consequence of the magazine editorial by the Urban Planning Institute of Belgrade as the leading professional organization of the analysed period. In this framework, seven groups of aspects have been identified (presented on Table 5.4) with a dominant representation of the aspects related to organization and management. The central theme in the framework of organization and management is occupied by the issue of self-management in the planning process (Stojkov 1974), as well as the issue of system and organization of spatial planning in city (Djordjević 1974). Additionally, the tendency to achieve synchronization with the national planning system (1975) is recognized. As part of the development process of self-management and its integration into the practice of planning, the theme of public participation is present in the institutional framework, which was discussed continuously through the contents of the magazine (Đurović 1972; Stojkov 1973; Jakšić 1978), as well as the issue of inter-institutional cooperation (Marinko and Djurović 1969) and cooperation with public (Lukač 1969). Other aspects within the institutional framework are built and realized in relation to the other two frameworks (research and theoretical-methodological). The procedural aspect interpreted through the thesis 'from plan to planning' (Glavički 1969) is the result of advocacy for the improvement of planning and design methodology within the theoretical and methodological framework. Critical-reflective thinking is manifested in correlation with the research framework to build a continuous constructive debate and discussion about current achievements and practices (Stojanović 1973). The housing aspect is a natural result of the tendencies that will be presented in the scale track analysis results when it comes to realization. Finally, the aspect of interests is reflected in relation to the aspects of heritage and culture represented in the research framework, which relate to the introduction of the topic of reconstruction and protection of heritage and the environment. In the institutional framework, the activation of interests in the process of reconstruction is considered (Stojkov 1978).

Table 5.3 Chronological overview of theoretical and methodological framework

Aspect groups	Description	No. of texts
1. Sociological/economical aspects	Sociology (Djurović 1969), economy (Rajić 1969), rational housing construction (Mendelson 1975), human and the space, and humanization of the life conditions in the city (Matičević 1978, 1979, 1980)	6
2. Environmental aspect	Natural and disaster risk management (Stojanović 1969), Master plan and natural environment (Pešić 1969), protection of the human environment by urbanism (Stojanović 1975), climatology and urbanism (Milosavljević 1977), urban environment factors and housing (Stojkov 1980)	5
3. Aesthetic	Aesthetic synthesis of the city (Stojanović 1969)	1
4. Urban form	Urban structure and urban analysis (Radović 1969), architectural composition (Kostić 1977), community centres open spaces for spatial planning (Đorđević 1977)	3
5. Results, consequences	Alienation, GUP as a means of indirect control of urbanization, existential and architectural space in community centres	3
6. Planning and design methodology	Methodology of planning city centres (Janić 1971), mathematical models for megapolis structure analysis (Perović 1973), criteria for goals establishing (Stojkov 1974), urban development models comparison (Janić 1975), methodology and algorithms of plans development (Bojović 1976; Vasić 1980), micro-movie techniques for spatial planning (Pavlović 1977)	7
7. Future of the planning and city	Futurology and planning (Lukić 1972), permanent planning, a city that maintains itself and changes (Bojović 1978)	3
8. Spatial planning	Spatial planning of Belgrade region	1
9. Education	Permanent education (Bogosavljević 1975)	1
10. Evaluation/assessment	Evaluation of traffic systems (Lukić 1975b)	1
11. Culture and Heritage	Conservation requirements (Tomić 1978), impact of urban solutions on the preservation (Zakić 1978), urban culture (David 1978), reconstruction (Glavički 1978)	4

5.4.2 Scale Track

Conceptual Framework. Conceptual framework engages monitoring and consideration of two content elements stated in indexes of Fig. 5.2—competitions and conceptual design projects. In both cases, continuity is recognized in the development of the conceptual framework with a special focus on the block level. However, in this case, it is important to highlight the potential limitations of the study caused by the nature of the magazine, which primarily focusses on the urban practice of city development, instead of discussing architectural aspects related to lower spatial levels. In the same

Table 5.4 Chronological review of institutional framework

Aspect groups	Description	No. of texts
1. Urbanism and cooperation	Inter-institutional (Marinko and Djurović 1969), cooperation with public (Lukač 1969) and public participation (Đurović 1972; Stojkov 1973; Jakšić 1978)	7
2. Procedural aspects	From plan to planning (Glavički 1969)	1
3. Critical-reflective thinking	Regarding critic in architecture and urbanism (Stojanović 1973)	1
4. Organization and management	Urban Institute self-management (Stojkov 1974), system and organization of spatial planning in city (Djordjević 1974), relation with national planning (Veljković 1975b), urban communities experiences (Veljković 1976), self-management planning (Vasić 1976), professional council (Stojanović 1977), committee for the arrangement of ambient units (Stojanović 1978), self-management principles and DUPs (Vasić 1979), human resources for planning (Urbanistički savez Srbije 1978)	9
5. Defense	Public defense needs (Bojović 1977)	1
6. Housing	Urban institute experience in housing (Stojkov 1977)	1
7. Interests	Activating interests in reconstruction (Stojkov 1978)	1

period, the publishing activity of the *Architecture Urbanism* (a magazine for architecture, urbanism, applied art and industrial design) published by the Association of Architects of Yugoslavia and the Urban Association of Yugoslavia Belgrade, whose focus was on issues of architectural design in addition to urbanism, was carried out almost in parallel. The competition practice was focussed on the block level, which is in relation to the unit of the planning composition of New Belgrade conceptualized by the notion of the superblock (approximate dimensions 400 × 400 m), which was the primary area of construction in the period under analysis. Accordingly, it is possible to recognize a specific example of 'planning by competition'. In the thematic sense and according to the competition brief, competition practice was dominantly focussed on housing, which was correlated with very active and continuous action in this field in the research framework. On the other hand, conceptual design projects were focussed on the topic of open public spaces and parks, which was in line with the developments in the theoretical and methodological framework, where the topic of new environmentalism, the relationship between man and nature, as well as the issue of protecting the environment comes into the centre (which can be seen in the chronological diagrams above).

Realization Framework. Realization framework engages monitoring and consideration of three content elements stated in indexes of Fig. 5.3—realizations (realized/built design projects), adopted and officially implemented plans, and adopted urban

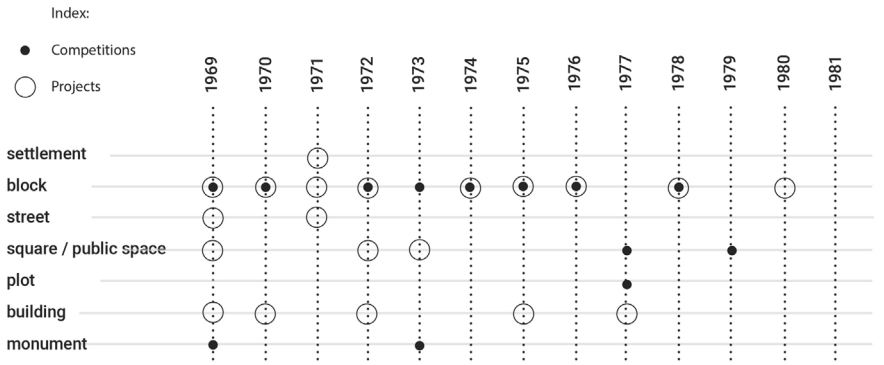


Fig. 5.2 Scalarity diagram of conceptual framework

programmes. In all cases, continuity is recognized in the development of the realization framework with a special focus on the block and settlement level. However, as the case of the conceptual framework, it is important to highlight the potential limitations of the study caused by the nature of the magazine, which primarily focusses on the urban practice of city development, instead of discussing architectural aspects related to lower spatial levels. When it comes to realizations, a dominant share of construction in the field of housing is recognized in the form of large-scale mass housing middle-class neighbourhoods. These realizations cover the scale of the block in the case of the development of the territory of New Belgrade, while in other cases it is the scale of settlements that are built in privileged positions in correlation with favourable environmental conditions. In the procedural sense, a specific process has been recognized that is strongly supported by competition practice from the thesis 'planning by competition' to 'construction by competition'. When it comes to plans, the dominant coverage at the city level is recognized, which is the result of an active period of development and adoption of the new Belgrade Master Plan from 1972. In addition, plans for the general regulation of New Belgrade (left bank of the Sava, administrative area of Belgrade) and Third Belgrade (left bank of the Danube, administrative area of Belgrade) were drawn up in this period. A specific feature is the creation of 14 reconstruction plans aimed at the reconstruction of blocks in the old city centre of Belgrade, as well as at the reconstruction of prominent streets on the city level—Knez Miloša Street and Knez Mihajlova Street. Finally, programmes of a systemic nature were recognized, which intend to regulate several environmental issues significant for the entire territory of the city—the regulation of riversides, the regulation of public city spaces and environmental protection.

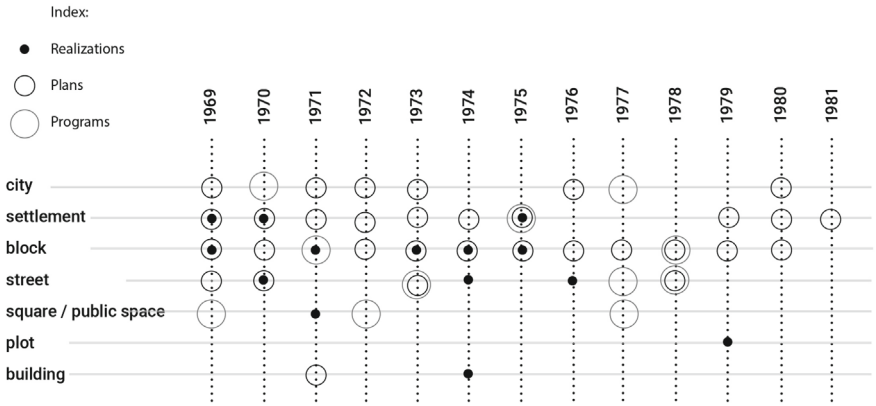


Fig. 5.3 Scalarity diagram of realization framework

5.5 Concluding Remarks

This paper established a historical review of academic and practical thoughts and actions relevant for the scope of urban morphology in Belgrade, Serbia, and accordingly revealing the roots of the Serbian network of Urban Morphology (SNUM)—viewpoint for understanding wider background of SNUM. Primarily, the research demonstrated periodicals as a system of knowledge and indicated the multi-layered content offered by this type of source as a kind of chronicle of the urban development of a certain spatial framework. Through the identification of relevant sources and the classification of articles, as well as their thematic grouping, a complex contextual framework has been recognized that has a direct or indirect influence on the local agenda of morphological studies. In this way, the initial assumption that morphological studies are most often influenced by contextual factors that came from the institutional, planning and theoretical-methodological framework was confirmed, which is why the importance of their understanding is extremely important for the understanding and further development of the urban morphology discourse. Through two-track analysis (notions track and scale track), the connection and dependence of different frameworks of action from the research framework, theoretical and methodological framework, institutional framework to realizations and conceptual planning and designing were unequivocally recognized.

This research provided an insight into the wider contextual factors of the development of knowledge and action in relation to the field of UM in Serbia, specifically in the period of intense urban growth, institutional consolidation and articulation of practical achievements, while initiating culture of documenting and archiving in urban planning research and practice. Together with the research presented within 5th ISUF Italy International Conference (Djokic et al. 2020a) that provided insight into the origins and traditions of education in the domain of UM at the higher education level at University of Belgrade—Faculty of Architecture (UB-FA), this paper

opens perspectives for further action within SNUM: (1) research of other types of sources published in the same period (1969–1981), which can contribute to the deepening of existing knowledge in the domain of UM; (2) direction towards the research of locally affirmative scientific journals (Arhitektura i urbanizam, Spatium, Serbian Architectural Journal—SAJ); (3) further development and advancements in specific topics within research scope of SNUM members, such as competition practice (Djokić et al. 2021), urban planning development and methodology in relation to urban form (Niković and Manić 2018), housing patterns (Gajić 2015; Gajić et al. 2021, Milovanović et al. 2022), post-socialist changes in urban tissues and specificities of modernist heritage and patterns (Milojević et al. 2019; Djokić et al. 2020b; Kantarek et al. 2022), environmental approaches (Djokić et al. 2016) and (4) development of special issues in the field of UM and analysis of contemporary scope that will affirm locally specific approaches developed within regional networks for which understanding of intellectual heritage of urban morphology in local context is of great importance.

Acknowledgements This research was funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia, grant number 200090 within Morpho-lab.

References

Bjelikov V (1977) Načini stanovanja u Beogradu [Ways of living in Belgrade]. Urbanizam Beograda 42:11–17

Bogosavljević D (1975) Mogućnosti i ograničenja permanentnog obrazovanja u savremenom društvu [Possibilities and limitations of permanent education in modern society]. Urbanizam Beograda 29:9–10

Bojović M (1976) Metodologija i algoritmika savremene izrade prostornih planova i njihova usaglašenost sa potrebama [Methodology and algorithms of contemporary development of spatial plans and their compliance with needs]. Urbanizam Beograda 37:24–26

Bojović M (1977) Potrebe opštenarodne odbrane u prostornim planovima [The needs of national defense in spatial plans]. Urbanizam Beograda 40:18–21

Bojović M (1978) Grad koji se održava i menja [A city that is maintained and changed]. Urbanizam Beograda 50:31–34

David M (1978) Urbana kultura [Urban culture]. Urbanizam Beograda 47:40–44

Djokić V, Milojević M, Djordjević A, Pešić M (2020a) Urban morphology education in Serbia: origin, genesis and new tendencies. In: Strappa G, Carlotti P, Ieva M (eds) Proceedings of the 5th ISUFitaly international conference urban substrata and city regeneration. Morphological legacies as a design tool. ISUFitaly, Rome, pp 665–674

Djokić V, Milovanović A, Ristić Trajković J (2020b) The textuality of the modernist rural landscape: Belgrade agricultural combine (PKB) as a driver of the urban development of third Belgrade. Land 9(11):452

Djokić V, Ristić Trajković J, Krstić V (2016) An environmental critique: impact of socialist ideology on the ecological and cultural sensitivity of Belgrade's large-scale residential settlements. Sustainability 8(9):914

Djokić V, Djordjević A, Pešić M, Milovanović A (2021) Urban morphology and urban design competitions in Serbia: between substantial and procedural aspects. In: XXVIII international seminar

on urban form ISUF2021: urban form and the sustainable and prosperous cities. University of Strathclyde, Glasgow, pp 1080–1087
Djordjević A (1974) Sistem i organizacija prostornog planiranja u Beogradu [System and organization of spatial planning in Belgrade]. Urbanizam Beograda 26:Prilog 6
Đorđević V (1977) Slobodni prostor mesne zajednice kao elemenat prostornog planiranja [Open space of community centers as an element of spatial planning]. Urbanizam Beograda 41:15–27
Đurović Đ (1972) Učešće javnosti u izradi Generalnog urbanističkog plana Beograda [Public participation in the development of the General Urban Plan of Belgrade]. Urbanizam Beograda 17:2–3
Đurović Đ (1969) Program saniranja nehigijenskog stambenog fonda u Beogradu [Program for rehabilitating unhygienic housing stock in Belgrade]. Urbanizam Beograda 2:24–25
Đurović G (1978) Mesto i funkcija starih ambijentalnih celina Beograda u njegovom kulturnom životu [The place and function of the old ambient units of Belgrade in its cultural life]. Urbanizam Beograda 50:47–50
Đurić Zamolo D (1971) Prilog proučavanju dokumentacije urbanističkog razvoja grada [Contribution to the study of documentation of urban development of the city]. Urbanizam Beograda 11:13–17
Đurić Zamolo D (1979) O rekonstrukcijama Beograda [About Belgrade reconstructions]. Urbanizam Beograda 52:38–40
Fatić S (1969) Analiza gravitacione zone Beograda [Belgrade gravitational zone analysis]. Urbanizam Beograda 4:14–16
Gajić R (2015) Urban morphology as a tool for exploring the land use in residential areas: example of New Belgrade. Spatium 33:76–83
Gajić R, Golubović-Matić D, Mitrović B, Batarilo S, Kordić M (2021) The methodology for supporting land use management in collective housing towards achieving energy efficiency: a case study of New Belgrade, Serbia. Land 10(1):42
Glavički M (1969) Od plana ka planiranju [From plan to planning]. Urbanizam Beograda 4:79–80
Glavički M (1978) Stručni savet kao jedan vid učešća stručne javnosti Beograda u toku izrade detaljnog urbanističkog plana područja Knez Mihailove ulice [Expert advice as a form of participation of the professional public of Belgrade during the development of a detailed urban plan for the area of Knez Mihailova Street]. Urbanizam Beograda 46:43–46
Gligorijević Ž, Graovac A (2018) 70 godina Urbanističkog zavoda Beograda [70 years of Urban planning Institute]. Urbanistički zavod Beograda, Beograd
Jakšić M (1978) Karakter i dometi učešća građana u planskom usmeravanju razvoja postojećeg gradskog tkiva kroz detaljne urbanističke planove rekonstrukcije [Character and scope of citizens' participation in the planning direction of the development of the existing urban fabric through detailed urban reconstruction plans]. Urbanizam Beograd 50:41–46
Janić M (1971) Metodološki pristup planiranju gradskih centara [Methodological approaches for planning city centers]. Urbanizam Beograda 13–14:11–13
Janić M (1975) Modeli urbanog razvoja – komparativna analiza [Models of urban development -comparative analysis]. Urbanizam Beograda 29:5–8
Jovanović N (1975) Međugradski autobuski terminal Jug u Beogradu [Intercity bus terminal Jug in Belgrade]. Urbanizam Beograda 32–33:10–17
Kantarek AA, Kwiatkowski K, Korbel W, Djokic V, Djordjevic A, Nikovic A, Samuels I (2022) Mapping post-socialist changes in urban tissues: a comparative study of Belgrade and Krakow. Urban Morphol 26(1):44–63
Karamata K (1969) Osnovni elementi za planiranje stanovanja [Basic elements for housing planning]. Urbanizam Beograda 4:26–27
Kolarić M (1971) Geografija kulture Beograda [Geography of Belgrade culture]. Urbanizam Beograda 13–14:4–6
Kostič K (1977) Teze o arhitektonskoj kompoziciji u urbanističkom planiranju [Theses on architectural composition in urban planning]. Urbanizam Beograda 41:28–31

Kovačević Ž (1973) Zagađenost životne sredine u Beogradu i mogućnosti rešavanja [Environmental pollution in Belgrade and solutions]. Urbanizam Beograda 23:prilog 4
Kovačević Ž (1975) Istorijski i današnji pogled na Beograd [Historical and present-day view of Belgrade]. Urbanizam Beograda 30:3–5
Lukač S (1969) Urbanizam i javnost [Urbanism and the public]. Urbanizam Beograda 4:78–79
Lukić M (1972) Futurologija i urbanizam [Futurology and Urbanism]. Urbanizam Beograda 15:21–23
Lukić N (1975a) Knez Mihailova ulica – zaštita nasleđa i uređenja prostora [Knez Mihailova Street—protection of heritage and arrangement of space]. Urbanizam Beograda 32–33:49–51
Lukić P (1975b) Vrednovanje saobraćajnih sistema u okviru prostornog planiranja [Evaluation of traffic systems in spatial planning]. Urbanizam Beograda 29:20–26
Lukić M (1979) Detaljni urbanistički plan bloka između ulica Nemanjine, Generala Ždanova, Birčaninove i Svetozara Markovića [Detailed urban plan of the block between Nemanjina, Generala Ždanova, Birčaninova and Svetozar Marković streets]. Urbanizam Beograda 52:30–33
Marinko V, Šurović Đ (1969) Osnovni oblici saradnje Zavoda sa drugim institucijama i javnošću [Basic forms of cooperation of the Institute with other institutions and the public]. Urbanizam Beograda 4:48–49
Martinkovič K (1975) Opšte karakteristike građenja novih naselja [General characteristics of the construction of new settlements]. Urbanizam Beograda 30:15–16
Matičević V (1977) Ambijentalne vrednosti Beograda [Ambiental values of Belgrade]. Urbanizam Beograda 43:15–18
Matičević V (1978) Razmišljanja na temu – čovek i prostor [Reflections on the topic—human and the space]. Urbanizam Beograda 48:41–42
Matičević V (1979) Razmišljanja na temu – čovek i prostor [Reflections on the topic—human and the space]. Urbanizam Beograda 51:48–51
Matičević V (1980) Razmišljanja na temu – čovek i prostor [Reflections on the topic—human and the space]. Urbanizam Beograda 57:65–67
Mendelson A (1975) Nova stambena naselja kao oblik razvoja Beogradu [New residential areas as a form of development in Belgrade]. Urbanizam Beograda 30:17–21
Milojević M, Maruna M, Djordjević A (2019) Transition of collective land in modernistic residential settings in New Belgrade, Serbia. Land 8(11):174
Milosavljević K (1977) Značaj klimatologije za urbanizam [The importance of climatology for urban planning]. Urbanizam Beograda 41:34–39
Milovanović A, Dragutinovic A, Nikezić A, Pottgiesser U, Stojanovski M, Ivanovska Deskova A, Ivanovski J, Damjanovska T (2022) Rehabilitation of mass housing as a contribution to social equality: insights from the east-west European Academic Dialogue. Sustainability 14(13):8106
Mišić R (1969) Higijenski aspekti urbanističkog planiranja Beograda: Opšta razmatranja/ Zagađenost komunalne atmosfere Beograda i mere za njeno otklanjanje [Hygienic aspects of Belgrade's urban planning: General considerations/Pollution of Belgrade's communal atmosphere and measures to eliminate it]. Urbanizam Beograda 4:40–46
Niković A, Manić B (2018) A possibility of introducing the concept of form into urban planning in Serbia. Spatium 40:18–24
Papić D (1973) Uticaj doseljenika iz ruralnih područja na gradsku sredinu [The impact of settlers from rural areas on the urban environment]. Urbanizam Beograda 20:19–21
Pavlović D (1977) Mogućnosti mikrofilmske tehnike za potrebe prostornog planiranja [Possibilities of applying micromovie techniques for spatial planning]. Urbanizam Beograda 38–39:49–51
Perović M (1973) Primena matematičkih modela u analizi strukture megalopolisa [Application of mathematical models in the analysis of megalopolis structure]. Urbanizam Beograda 20, Prilog 1:30–33
Perović M (1979) Anatomija Beograda [Belgrade Anatomy]. Urbanizam Beograda 53–54:57–76
Petrović V (1977) Centralna zona Beograda – mogućnosti programske i funkcionalne organizacije [Central zone of Belgrade—possibilities of programmatic and functional organization]. Urbanizam Beograda 43:19–23

Pešić D (1969) Tretiranje prirodne sredine u fazi generalnog urbanističkog planiranja [Treatment of natural environment in Master planning]. Urbanizam Beograda 43:19–23
Popović B (1975) Aktuelna stambena politika Jugoslavije [Current housing policy of Yugoslavia]. Urbanizam Beograda 30:12–13
Radović R (1969) Fizička struktura grada kao predmet urbanističke analize [The physical structure of the city as a subject of urban analysis]. Urbanizam Beograda 4:66–71
Rajić R (1969) Ekonomska nauka i urbanizam [Economic science and Urbanism]. Urbanizam Beograda 4:50–51
Rašević M (1969) Tendencije u dosadašnjem demografskom razvitku Beograda i perspektive za budući grad [Tendencies in the demographic development of Belgrade so far and perspectives for the future city]. Urbanizam Beograda 4:17–18
Šegvić A (1978) O kritičarima i kritici graditeljstva [About criticism and critics of construction]. Urbanizam Beograda 47:24–32
Škalamera Ž (1974) Područje Novog Beograda na istorijskim planovima [The area of New Belgrade on historical plans]. Urbanizam Beograda 25:37–40
Šimić LJ (1980) Zaštita životne sredine i privatna svojina [Environment protection and private property]. Urbanizam Beograda 56:21–24
Stojanović B (1969) Novi aspekti u savremenom urbanističkom planiranju [New aspecs in contemporary urban planning]. Urbanizam Beograda 4:52–62
Stojanović B (1973) O kritici arhitekture i urbanizma [About critic of architecture and urbanism]. Urbanizam Beograda 22:19–20
Stojanović B (1975) Zaštita čovekove okoline urbanizmom [Protection of the human environment through urbanism]. Urbanizam Beograda 31:1–6
Stojanović B (1977) Stručni savet Zvoda za planiranje razvoja grada Beograda [Expert advice of the Board for Planning the Development of the City of Belgrade]. Urbanizam Beograda 44–45:9–13
Stojanović B (1978) Odbor za uređenje ambijentalnih celina grada [Committee for the arrangement of ambient units]. Urbanizam Beograda 48:51–52
Stojkov B (1973) Neke karakteristike učešća javnosti u izradi Generalnog urbanističkog plana Beograda [Some characteristics of public participation in the preparation of the General Urban Plan of Belgrade]. Urbanizam Beograda 20:1–4
Stojkov B (1974) Kriterijumi za uspostavljanje ciljeva prostornog razvoja grada [Criteria for establishing the goals of spatial development of the city]. Urbanizam Beograda 27:9–11
Stojkov B (1977) Aktivnosti Zavoda u oblasti stambene izgradnje Beograda [Activities of the Institute in the field of housing construction in Belgrade]. Urbanizam Beograda 42:5–11
Stojkov B (1978) Aktiviranje neposrednih interesa u rekonstrukciji grada [Activation of immediate interests in the reconstruction of the city]. Urbanizam Beograda 50:27–30
Stojkov B (1980) Faktori životne sredine kao kriterijumi za izbor lokacija za stanovanje [Environmental factors as criteria for selecting residential locations]. Urbanizam Beograda 59–60:21–24
Tomić V (1978) Rekonstrukcija – decentralizacija i restruktuiranje grada [Reconstruction—decentralization and restructuring of the city]. Urbanizam Beograda 50:21–22
Urbanistički savez Srbije (1978) Kadrovi za planiranje [Human resources for planning]. Urbanizam Beograda 51:8–13
Urban Planning Institute of the City of Belgrade (1969) Povodom izlaženja prvog broja [To the first number issue]. Urbanizam Beograda 1:1
Vasić Z (1976) Samoupravno planiranje [Self-management planning]. Urbanizam Beograda 37:20–21
Vasić Z (1979) Samoupravno planiranje [Self-management planning]. Urbanizam Beograda 51:20–21
Vasić Z (1980) Metodologija izrade DUP-ova centralnih MZ gradova srednje veličine na primeru DUPa III MZ sa gradskim centrom u Obrenovcu [Methodology for creating DUPs of central MZ cities of medium size on the example of DUP III MZ with the city center in Obrenovac]. Urbanizam Beograda 56:27–32

Veljković V (1975a) Pokazatelji stambene izgradnje [Indicators of housing construction]. Urbanizam Beograda 30:14–15
Veljković V (1975b) Nacionalno i regionalno planiranje kao okvir za planiranje u lokalnim upravama [National and regional planning as framework for planning in local municipalities]. Urbanizam Beograda 31:16–17
Veljković V (1976) Planiranje u mesnoj zajednici [National and regional planning as framework for planning in local communities]. Urbanizam Beograda 34–35:2–6
Zakić N (1978) Uticaj i posledice urbanističkih rešenja na zaštitu velikih gradova [The impact and consequences of urban solutions on the protection of large cities]. Urbanizam Beograda 48:43–49

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 6
Quantity Versus Quality: Do Citizens in Denser Neighbourhoods Have Poorer Access to Urban Open Spaces? A Pilot Study in Stavanger, Norway

Todor Kesarovski and Fabio Hernández-Palacio

Abstract The sufficient provision of urban open spaces (UOS) is fundamental for sustaining good quality of life in cities. This is an aspect long established within urban planning. Indeed, the balance between built masses and open spaces has been crucial for the discipline's development and innovative practices in spatial design. This paper presents a pilot study correlating the concentrations of built form and population with 10-minute walk access to UOS, including both grey and green areas. We realise this in three steps. First, we verify the availability of all UOS for flexible utilisation by the public. Second, all UOS are evaluated through a qualitative score matrix. And third, we assess the amount of UOS that is accessible from each residential building within the 10-minute isochrone through network analysis. The research results challenge the notion that citizens in denser neighbourhoods have poorer provisions of good quality UOS. On the contrary, the examined case studies illustrate that inhabitants within denser areas have physical access to a greater quantity of UOS. This fact becomes even more significant when one considers the individual open spaces' elements, amenities and connectivity. The realised analysis indicates that if one aims to effectively assess the provisions of UOS within cities, a more complex and diverse picture must be drawn in the evaluation process. Only then the impact of planning strategies such as urban densification can be fairly evaluated with respect to the pressure the process puts on the available green and grey UOS.

Keywords Spatial density · Urban open spaces (UOS) · GIS analysis · Accessibility · 10-minute city

T. Kesarovski (✉) · F. Hernández-Palacio
Department of Safety, Economics and Planning, University of Stavanger, Kjell Arholms Gate 41, 4021 Stavanger, Norway
e-mail: todor.m.kesarovski@uis.no

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_6

6.1 Introduction

Open space in cities is as essential as built-up space for fulfilling urban functions. Thus, the sufficient provision of urban open spaces (UOS) is considered crucial in spatial planning, serving vital functions that can be grouped into three large categories. First, UOS are critical for sustaining a ***healthy and safe environment*** in cities by guaranteeing sufficient ventilation and natural lighting in buildings and urban residents' access to green areas for recreation and comfort. Second, UOS facilitate a ***meaningful environment*** enriching the human experience of living in society by providing spaces for social interaction and possibilities to (re)shape collective identities. And third, UOS are fundamental for accessibility and connectivity, enabling a well-functioning ***urban environment for a prosperous life***.

Even in very compact urban environments, such as in some preindustrial areas, between 50 and 60% of the ground floor area is open space. This proportion has grown enormously with the introduction of modern planning since the 1850s. Indeed, the quantity, the quality and the connectivity of open spaces were fundamental elements in the modernisation of the city since the second part of the nineteenth century. The Haussmann plan for Paris and the Plan Cerdá for Barcelona are prime examples of this approach to reshape and expand existing cities from a rational logic of accessibility and connectivity to and through open spaces. For example, the open space per block in the Plan Cerdá is between 60 and 80% (Pallares-Barbera et al. 2011; Santasusagna Riu et al. 2021).

During the first half of the twentieth century, the question seemed to be how to increase open space in urban areas by taking advantage of new technological advances. The advances in transport technology facilitated access to vast peri-urban areas making land for urban development cheaper. The development of new construction techniques for high-rise buildings enabled an increased density while decreasing building footprints. Frank Lloyd Wright's Broadacre City is a prime example of the first, and Le Corbusier's Ville Radieuse of the second. In both cases, the amount of open space increased enormously, reaching over 90%. Broadacre City and the Ville Radieuse were both unrealised plans. However, they inspired new trends in urban design that, among many other things, multiplied the area of open spaces in cities. With the increase in quantity came a decrease in quality, mainly triggered by the need for green buffer areas to separate roads from buildings and the loose connection between buildings and open space in new neighbourhoods.

6.2 Research Problem

Today, the problem with open spaces in cities, particularly in affluent countries, is not scarcity but wastefully spent. This problem is especially omnipresent in most areas developed after the 1950s. Squandered open space is synonymous with poor urban quality. The question then is how to requalify or better use these spaces, including

the possibility of using some of them for new buildings, better articulated with their adjacent open spaces to enhance urban quality through densification. This relevant question has been explored in the work of Ståhle (Ståhle 2010). In this work, we use a different approach. Evaluating these spaces' quantity, quality and accessibility is a fundamental step towards a densification strategy to integrally improve the city's sustainability. This study aims to contribute to this endeavour by testing the following hypothesis.

> Inhabitants of more compact neighbourhoods in Stavanger enjoy better access to high-quality open spaces than inhabitants in sprawled peripheral areas.

6.3 Methodology

The principal objective of this study is to propose a methodology that can explore the provision of open spaces. The method considers distribution, accessibility, quantities (areal aggregation) and qualities of open spaces. Moreover, it relates these measurements with urban form quantifications and local inhabitants' concentration. The proposed approach is structured on the following operations:

(1) Verifying the possibilities for utilising the individual urban open spaces based on their physical access, ownership and functional regulation.
(2) Applying a qualitative score matrix for individual open spaces based on their characteristics.
(3) Performing network analysis within the selected areas of interest where individual residential buildings are utilised as a travel origin.

To demonstrate the possibilities of the research method, we employ it in a pilot study focussing on four areas of interest (aggregation of *grunnkrets*[1] units) located in two districts within the municipality of Stavanger, i.e. Storhaug and Hundvåg. The following paragraphs describe in further detail the specific steps of the proposed methodology.

6.3.1 Utilised Datasets

The study integrates datasets from various sources, whose description is presented in Table 6.1. Most of them are collected in geo-referred format, but certain adjustments, integration and modifications are required to serve the empirical explorations. The three most significant data processing operations, part of the preparatory step, are:

[1] The *grunnkrets* unit is the smallest statistical unit in Norway, and they vary in size and population. In the case of the municipality of Stavanger, there are 247 units located within 9 districts (*Bydeler*). The grunnkrets with higher population and built density tend to have smaller areas than those in sparsely populated zones.

Table 6.1 Employed datasets in the research. *Hyperlinks to access the datasets* via *public platforms are added where applicable (in blue)*

Dataset	Description	Format	Source	Year
FKB-AR5	A dataset representing the land resources within the municipality of Stavanger	.shp format (FGDB 10.0, SOSI 4.5)	*Statens Kartverket* (Norwegian Mapping and Cadastre Authority) via *Norsk institutt for bioøkonomi* (Norwegian Institute for Bioeconomy)	2020
FKB-Naturinfo	A dataset depicting the areas where tree high, medium or low tree vegetation is present			
FKB-Vann	A dataset mapping the water features within the area of interest, including sea, rivers, creeks, lakes, urban ponds, fountains, etc.			
Eiendom Matrikkel	Cadastral properties register dataset depicting the spatial boundaries of individual properties within Stavanger municipality	.shp format (FGDB 10.0, SOSI 4.5)	*Statens Kartverket* (Norwegian Mapping and Cadastre Authority) via *Geodata AS*	2020
Stavanger Anleggsregister	A data record of public spaces within Stavanger municipality, incl. parks, sport fields, children's playgrounds, outdoor recreation areas, etc.	.geoJSON	Municipality of Stavanger	July 2022
Elveg 2.0	Road network dataset comprising all driveable roads that are longer than 50 m or part of a network and pedestrian and cycle paths and cycle paths represented as road link geometry. The dataset is exported from the National Road Data Bank (NVDB)	.shp format (SOSI 4.5)	*Statens Kartverket* (Norwegian Mapping and Cadastre Authority) *Statens Vegvesen* (Norwegian Public Roads Administration)	February 2021

(continued)

Table 6.1 (continued)

Dataset	Description	Format	Source	Year
Signalanlegg Rogaland	A data record of the traffic lights signals in the administrative county of Rogaland, including their geographical location and type	.kml format	*Rogaland Fylkeskommune* (Rogaland County)	February 2022
Census data	Population data on *grunnkrets level*, representing the smallest statistical units in Norway	.shp format (FGDB 10.0, SOSI 4.5)	*Statistisk sentralbyrå - SSB* (Statistics Norway)	2020
FKB-Bygning	Detailed building information, including building types, roof superstructures, descriptive building lines (e.g. ridgeline), and building attachments (e.g. verandas)	.shp format (FGDB 10.0, SOSI 4.5)	*Statens Kartverket* (Norwegian Mapping and Cadastre Authority) via Geovekst	2020
Bygning Matrikkel	Cadastral building register dataset with information per individual building, including gross floor area (GFA), gross floor area used for housing (ResGFA), gross floor area for other purposes (OthGFA), number of units (residential—dwellings or commercial), and height (H), expressed in number of floors	.xlsx tabular format	*Statens Kartverket* (Norwegian Mapping and Cadastral Authority)	June 2020

- Performing spatial interpolation of various public land use datasets (*FKB-AR5*, *FKB-Naturinfo*, *FKB-Vann*), *Eiendom Matrikkel* (cadastral properties register data) and *Stavanger Anleggsregister* (open spaces register) to structure the basis for the performed ***assessment of the open spaces***.
- Setting up the ***pedestrian accessibility model*** by processing the transport networks dataset (*Elveg 2.0*) and integrating the regional traffic lights signals (*Signalanlegg Rogaland*).
- Integration of *FKB-Bygning* (a constructions dataset), *Bygning Matrikkel* (cadastral building register) and census data on *grunnkrets* level to set the basis for

calculating spatial densities and demographic distribution within Stavanger municipality.

6.3.2 Urban Open Space Assessment

In broader terms, urban open space (UOS) is defined as ***any urban ground space, regardless of public accessibility, that is not roofed by an architectural structure*** (Stanley et al. 2012). In the context of Stavanger municipality, such spaces include, among others, streets, parking lots, sidewalks, pathways, parks, urban gardens, courtyards, waterfront promenades, cemeteries, green areas (covered with grass, trees, shrubs, or other vegetation), schoolyards, playgrounds, squares, plazas and vacant lots. However, this diversity of spaces serves urban life in different ways and therefore requires other valuations. For this purpose, we propose two basic valuation criteria: availability and meaning.

Availability: Urban open spaces offer different degrees of availability. For example, not all are publicly accessible; some are publicly accessible but have functions limiting public appropriation, some are used in multiple ways and others are only available for a limited group of people.

Quality: People value urban open spaces differently based on their position within the urban system, the environmental and human-made elements they incorporate, their functions and the socio-cultural meaning they convey.

Availability and quality assessment of individual UOS are incorporated in the analysis through interpolating different data sources (*FKB-AR5*, *FKB-AR5-Naturinfo*, *FKB-Vann, Eiendoms Matrikkel, Stavanger Anleggsregister*) and the additional verification through satellite images and *Google Maps*. The following paragraphs reveal further details regarding how we methodologically specify these operations.

Availability Assessment of Urban Open Spaces—*AVi*

The availability of urban open space is mainly determined by its accessibility and readiness for use by ordinary people. The assessment, therefore, consists primarily of classifying the spaces according to their degree of availability. In this regard, we made three categories: unavailability, private availability and availability. Unavailable open spaces (***uaUOS***) are areas that, despite the proximity, do not have conditions for everyday people's uses. Such areas are typically inaccessible to the public. However, they provide some specific services, for example, agricultural lands, military sites, roads with a speed of over 30 km/h, port yards and other industrial open areas. The second demarcation concerns the private open spaces (***prUOS***), including gardens, patios and courtyards, depending on building typologies. Private open spaces are *available for appropriation* only for the users of the building(s) they belong. The rest are considered as *available urban open spaces* (***aUOS***). The classification of open spaces in one of these three categories is the basis for estimating the index of urban open space availability per inhabitant, i.e. ***AVi***.

$$AVi_y = \frac{aUOS_y}{POP_y} = \frac{CA_y - \left(GBF_y + uaUOS_y\right) + prUOS_y}{POP_y}$$

where ***AVi*** is the ***Availability index*** of urban open spaces, ***y*** represents the residential building for which the estimation is performed, ***CA*** represents the catchment area around ***y*** (*10-minute walking isochrone*), ***aUOS*** is the aggregation of the available urban open space for various uses within ***CA***, ***GBF*** is the gross building footprint within ***CA***, ***uaAOS*** is the aggregation of unavailable for flexible use urban open space within ***CA*** and ***POP*** is the total number of occupants within ***y***.

Quality Assessment of Urban Open Spaces—*AQi*

Quality assessment is executed through an evaluation matrix relating to the characteristics of individual spaces. This matrix adopts the conceptual and theoretical considerations presented in the previous sections of this paper. Based on this, we define three aspects and six indicators upon which all UOS are assessed. Table 6.2 and Fig. 6.1 depict how this assessment matrix is structured and applied to evaluate individual UOS quality values (***Q***). Since this study is developed from the perspective of spatial planning and urban design, it is worth underlining that the quality assessment is shaped with an emphasis on usability.

An important demarcation to be considered here is that as part of estimating the quality assessment of individual urban open spaces (***AQi***), the unavailable spaces *(uaUOS)* are incorporated since they also provide at least environmental qualities to the respective urban areas. Thus, we assess the green *uaUOS*, such as agricultural lands and unavailable private spaces *(prUOS)* within the area of aggregation, with a score of 0.75 according to the matrix, since they secure air ventilation, natural sunlight, greenery and trees. Similarly, the grey *uaUOS*, including vehicular roads with a speed limit above 30 km/h and industrial and harbour sites, are assigned a score of 0.50 due to the air ventilation and natural sunlight they provide. Consequently, the ***AQi*** is calculated as follows:

$$AQi_y = \frac{w\mathrm{UOS}_y}{\mathrm{POP}_y} = \frac{\left\{\left[S_{\mathrm{UOS}(1)} * Q_{\mathrm{UOS}(1)}\right] + \left[S_{\mathrm{UOS}(2)} * Q_{\mathrm{UOS}(2)}\right] + (\ldots) + \left[S_{\mathrm{UOS}(n)} * Q_{\mathrm{UOS}(n)}\right]\right\}_y}{\mathrm{POP}_y}$$

where ***AQi*** is the ***Aggregated Quality index*** of urban open spaces, ***y*** represents the residential building for which the estimation is performed, ***w*UOS** is the aggregation of the urban open spaces (**UOS**) within the respective catchment area (**CA**) around ***y*** (*10-minute walking isochrone*) while considering their individual qualities (***Q***), ***S*** represents the areal coverage of an individual **UOS** which is within **CA**, and **POP** is the total number of occupants within ***y***.

Table 6.2 Description of the different aspects/indicators used to estimate individual UOS values

#	Qualitative aspects and indicators		Weight
[A1]	**Environmental quality** - evaluating whether the space provides basic environmental comfort for users		**1.00**
	[1.1] Air ventilation and natural sunlight		/0.50
	[1.2] Integration of natural elements within the space		/0.50
		[1.2.1] Presence of greenery and vegetation within the space	//0.125
		[1.2.2] Presence of trees within the space	//0.125
		[1.2.3] Presence of water elements (creeks, rivers, ponds, lakes, sea, fountains, etc.)	//0.125
		[1.2.4] Scenic views	//0.125
[A2]	**Social meaning and collective identity** - evaluating the conditions to facilitate social interactions, meaning and identity		**1.00**
	[2.2] Activities within the space		/0.50
		[2.1.1] Conditions for regular activities (daily/weekly), including social gatherings, sports, recreational activities, etc.	//0.25
		[2.2.2] Conditions for occasional economic and organised cultural activities (monthly or rarer)	//0.25
	[2.2] Amenities, socio-economic and cultural uses of the buildings surrounding the space		
[A3]	**Supporting mobility and accessibility** *evaluating the basic conditions for urban connectivity and accessibility*		**1.00**
	[3.1] Serving spatial connectivity and urban mobility networks		/0.50
	[3.2] Spaces of significant activity because of their position in the urban system (highly integrated and connected spaces attracting pedestrians)		/0.50
Aggregated UOS qualitative value (Q)			**3.00**

6.3.3 Estimating Urban Open Space Quality Index (UOSi)

GIS Network Analysis

The empirical estimations presented in this study are generated through GIS network analyses. We use the technique to calculate service areas around each point of interest (POI), i.e. the residential buildings within the selected *grunnkrets* units for this study. To estimate the available provisions of UOS for each POI, we employ the threshold of 10-minute travel by foot, following the work of Øksenholt et al. (2016). Furthermore, we estimate the time isochrones around each POI by utilising the average

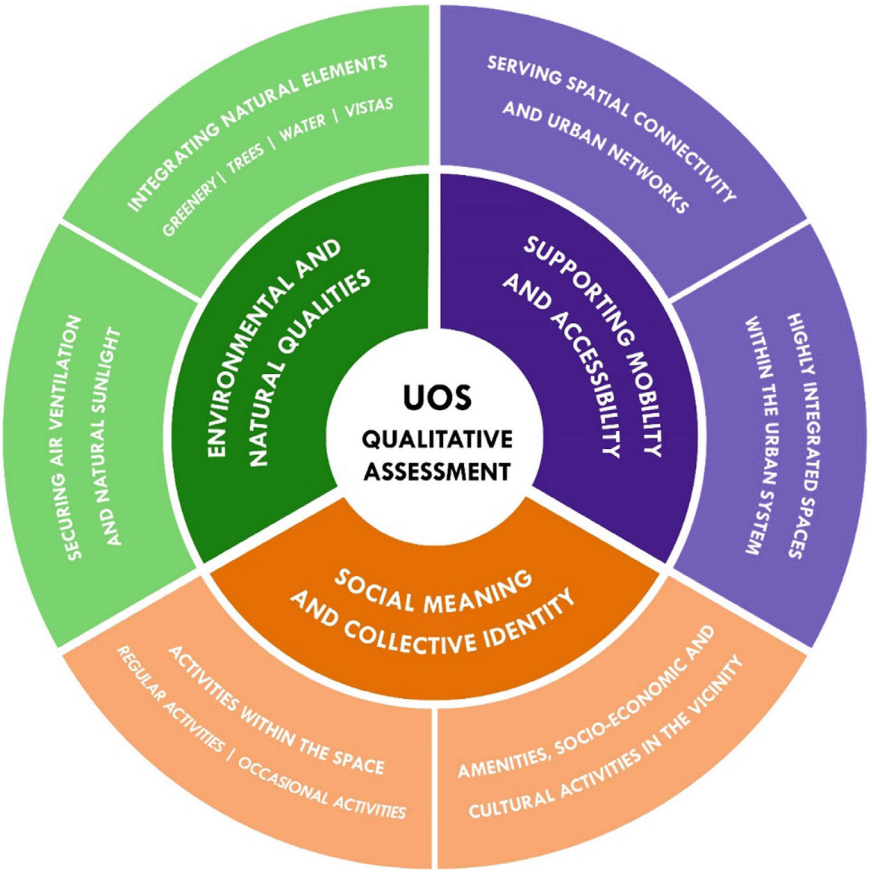


Fig. 6.1 Visual diagram illustrating the aspects and indicators applied to evaluate individual UOS qualitative value (Q). *Source* The graphic is designed and created by the authors

walking speed for healthy adults of 4.86 km/h along the pedestrian network (Montufar et al. 2007) and incorporating time barriers, i.e. waiting times at the traffic light signals within the municipality of Stavanger. This GIS processing operation is visually depicted in Fig. 6.2.

As a result, we can estimate an individual service area polygon around each POI, referring to a 10-minute walking time isochrone. Thus, we can analyse the provision of UOS per occupant for each residential building through its respective service polygon. Consequently, we can also logically calculate the average UOS provisions per inhabitant for each *grunnkrets* unit by aggregating the estimated scores per occupant for each residential building and considering the latter's total number. We repeat the process concerning the Availability index (*AVi*) and the Aggregated Quality index (*AQi*). The difference between the two estimations is visualised in Fig. 6.3.

Fig. 6.2 A highlight of the urban elements used to process the estimation of the *Availability index* and *Aggregated Quality index*, incl. *grunnkrets*, serving as units of analytical aggregation (A), residential buildings, serving as POIs and pedestrian network to generate service area polygons

$$UOSi_A = \frac{UOS_{y(1)} + UOS_{y(2)} + (\ldots) + UOS_{y(n)}}{n}$$

where ***UOSi*** is either the ***Availability index (AVi)*** or the ***Aggregated Quality index (AQi)*** of urban open spaces, ***A*** represents the area of aggregation (*grunnkrets* units of interest), ***y*** represents the residential buildings located within ***A*** and ***n*** is the total number of residential buildings within ***A***.

Fig. 6.3 Representation of the index estimations for an individual residential building (POI) concerning ***AVi*** (left), estimating the available provision of UOS and ***AQi*** (right), estimating the provision of UOS, considering the qualities they provide

6.4 Pilot Study Case Selection

For this pilot study, we explore two districts within the municipality of Stavanger, i.e. Storhaug and Hundvåg. Both areas accommodate large populations in the context of Stavanger and represent prominent districts of the city. However, they differ in terms of urban morphologies and density developments. Storhaug is an early twentieth-century neighbourhood near the city centre, where urban villas, many of them divided into apartments, are the main architectural typologies. More recently, a large part of the district has been densified by the introduction of multi-family housing. The area has a higher concentration of inhabitants and built density than the rest of the municipality. On the contrary, the residents of Hundvåg traditionally occupy single-family houses. Still, due to the area's relative proximity to the city centre of Stavanger, newer typologies have been adopted after the construction of *bybrua* (the vehicular and pedestrian connection with the city). These new expansions have been realised as greenfield developments. To a large extent, they are characterised as mixtures of individual row houses and low-height multi-family apartment blocks, spatially arranged as spatial blocks next to agricultural lands. Based on this description, we can identify specific typologies which can be explored as individual study areas within these two municipal districts.

To ensure that the specific areas to analyse are representative in terms of compactness, we consider two indicators in the selection process: ground space index (GSI) and population density (POPd), referring to the concentration of buildings and residents, respectively. Based on the values of these two indicators, we identify the representative ranges for each of the districts (i.e. the *mean value* for the whole area ± *a quarter of the standard deviation*) and specific study case areas fitting within these ranges (see Figs. 6.4 and 6.5). In addition, Table 6.3 illustrates the details

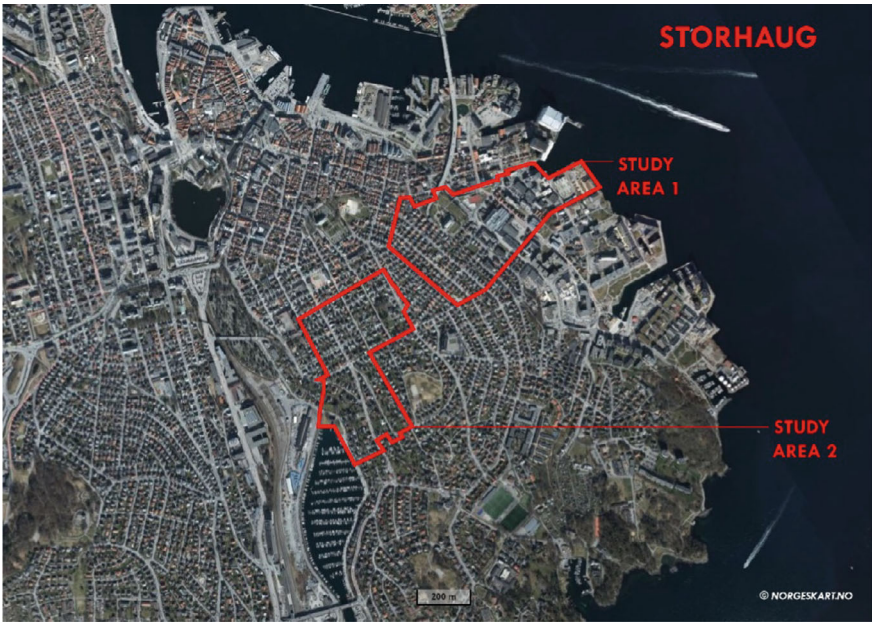


Fig. 6.4 Selected areas for examination within the district of Storhaug. Basemap image: Norwegian Mapping Authority (Kartverket), obtained via Norgeskart.no [accessed March 2024]

regarding this selection and includes additional parameters of the case studies, such as areal coverage and approximate distance from the central core of Stavanger.

6.5 Empirical Results and Interpretation

The GIS-based operations performed allow us to extract useful empirical outcomes to test the initial hypothesis. Table 6.4 depicts these results and includes the aggregated scores for each study area concerning the provision of UOS per inhabitant within 10 minutes of walking regarding their availability (*AVi*) and assessed qualities (*AQi*). Furthermore, as part of the analytical process, we extract the aggregated values of the mean UOS qualitative scores (Q) per m^2 for the *aUOS* and the average *prUOS* per inhabitant for each study area since these variables seem to be also relevant to the research discussion. These pieces of extracted empirical information outline a few avenues for further interpretations, which are intertwined with the presentation of results in the following paragraphs.

First, we can look at the results regarding the availability assessment of urban open spaces (*AVi*), an index that refers to the value of the available urban open space area (in *hectares*) per inhabitant within a 10-minute walking isochrone. On average, the residents of the Study Area 1 (*Johannes* and *Lervik 2*) have the highest UOS

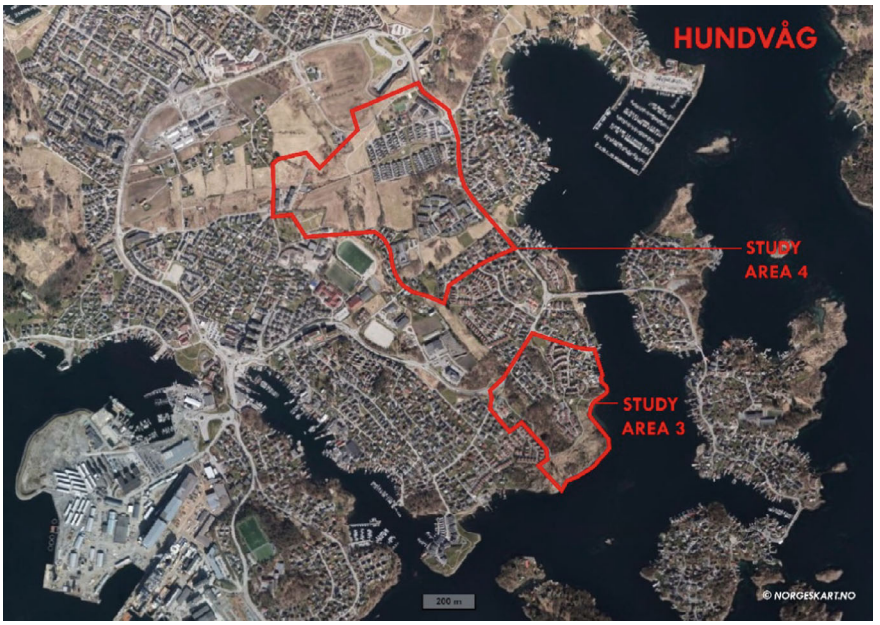


Fig. 6.5 Selected areas for examination within the district of Hundvåg. Basemap image: Norwegian Mapping Authority (Kartverket), obtained via Norgeskart.no [accessed March 2024]

Table 6.3 Details regarding the selected *grunnkrets* (aggregation) units to be examined, the districts where they are located and the municipality of Stavanger

Study areas of interest *(aggregated number of grunnkrets)*	Built density (*GSI—ground space index)*	Population density *(inhabitants per hectare)*	Area (ha)	Apprx. distance from city centre (km)	Apprx. walking time from city centre (minutes)
Storhaug (26*)	**0.239** *(SD/4 = 0.029)*	**51.3** *(SD/4 = 7.2)*	**325.8**	–	–
Study Area 1 (2) *Johannes, Lervik 2*	0.268	54.5	21.2	1.2	15
Study Area 2 (2) *Storhaug 3, Paradis 2*	0.210	52.5	15.1	1.3	17
Hundvåg (25)	**0.117** *(SD/4 = 0.017)*	**22.7** *(SD/4 = 3.8)*	**655.6**	–	–
Study Area 3 (1) *Kuneset*	0.110	22.9	14.7	6.3	73
Study Area 4 (4) *Austbø 3, Austbø 4, Austbø 5, Skeie 5*	0.100	24.2	36.3	5.2	68
Municipality of Stavanger (247)	**0.038**	**5.6**	**25 596.3**	**-**	**-**

Table 6.4 Provision of UOS per inhabitant within the study areas of interest, estimated through *AVi* and *AQi* and concerning both public and private open spaces, their availability and quality

Study areas of interest *(aggregated number of grunnkrets)*	*AVi*	*AQi*	*aUOS* quality/m^2 *mean value*	*prUOS* per person (m^2)
Storhaug (26)*				
Study Area 1 (2) *Johannes, Lervik 2*	48.3	89.838	1.86	26.50
Study Area 2 (2) *Storhaug 3, Paradis 2*	46.0	85.100	1.85	90.79
Hundvåg (25)				
Study Area 3 (1) *Kuneset*	27.6	40.572	1.47	77.38
Study Area 4 (4) *Austbø 3*, *Austbø 4*, *Austbø 5*, *Skeie 5*	40.5	62.370	1.54	56.82

available, 48.3 ha, within a 10-minute walk. The scores for Study Area 2 (*Storhaug 3* and *Paradis 2*), Study Area 3 (*Kuneset*) and Study Area 4 (*Austbø 3–5* and *Skeie 5*) are, respectively, 46.0, 27.6 and 40.5. These estimations already reveal an interesting finding. Indeed, the residents of Study Area 3, which is characterised as the examined case with the lowest POPd (22.9 inh/ha), have the poorest availability of UOS to utilise for various purposes in their vicinity. On the contrary, in the cases of Study Areas 1 and 2 within Storhaug, where the POPd is more than double, residents have a significantly higher availability of UOS.

Second, we examine the results concerning the quality assessment of urban open spaces (*AQi*), estimated as explained in the previous section. The index refers to the value of the total UOS area (in *hectares*) per inhabitant within the 10-minute walking isochrone after the quality assessment for each space is performed. According to *AQi*, we can outline that Storhaug score's higher values, respectively, 89.838 for Study Area 1 and 85.100 for Study Area 2. On the other hand, the estimated outcomes for Study Areas 3 and 4 are 40.572 and 62.370. However, it is worth underlining that there is a greater proportional difference between the scores of *AVi* and *AQi* for the cases in Storhaug compared to those in Hundvåg. This results from the generally higher values that individual *aUOS* scores concerning the qualitative assessment matrix presented above (see Fig. 6.1 and Table 6.2). As we can see in Table 6.4, the mean of the UOS qualitative value (Q) per m^2 is the highest in the case of Study Area 1, i.e. 1.86, followed by 1.85 (Study Area 2), 1.54 (Study Area 4) and 1.47 (Study Area 3).

Third, although not examined as a focal point of this pilot study, it is also interesting to pay attention to the findings depicting the provision of private UOS per inhabitant for the examined areas. The estimated values reveal certain results worth highlighting. On the one hand, the residents of Study Area 2 have higher provisions of *prUOS* (90.79 m^2), followed by those inhabiting Study Areas 3 (77.38 m^2), 4 (56.82 m^2)

and 1 (26.50 m^2). From these figures, we can underline that the provisions of *prUOS* within Study Area 2 in Storhaug are much higher than the ones in the study areas in Hundvåg (3 and 4) despite being a significantly denser area concerning both built form and population.

6.6 Reflection and Conclusion

This research elaborates on a method to evaluate the provisions of urban open spaces (UOS) in detail. The approach considers distribution, accessibility, quantities (areal aggregation) and qualities of open spaces in relation to urban form and local population densities. Furthermore, this pilot study also explores the hypothesis of whether *inhabitants of more compact neighbourhoods in Stavanger enjoy better access to high-quality open spaces than inhabitants in sprawled peripheral areas.*

As a highlight of the empirical outcomes presented in the previous section, we can argue that the executed study can confirm this research hypothesis. This is evident for the concentration of residents; according to *AVi* and *AQi* estimations within the examined cases, the areas with higher population density enjoy the better provision of urban open spaces. The correlations between built density, expressed in gross space index (GSI), and *AVi*/*AQi* illustrate a similar picture for the analysed sample. Residents in Storhaug areas, characterised by higher GSI, have greater availability and higher quality urban open spaces within 10-minute walking than the study areas in Hundvåg.

However, the limited size of the sample used in this study does not allow generalisations. The validation of this approach requires larger models, including entire cities or a more significant number of samples from different cities. The method can also be improved by a more detailed analysis of building typologies and private/semi-private UOS, such as balconies and rooftops. Another limitation of this methodology is the substantial amount of local knowledge required for its implementation. The flexible uses of specific UOS for the organisation of seasonal events, closing of vehicular traffic along streets for a period throughout the year, and similar activities reflect on the qualitative assessment of individual UOS. Combining publicly accessible datasets and tools such as Google Maps is valuable. Still, knowledge of how urban open spaces are used over time is fundamental. Indeed, exploring these shortcomings provides avenues for further research directions and can eventually reveal additional details regarding the method's applicability, potential and limitations.

References

Montufar J, Arango J, Porter M, Nakagawa S (2007) Pedestrians' normal walking speed and speed when crossing a street transportation. Res Rec: J Transp Res Board 2002:90–97. https://doi.org/10.3141/2002-12

Pallares-Barbera M, Badia A, Duch J (2011) Cerdà and Barcelona: the need for a new city and service provision. Urbani Izziv 22(2):122–136. https://doi.org/10.5379/urbani-izziv-en-2011-22-02-005

Santasusagna Riu A, Tort Donada J, Vadri Fortuny MA, Carril PV (2021) Estimating public space metrics from nineteenth-century urban cartography: Barcelona's Cerdà Plan of urban expansion. Environ Plan B: Urban Anal City Sci 48(9):2640–2655. https://doi.org/10.1177/2399808320987562

Stanley BW, Stark BL, Johnston KL, Smith ME (2012) Urban open spaces in historical perspective: a transdisciplinary typology and analysis. Urban Geogr 33(8):1089–1117. https://doi.org/10.2747/0272-3638.33.8.1089

Ståhle A (2010) More green space in a denser city: critical relations between user experience and urban form. Urban Des Int 15(1):47–67. https://doi.org/10.1057/udi.2009.27

Øksenholt VK, Tønnesen A, Tennøy A (2016) Hvordan utforme selvforsynte boligsatellitter med lav bilavhengighet? Retrieved from Transportøkonomisk Institut -TØI. https://www.toi.no/publikasjoner/hvordan-utforme-selvforsynte-boligsatellitter-med-lav-bilavhengighet-article34176-8.html

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 7
Reading for Rewriting Chinese Urban Form: The Dual Typo-Morphology of Nanshijie Block in Ganzhou

Laura Anna Pezzetti and Li Bao

Abstract Reading urban form is essential for establishing a cultural relationship with the site's history, memory and future writings. As Chinese historic sites are generally considered the loci of a despatialised textual memory lacking physical substance, the condition of latency and disappearance together with an overestimation of intangible values too often open the path to unjustified erasures, substitutions and re-historicisation through replicas. Yet, by understanding the place not only through what is today detectable by the eye but rather as a historically layered and culturally defined context, we can inaugurate a methodology to decode the site as an "already-written" text that requires interpretation and guides future writing. The Nanshijie site in Ganzhou Historic City is a paradigmatic urban text that has become unreadable. Through the reading of morphology and building types combined with the hermeneutic work of decoding traces and absences, the research revealed the latent urban form in three structuring components and "Latent Structures" that still inform the site's readability and potential *rewritability*. The cognition and interaction between these essential components should be the starting point for defining the "city part" and its conservation boundaries, that is, integrating preservation, regeneration and design approaches into one co-evolutionary *rewriting* of urban form.

Keywords Rewriting urban form · Latent structures · Ganzhou Nanshijie unit

L. A. Pezzetti (✉)
Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy
e-mail: laura.pezzetti@polimi.it

L. Bao
Southeast University, Sipailou, Nanjing 210096, China

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_7

7.1 Decoding a Composite *City Part*

Understanding urban form through the interaction between the substrata of urban origins and the palimpsest of their historical structures and imbued cultural narratives is a decisive issue for *continuing to write* (Pezzetti 2020a, b) on the text formed by the existent city.

In Chinese historic sites, which are generally considered as the loci of a despatialised textual memory lacking physical substance, the condition of latency and disappearance together with an overestimation of intangible values too often open the path to unjustified erasures, substitutions and re-historicisation through generic replicas. Besides, the absence of morphological investigation within urban and architectural design projects also contributes to the massive erasure of any topographical urban and rural sign, resulting in the production of estranged objects rather than a layered cultural construction of meaningful urban morphologies.

On the contrary, if we understand the site not only as what is today perceivable by the eye but rather as a historically and culturally defined context, Chinese historic places can be then read as "already-written" text and the design project as a new "active writing", which need to be linked together by relations of meaning (Pezzetti 2020a).

Reading the generative matrixes of urban form is essential for establishing a cultural relationship with the site's history, memory and future writings. Including its visible, lost and underground traces, the site forms a composite, interrupted or incomplete text that requires interpretation of its multiple components, memories and signs, including future ones.

The Nanshijie historic site in Ganzhou Historic City is a paradigmatic miscellaneous urban text that has become unreadable (Fig. 7.1). Besides, it is also representative for studying the urban form of those *city parts* ("parti di città", Aymonino 1970) in the Chinese historic city presenting the interaction between *serial buildings* morphology and *nodal specialised buildings* (Caniggia and Maffei 1979), or *primary elements* (Rossi 1966). The morphological and compositional study of these urban parts characterised by the compresence of types related to ordinary mixed residential-commercial use and nodal types characterised by singular dimensions and use, in this case the temples, has not been explored in China. The two components are studied separately, the second mainly by historians and restorers.

The research on Nanshijie structuring principles, types and morphology combined with the hermeneutic work of decoding fragile traces and absences as well, revealed a composite hidden order established by three compositional principles connected with as many built components. Although fragmentary, concealed or disappeared, they still provide the major key for the cognition of Nanshi site urban form. The interaction among these three essential components in the morphogenesis of urban form should be instead the starting point for defining the variables of congruence/incongruence, continuity/discontinuity, that is, rooting the boundary of the conservation area and design schemes in the urban form structure while integrating

Fig. 7.1 Aerial view of the central part of the Nanshijie Block, with the temple complex and the Ciyun Pagoda now enclosed in the school boundary (*Source* Workshop Survey by the authors in 2021)

preservation, regeneration and redevelopment into one co-evolutionary urban form *rewriting*.

7.2 Ganzhou Nanshijie Block Case Study

Ganzhou is a waterfront fluvial city in the south of Jiangxi (Gan) Province in a context of mountains, valleys and plain at the confluence of the Zhang and Gong Rivers forming the Gan River, the second largest tributary of the Yangtze River (Fig. 7.2). Its 2000 history dates back to Western Han Dynasty, which had its most flourishing point during the Song Dynasty (960–1269).

As for most Chinese cities, the historicity of Ganzhou does not correspond to the physical permanence of the city and not even to the persistence on the same place. Besides ancient capital cities like Xi'an, defensive and commercial cities like Ganzhou were often equally "moving cities" (Pezzetti 2020a, b) that changed site and name throughout their history. Gan County, in fact, went through four sites (Wu 2016; Han and Huang 2013) and five relocations (Figs. 7.2 and 7.3).

Firstly, during the Han Dynasty (201 BC) the Emperor Liu Bang settled the town as a defensive position in the upper reaches of the Ganjian River. Between 349 and 411 AD, during the Western Jing Dynasty, the town moved to Hugang Gelao City, still conceived as a stronghold organised around military functions. During the Eastern Jin Dynasty (349 AD) the town moved again to the site between Zhanggong and the two rivers, Zhang River and Gong River, where Ganzhou Old Town is now located.

Fig. 7.2 Geo-topographical map, 1721–1722 (*Source* Kangxi Provincial Atlas of China)

After its destruction caused by war, Gan County moved to Qili Town, southeast to Gong River, where porcelain was fired during the Five Dynasties. Finally, due to the superior geographical advantage, the site of Gan County was moved back to the confluence of the three rivers in 552 AD (Southern Liang Dynasty), and Ganzhou earned a new role as a political, economic and cultural centre of the region began during the Tang and Song Dynasties (Han 2001; Wu 2016), when the town was renamed from Qianzhou to Ganzhou (Fig. 7.12).

As waterways were the main transportation mode, the location at the confluence with the second largest tributary of the Yangtze River turned Ganzhou into a rich river transport hub (Wu 2016). As pontoon bridges and docks were built in the Song Dynasty to the east of the city, merchants and workers settled along the rivers (Fig. 7.12b).

In addition to commerce, the flourishing of the city fostered cultural and educational facilities such as prefectural schools, county schools, Confucian temples, and governmental and private examination institutions. While the political and constitutive centre settled on the highest terrain in the northern urban part, south to the confluence of the rivers, the new religious-cultural buildings were built in the new urban expansion area southeast of the city, endowed by the best Fengshui and landscape scenery.

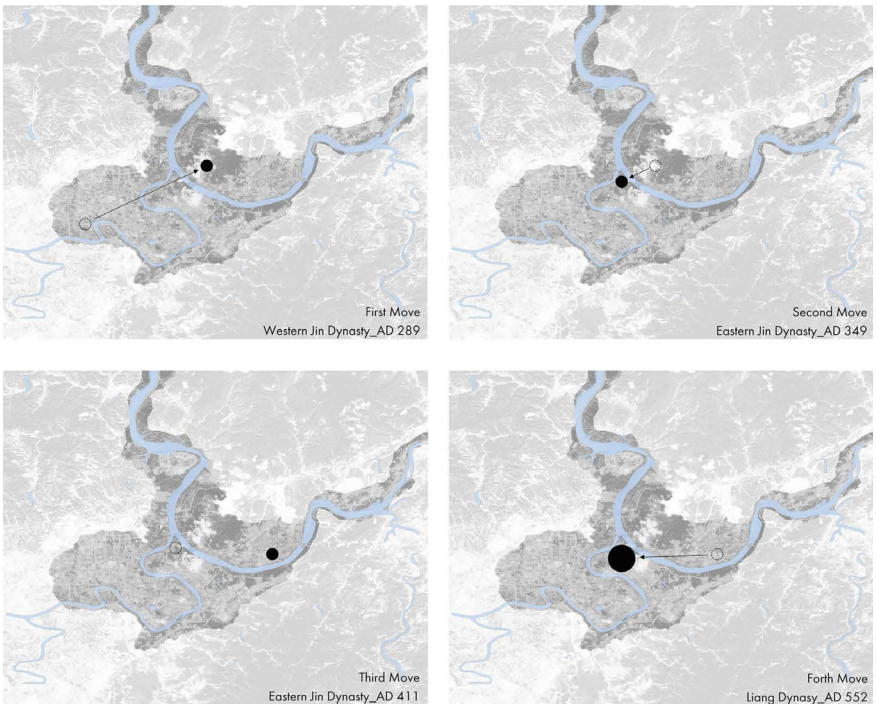


Fig. 7.3 Schemes illustrating the four locations of Ganzhou in history (drawn in the PoliMi-SEU Collaborative Class, a.a. 2021–22, after Wu 2016)

7.2.1 The Fushougou Ditches as the City's Underground Plan

Ganzhou Fushougou is a system of pools, underground ditches and walls planned by Liu Yi in the Song Dynasty to control flood-related hazard. Later an ingenious system of "water windows" was added to the city wall in order to drain water into the river. It was a complete urban drainage system in stone and blue bricks that is mostly still in use today (Han and Huang 2013; Ye-Shuang et al. 2018).

As the rivers surrounded the city on two out of the three sides (Fig. 7.2), the floods occurred frequently in the rainy season. The original Jing Dynasty city was located on the highest ground and relied on the surrounding earthen city wall to resist floods to a certain extent, while the later Song expansion included wetlands. This initial settlement strategy relying on topography needed to be complemented by strengthening the earthen walls with bricks and iron to improve their flood resistance and by planning an underground system of ditches. On two maps drawn during the Qing Dynasty (1862–74, Tongzhi Period; 1875–1908 circa), the underground drainage system called Fushougou is the very subject of the maps. They represent

Fig. 7.4 Map of Ganzhou in 1862–74 (Qing Dynasty) (*Source* Wei and Zhong 1989)

the "Fu" and "Shou" characters formed by the meandering ditches in the two flood zoning sections (Figs. 7.4 and 7.5).

In the absence of maps recording Ganzhou urban form in the Song Dynasty, and despite the approximation of the Qing Dynasty maps, the research carefully confronted and overlapped the hierarchy of the road network with the Fushougou underground structure, from the Qing Dynasty onwards (Fig. 7.7). The paper postulates that the structure of the Ganzhou plan in the Song Dynasty can be firstly understood from its underground. Besides the technical role of the ditches, their layout had to be necessarily integrated with the new urban planning of the urban area within the new extended city wall (Figs. 7.4, 7.5, 7.6 and 7.7).

7.2.2 The Nanshijie Historic Block

The area considered for our morphological investigation is the Nanshijie historic district and overall block (bordered by Zhongjieying, Dagon Road, Haihui Road and Houde Road) in Ganzhou Historic City (Figs. 7.10, 7.11 and 7.20a) where

Fig. 7.5 Qing Dynasty Map of Fushougou (1875–1908) overlapped onto the present aerial map (by the authors)

most cultural and educational facilities were settled in the Song Dynasty because of the favourable Fengshui and scenery. In the Song Dynasty, the city wall expanded considerably outside the Chen-Tang Dynasty wall to include large areas of wetlands and highlands (Fig. 7.12a, b). Besides, several new roads were needed to shape the expansion, including the Nanshijie block.

In this southern part of the city, the main cultural and educational facilities of the Song City expansion were concentrated. In the Nanshijie block, five temples could be listed: the disappeared Jingde Temple (Tang Dynasty) with the Ciyun Pagoda (Song Dynasty), the Confucius Wen Temple (Qing Dynasty), the Martial Wu Temple (Qing Dynasty) and the disappeared Dafo and Guangxiao Temples. Besides, the presence of educational facilities was recorded by the County and State Schools (Song Dynasty) and Yangming Academy (Republic of China). Moreover, in the block north of Nanshijie we can also find the relevant institution of the Examination Hall and Xianxian Academy, both established in the Song Dynasty.

At the centre of the block, on a higher level, the partial remains of three of those cultural buildings are now listed as Heritage Preservation Units: the Wen Temple,

Fig. 7.6 Map of Ganzhou Fushougou surveyed in the 1990s (*Source* Urban Construction Chronicle)

the Wu Temple and the Ciyun Pagoda (1023), a fragment of the disappeared Jingde Temple (Fig. 7.10). The Wen Temple was a Confucian temple first built in 1050, during the Song Dynasty and moved several times. The present building mostly dates back to its reconstruction in the Qing Dynasty, around 1731–36. Listed as a Provincial-level heritage site in 1987, the Temple was converted into a new school during the Cultural Revolution. While the reuse destroyed the Pan Pond, Lingxing Gate, Wanren Wall by turning them into playgrounds, on the other hand, it saved the building from demolition. A couple of years later, the Houde Road Primary School was relocated from the Wen Temple to the present site (Fig. 7.11).

The adjacent Wu Temple was also a Confucian architecture built during the Qing Dynasty. While the Wen Temple represented the foundation of traditional Chinese education, the Wu Temple was intended to praise and express loyalty and righteousness. Today it is part of the Ganzhou Zhixing High School (Figs. 7.11).

The Ciyun Pagoda built in 1023 AD, during the Northern Song Dynasty (960–1127), features a hexagonal plan and nine floors in a slender and light tower in brick structure, which escaped the fire that destroyed the wooden parts during the Qing Dynasty. It used to belong to the Jingde Temple, now disappeared. An undated map probably drawn by Han himself (Han 1992) shows the Pagoda in relation to the Wu,

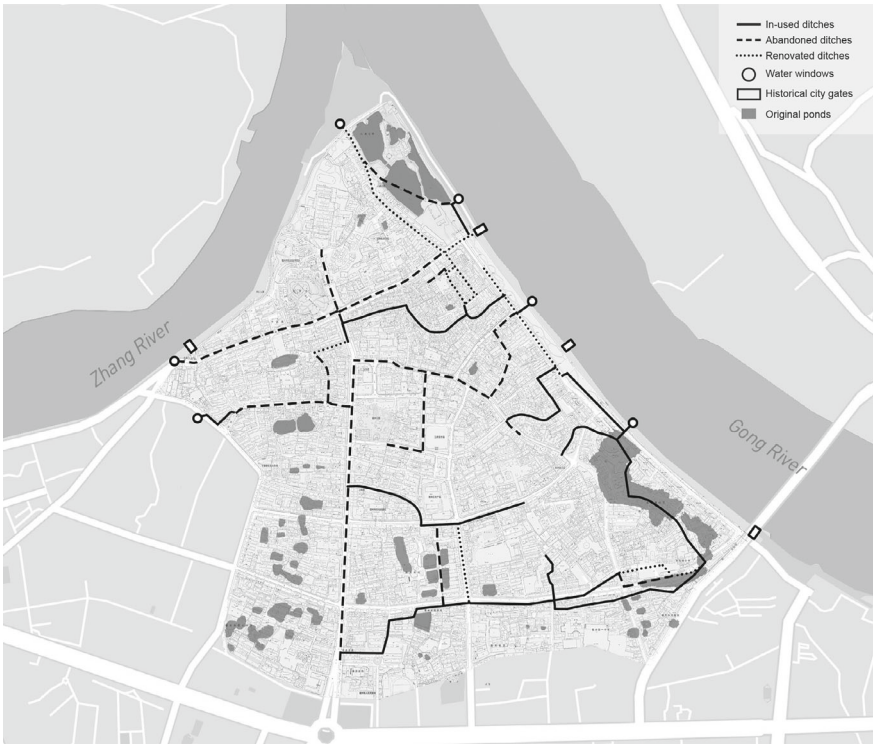


Fig. 7.7 Overlapping of the Fu and Shou ditches and the collecting ponds in 1965 (by the authors)

Fig. 7.8 Map of Ganzhou in 1946 with built-up areas (*Source* Gazetteer Bureau of Ganxian, Zhang and Chen 1946)

Fig. 7.9 Map around the 1930s, detail (*Source* https://chmap.mpiwg-berlin.mpg.de/lgtu)

Fig. 7.10 Protection levels and boundary in Nanshijie established by the existing Conservation Plan, based solely on the age of surviving buildings (Redrawn by the authors after the Conservation Plan of 2009)

Fig. 7.11 Survey of functional systems in Nanshijie block in 2021 (*Source* Hou et al. 2021)

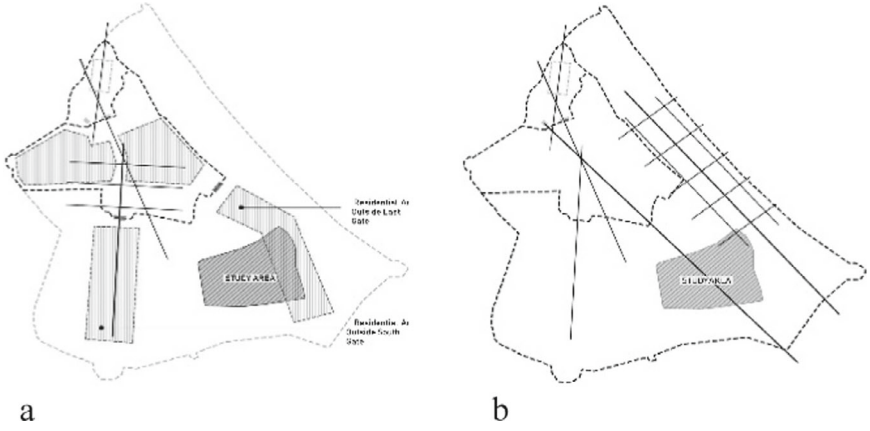


Fig. 7.12 Diagrams of Ganzhou structure in: **a** Southern Cheng Dynasty-Tang Dynasty (AD 552–902); **b** Song Dynasty (AD 902–1073), (redrawn by the authors after Wu 2016)

Fig. 7.13 Heights of buildings in Nanshijie block (by the authors in the Collaborative Class)

Wen and a remnant of the Ciyun Temple turned into a school building (Figs. 7.25, 7.26, 7.27, 7.28 and 7.29).

At present, the public cannot visit the Pagoda since it has been included in the relocation area of the Houde Road Primary School. If, on the one hand, this is close to the original educational zoning of the Song City, on the other hand, the segregation of the Pagoda excludes this relevant heritage from urban life (Figs. 7.11 and 7.23).

Another relevant component of the historic district is Nanshijie Street (Figs. 7.16, 7.21, 7.30, 7.31 and 7.32) with its courtyard houses that are nowadays listed as "historic buildings" (only 8 of them) and as "traditional buildings" in the present Conservation Plan (2010, Fig. 7.10). The relation of the Wu Temple and Ciyun

Fig. 7.14 Nanshijie, Ciguling and Zao'erxiang morphological semantic units (drawn by the authors in the Collaborative Class)

Pagoda with the schools' areas reflects the courtyards escaped from the widespread demolitions of the 1970s and has mainly survived along the western side of the Nanshijie, which until 1965 formed the eastern boundary of the block before the construction of the wide thoroughfare, Haihui Road. Some scattered courtyard houses also remain north of the temple area, along Dagong Road and the adjacent historic districts (Figs. 7.13, 7.14, 7.17, 7.18, 7.19 and 7.20).

Some previous research mostly investigated the Fushougou as a technical infrastructure (Han and Huang 2013; Ye-Shuang et al. 2018). A preliminary study by Huang and Wang (1999) explored the characteristics of general urban planning of Ganzhou. Recently, Wu (2016) studied the origins of the urban structure keeping the investigation work at the same very large scale while relating the layout of major

Fig. 7.15 Mapping of the roof types in Nanshijie's Semantic Unit (by the authors)

roads and planning axes to the definition of the large functional zoning areas, which have been hypothesised relying on the interpretation of written sources rather than on the evidence of urban facts, built heritage, topographical traces and maps (Fig. 7.12a, b). Such a broad scale of investigation is insufficient to shed light onto the urban structure and morphology of urban parts, their relation to architectural types and fabrics, the comparison with existing historical records and the archive constituted by the reality of the site itself.

Other studies, in the form of "conservation" plans or surveys for repair and renovation design, have instead targeted preservation zones, including Nanshijie, by mapping the basic characteristics of the fabrics, they too with no relation to urban form and morphology ("Ganzhou Preservation Plan 2010", Shanghai Tongji Institute of Urban Planning and Design 2009), or surveying single courtyard houses as static objects with no relation to the palimpsest formed by both buildings and tissue (Cultural Relics Conservation and Research Centre of Guizhou 2017). Some

Fig. 7.16 Morphological periods (in black Traditional Period; in grey Planned Economy Period; in light grey Contemporary Period after 2000) (by the authors in the Collaborative Class)

Fig. 7.17 Aerial map of Nanshijie historic block in Ganzhou in 1965 (courtesy of SEU University)

Fig. 7.18 Aerial map of Nanshijie historic block in Ganzhou in 2001 (courtesy of SEU University)

Fig. 7.19 Study on the evolution of Nanshijie morphological semantic unit in Ganzhou in the 1920s, 1965, 2004 and 2020 (drawn by the authors in the Collaborative Class)

courtyards built during the Republic of China were not included in the Traditional Buildings while along Dagong Road some others fell into the Construction Control Zone, that is, have no protection. The block form and its relations with the adjacent historic districts and Fushougou are ignored and thus also the role of the temples in shaping the urban form (Fig. 7.10).

There is a need to read the city through an integrated reading of *urban facts* and traces in their relations to a meaningful urban form. The urban form architects need to interpret when they conserve or add new signs of design.

Fig. 7.20 Synchronic superposition of four morphological periods (1912–1946; 1965; 2004; 2020) analysing permanencies and transformations (in black, the previous period; in grey, the historic section; in red, the present time) (drawn by Pezzetti L.A. in the Collaborative Class)

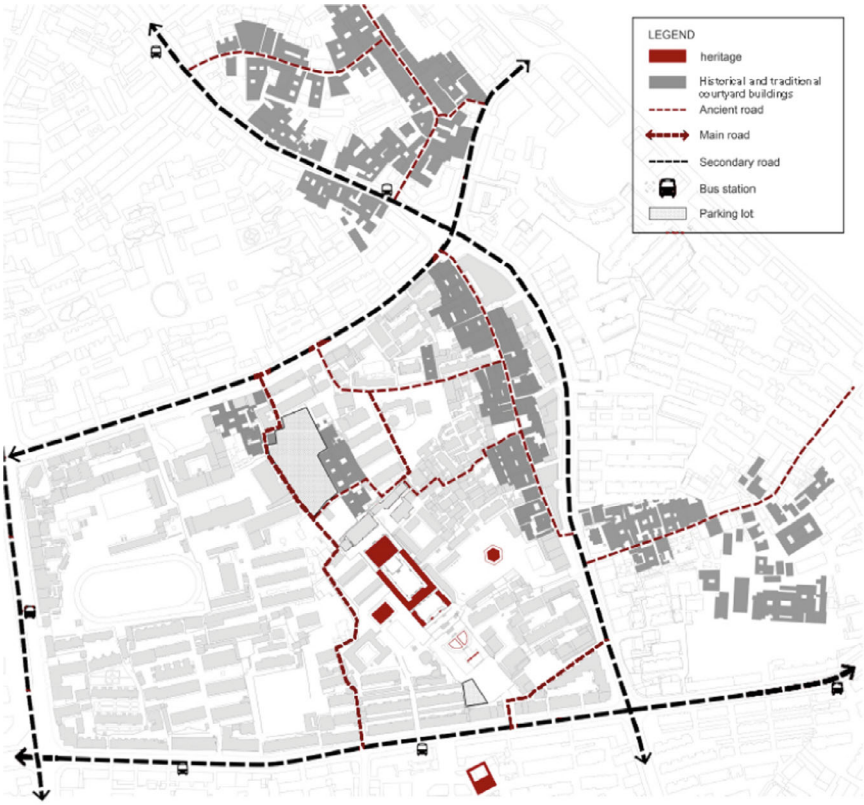


Fig. 7.21 Identification of the *urban part* and historic conservation area according to the *semantic unit*, in its relationship with the Zao'erxiang and Ciguling historic districts (by Pezzetti L.A.)

7.3 Methodology

The purpose of this paper is to study the *latent structures* and principles presiding over the urban form laying under the present disorder of this Chinese composite block where two essential traditional structures are located: the temple enclosures with an adjoining pagoda and the courtyard houses.

The aim is to clarify the latent order to define preservation boundaries and renewal design principles that are meaningful to urban form, that is, *continuing to write* on the existent text. The paper explores and discusses the morphological *invariants* of the Song block and the dual composition structured by the two historic structures, clarifying their related orders.

Typo-morphological studies can provide a sound methodology to analyse urban form synchronically and diachronically, in its hierarchical structures and orders, morphological units and components, plot's structure and building types.

Fig. 7.22 Hierarchy of historic streets in relation to the Fushougou and existing historic and traditional building patterns (by the authors and the Collaborative Class)

Fig. 7.23 Gated compounds and their accessibility (by the authors and the Collaborative Class)

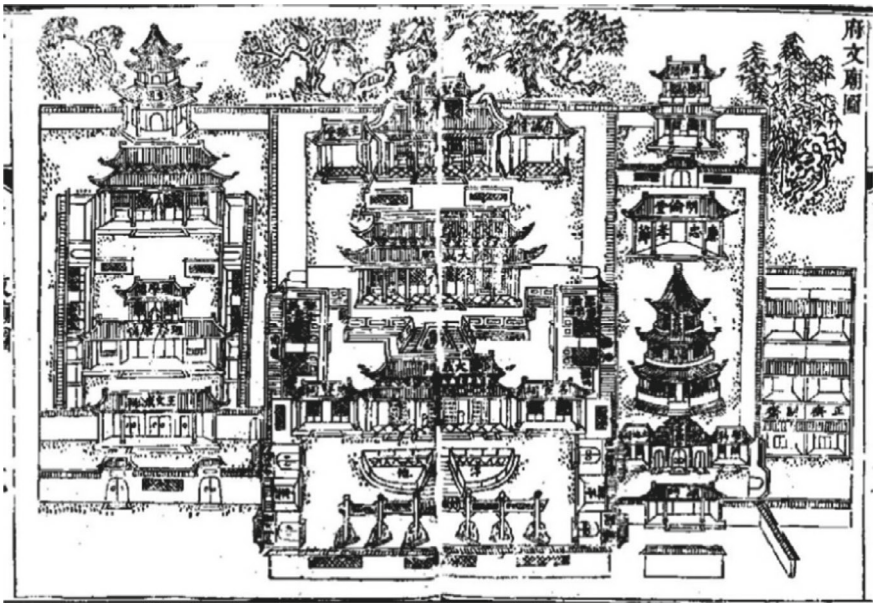


Fig. 7.24 Illustrations of the Wen Temple in the Qing Dynasty (Gan Chronicles 1873 ca.)

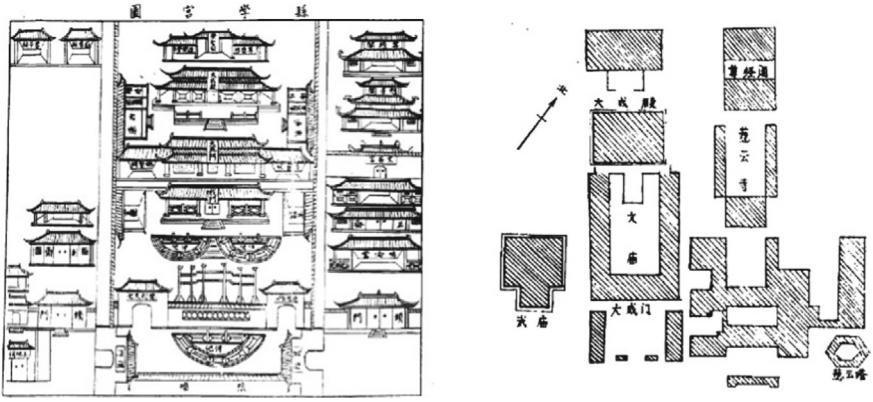


Fig. 7.25 Comparison between the Wen Temple in the Tonzhi period (1861–75, Qing Dynasty), (*Source* Ganxian Zhi 1872) and as included in the study of Han Z.F (*Source* Han 1992)

The methodology integrates historical-structural investigation with the typo-morphological investigation, developing further and innovating the traditions of study established in the cultural area that Manfredo Tafuri defined the "Venice-Milan axis", which includes scholars such as Rossi, Canella, Aymonino, Polesello and Semerani among others. In this tradition of research, which focusses on the relationship between architecture and the city or settlement and on the urban value

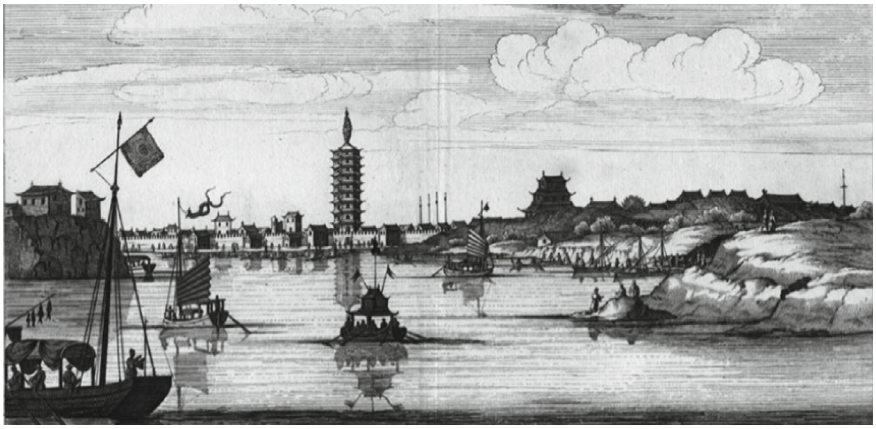


Fig. 7.26 Illustration of Ganzhou with the Ciyun Pagoda by Nieuhoff (1665) (https://zh.wikipedia.org)

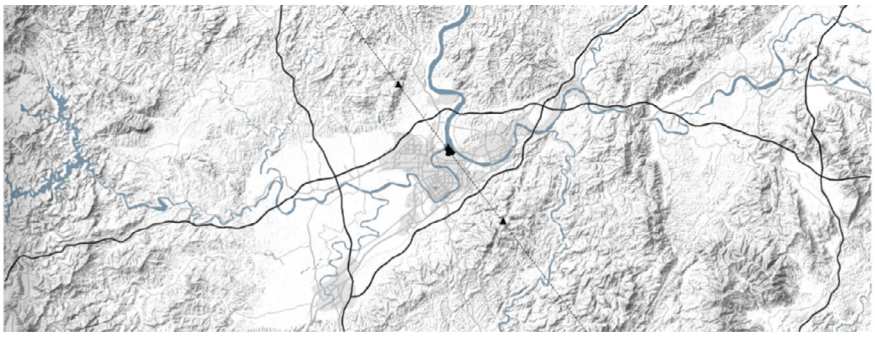


Fig. 7.27 The axis of the Wen Confucius Temple of Ganzhou in its relation to the two geographical landmarks (drawn by Hou F., Wei X., and Zhou B., Master Thesis, Politecnico di Milano)

of architectural design, the analytical and conceptual tools are never separated from the composition of architecture and urban form as a specific form of knowledge of reality.

Typo-morphology (Aymonino 1970) studies the relation between building types and the *city's parts* in the urban form development by analysing synchronically and diachronically significant historic sections within the dialectic between permanencies and variations.

Building typology is assumed as the main instrumentation to accomplish studies on urban phenomena while needs to be redefined in relation to the research (formal types, functional types) as far as considering the city as a "*whole architecture*" (Aymonino). Typology is the search for the *invariant* of the morphology in a given time context (Canella 1965), and can be subdivided between *singular buildings* and *repeated systems*. By identifying significant historic sections, urban form and

Fig. 7.28 Interpretative mapping of the three structuring components of Nanshijie *composite semantic unit*: the Fushougou track; the primary elements defined by the temples' types and Pagoda; the fishbone fabric defined by the courtyard house types, including part of the Ciguling Street and District on the east (drawn by Pezzetti L.A.)

phenomena are studied by correlating building types to settlement systems, and the latter to the identification of the "city's parts" (Aymonino). These configure *morphological semantic regions* (Samonà 1979, now in Samonà and De Carlo 1994; Pezzetti 2019) defining "*formally accomplished parts*" (Aymonino, Semerani, Polesello) or potential units (Fig. 7.14). As the typo-morphology approach is design oriented, it considers the type synchronically in its potential architectural "*accomplished form*", refusing any linear derivation mechanism between historic analysis and design.

While this approach is essential to studying urban form as a whole, primary elements and architectural types as architectures, the studies of Muratori (1960) relating to the type as historically defined, focussed instead on the morphology of ordinary tissues, studied diachronically in their historic processuality. His methodology contributed to enlightening the second component of the Nanshijie block, the courtyard dwellings, which together with the temples and pagoda *specialised buildings*, compose the urban morphology as an interrelated organism.

Fig. 7.29 Typo-morphological interpretative mapping of Nanshi block showing the patterns formed by the building types in 1965 (primary elements, courtyard houses and traditional dwellings) and in 2021 (primary elements, courtyard houses, traditional dwellings and modern linear building) (drawn by Pezzetti L.A.)

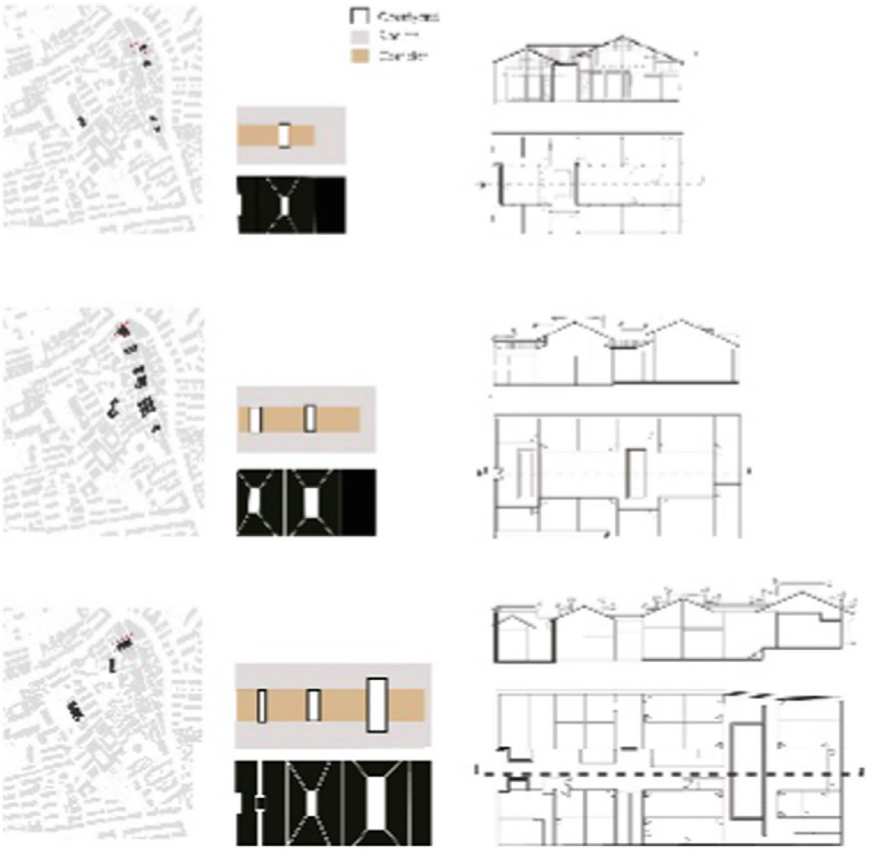


Fig. 7.30 Distribution of the typological variations of the courtyard type in the block (single, double, multiple patio yards) (drawn by the Authors in the Collaborative Class)

These two branches of Italian studies have long been separated and cannot be homologated in terms of either methods or ends. Yet, considering one without the other would be insufficient to read the two components and enlighten the iconic aspect of this specific urban form.

Most morphological studies in China are based on Conzenian and Caniggian methodologies focussing on traditional residential textures. In a design-oriented approach, the role of the plot and its related socio-economic dynamics that have been recognised by both Conzen (1960) and Rossi (1966) need to be studied in terms of architectural typologies within their spatial orders and cultural *mise en forme.*

Moreover, reading the urban composition means reading the *iconology* of the urban form, which is essential in design-oriented research as it provides a bridge between content and form since images disclose the maximum of possible meanings (Samonà 1979, in Samonà and De Carlo 1994). In architecture, unlike language, images are not either conventional or significant while they are always significant.

Fig. 7.31 Single and double patio types in the first section of Nanshijie, western side (*idem*)

In the city, images provoke associative processes, as theorised by Lynch (1960). *Legibility* and *imageability,* therefore, are necessary qualities for urban parts to be acknowledged by the people and acquire mnemonic and emotional properties.

In the same years, the typo-morphology inaugurated by Aymonino (1970) and Rossi (1966) specified with higher architectural concreteness, complexity and instrumentation, the nature of *urban facts* by reading them in their architectural-urban types, the raison d'être of their forms, their style and history, as well as in the idea of the city and architecture that some specific *urban parts* express.

Whenever the imageability of urban parts is compromised, mutilated or lost, the concept of mere "presentation" of historical sites (ICOMOS 2008) becomes insufficient. Typo-morphology combined with the reading of the historic palimpsest offers a knowledge basis for the *urban project*, tracing the principles for reconstructing a form of readability (i.e. recognisability within a coherent system), identity (recognised in its "separable identity" from other urban facts), structure (clarity of spatial relationships between the object and the observer), meaning (whether practical or emotional) and, finally, interpret and *rewrite* the site in its architectural figuration.

As Aldo Rossi stated, architects should ask themselves "what we expect from morphological research", the purpose of which is studying the raison d'être of urban form and defining principles for development consistent with specific urban physiology.

Fig. 7.32 Elaboration showing the characteristics of courtyard types and typological process in Nanshijie Street: **a** roof types in traditional and historic buildings; **b** plans of typical courtyard types; **c** typological plan of Nanshijie (drawn and arranged after the survey by the Cultural Relic of Guizhou in 2017, and our workshop survey); **d** main typological process in the whole block (drawn by Pezzetti L.A.)

For Rossi, the first issue is to define the investigation field so as to investigate only what is relevant to explain the urban form and its architectural components, avoiding a summation of neutral analysis and issues.

In this research, the reading procedure aims to unveil the *latent urban structure* (Pezzetti 2019, 2020b) concealed under chaotic development. We assume that it provides the links between tangible and intangible forms, material substance and essence, that is, the past, present and future of a long-established palimpsest.

Advancing the typo-morphological approach in a prospect of Layered Morphologies (Pezzetti 2019), also the Chinese city is studied as an already-written text that has been designed and scratched several times. The present time forms this "voluminous text of multiple writings" (Derrida 1986), which are formed by building types and urban structures as well as by fragile topographical signs, absences and even erasures. This meaningful whole is the text that architects need to constantly decode and recode in an *urban project* approach in order to provide cultural continuity and meaning for the present.

Any action of erasure, conservation, enhancement or construction, any reason and method of transformation should relate to the interpretation of this whole according to the site's formal structure and narrative to be continued by overwriting old and new layers. In this line of thought, also the Chinese City in turn may disclose an unexpected depth of layers of meaning and permanencies that would only be revealed by integrating a careful reading of physical traces, historical analysis of disappeared components together with imbued textual narratives.

To investigate the historic palimpsest, the research confronted topography, underground structures and traditional streets tracing; architectural invariants in their formal and settlement structures; and the typological process at the urban level.

Fabric units identified four morphological periods (1920–46, 1965, 2004, 2020) marking the moments of transformation (Figs. 7.19 and 7.20). Mapping was based on ascertained historical maps, orthophoto and field surveys. Besides, the onsite survey highlighted the fragmentation within the urban block due to the block subdivision in gated compounds (Fig. 7.23).

Mapping considered types together with their land to retain the three-dimensional content of architecture. At the different scales of analysis, *interpretative drawings* were conceived to provide the "language of description" suitable to architectural and urban contents. In the maps, types were studied and described through plans and roof shapes, which are necessary to grasp the features of the enclosed temple type, polarising pagoda and courtyard typology variations.

As a result, the *morphological semantic units* were therefore delineated in relation to the typological orders established by these three traditional building types and related spatial units, rather than land and building utilisation (Figs. 7.14 and 7.20).

Some cultural specificities behind the urban form, such as Fengshui, building codes and cultural characteristics, contributed to innovating the methodological tools and articulating the investigation approach in the context. Therefore, the research took into consideration the foundational geomancy of the site and the geographical landmarks, the historical maps as a knowledge base for interpretative mapping and the

formal structure of both existing and disappeared types (Jingde Temple) according to their polarising or aggregative principles.

Along this line of thought, the methodology of both reading and intervention was based on typo-morphological analysis: morphology is precisely the basis (but not mechanically the design solution) of both the *status quo* and the state of design.

7.4 The Three Latent Orders: The Underground Fushougou, the Bordering Fishbone Texture and the Autonomous Primary Elements

In the present situation, the urban form appears as a text that has become unreadable because of its chaotic development in modern times, the fragmented condition of ancient buildings and the unregulated and miscellaneous additions of different periods and scales.

Yet, by combining a historical-structural investigation methodology together with a typo-morphological analysis, the research work has revealed that this unique settlement structure can be interpreted as the combination of three different orders, latent in the present text. Integrating literature review, historic maps and orthophoto information, as well as mapping analysis with field and drone surveys, a series of analytic and interpretative maps were drawn to assess both the generative matrix and the historic palimpsest.

7.4.1 Form and Typological Process in the Nanshijie Block

Due to the lack of information related to the fabric in Chinese historic maps and records, the processual analysis started from the redrawing of the 1942–1946 maps and 1965 orthophoto, which account for the typo-morphological continuity of the Traditional Period in China. Based on ascertained documents, four historic sections (1920–46, 1965, 2004, 2020) were extracted and compared through diachronic and synchronic analysis (Figs. 7.19 and 7.20). First, they show that the form of the block in the Song Dynasty does not coincide with the present one. The eastern boundary was formed by Nanshijie Street had a different southeast corner both modified by the tracing of new thoroughfares around 2000. The Fushougou survey confirms the old track.

In the maps drawn in the 1930s and in the more detailed one in 1946 (Figs. 7.8 and 7.9), the form of the old block is recognisable while its traces are still retained in the topography (Figs. 7.17, 7.18, 7.19 and 7.20). The first map provides information on the form of the block; the second reconfirms it and adds information on the built-up areas and existing inner roads and alleys. The original form of the Song block can be identified up to the 1965 aerial map (Fig. 7.17), which nonetheless clearly shows

both the courtyard types and the now disappeared collecting drainage ponds, as well as the modifications that occurred to the temples' area.

Second, from the historic sections, the analysis of the roads hierarchy and plots patterns was drawn allowing to cognise four old paths along which few disappeared courtyard houses developed within the block (Fig. 7.20a, b). Yet, in the Contemporary Period, the street structure is insufficient to judge the porosity of the fabric. In the Chinese city, the analysis needs to be supplemented with the survey of gated compounds and their accessibility, which shows the poor permeability and high fragmentation in the block (Fig. 7.20b, c). Besides, compounds provide information about the contemporary plots' structure and use, which may not coincide with their morphological period, as the case of the Ciyun Pagoda nowadays enclosed in the school compound exemplifies (Fig. 7.11).

Third, historic sections showed the existence of empty regions (farmland) surrounding the religious area which reinforce the hypothesis of the independence of its types from the block. The sections also clarify the typological process with the progressive infill of the religious area and the substitutions of courtyards with different building types and functions along the block margins: traditional buildings (Republic of China), Cultural Revolution and Planned Economy multi-story linear houses (1965); apartments blocks and gated facilities fragmenting the inner region (educational buildings and hospitals) (2004); and malls and mixed-use buildings on the borders (2020) (Figs. 7.19, 7.20 and 7.32d). The mapping of building heights and of the four roof types (gabled, pitched and flat roofs) completed the identification of historic features and morphological periods (Figs. 7.12, 7.13, 7.15 and 7.16). Moreover, it visualised the increment of buildings' height from the centre to the boundaries, where linear mixed-use residential-commercial buildings have substituted courtyard types, and in correspondence to the hospital compound (Fig. 7.12c). The mapping of functional systems (Fig. 7.11) shows educational and hospital facilities, jointly with residential buildings, progressively occupying all green and agricultural space around the temples' area (Figs. 7.11, 7.19 and 7.20).

In the perspective of Layered Morfologies, the synchronic superposition of past and present status studied in detailed sections permanencies and modifications in the four morphological periods by confronting three layers: inherited elements from previous period, selected historic section and present status (Fig. 7.20).

7.4.2 The Underground Structuring Order of the Fushougou

In Ganzhou, the unique structure of the Song Fushougou underground network corresponds to the first order of latent structures, the infrastructural one. After comparing the Fushougou tracks with the road network, the research posits that the Ganzhou Song City should first be understood through its subterranean layout, which can be interpreted as the foundational scheme for the Song Dynasty's urban expansion plan. Although the Fushougou maps drawn during the Qing Dynasty (Fig. 7.4) are imprecise and sinuous in their tracing, in their attempt to reveal the symbolism of "Fu"

and "Shou" characters, we could relate clearly their Fushougou tracks to the ones represented in the 1990 map (Fig. 7.6). This map, nonetheless, also surveyed some other tracks, which may represent later developments.

This correspondence of Fushougou to the coeval street patterns established in the Song Dynasty's urban expansion seems quite rational in relation to the ditches' function and possibility of inspection, being the roads free of constructions. The survey executed in 1990 (Fig. 7.6) by the Ganzhou Urban Construction Bureau shows both operating and decommissioned ditches. Its superposition on the urban map (Fig. 7.7) discloses a clear relationship between roads and underground ditches that reinforces the hypothesis that the new road structure during the Song Dynasty was conceived in accordance with the topography and underground Fushougou tracks. Moreover, in the 1990 map, the southeast corner corresponds to the original boundary of the block before the rectification of the road and demolition of the courtyard houses. In addition, the Map of 1965 shows the existence of many ponds around the southern border, where the ground is lower, which acted as collectors of water connected to the drainage system.

A later inspection carried out in 2015 under the supervision of Prof. Wu (2016) was unfortunately limited to some small sections only, which nonetheless confirmed the joints in the previous map and provided more information about the arched section and ditches' operation. One of these survey points concerned the small street flanking the temple area and the road sections before and after the southern Houde Road. The road groove is the sign that establishes the continuity of the context.

7.4.3 The Autonomous Primary Elements: The Temples

Once ascertained this peculiar relationship between the Fushougou tracks and three sides of the block's form plus the inner meandering street flanking the temples' area, the research developed an analysis of the topographical traces and architectures, comparing the onsite data with the cartographic analysis, including the 1965 satellite map.

The typo-morphological analysis of the historic architectures combined with a hermeneutic investigation of fragmentary topographical traces revealed a pre-existing double order: the one established by the religious and cultural buildings in the centre of the block and the one set by residential types on its margins (Figs. 7.28 and 7.29). A first hint of the latent order presiding over the temple's area is the orientation of the axes structuring the temples' layout. The parallel axes of the Wen and Wu Temples, and probably of the disappeared Jingde Temple, are directed southwards to the Kongtong Mountain Baogai Peak (Fengshan Mountain), regarded as a "Feng-shui Mountain", and northwards to the Yao Lan Zhai (Sanyang Mountain). For these important religious-cultural buildings in the city, this resonance between urban landscape and environmental landmarks forced the convention of north-to-south axial orientation (Figs. 7.27 and 7.28). Besides, the axes are also parallel to the river (Fig. 7.12d).

Looking closer at the large-scale Confucian Temple, also known as Ganxian County School, we can observe that the original structure of the Wen Temple followed the codified type as clarified by its illustration in Qing Dynasty extracted by the Gan County Chronicles (around 1873, Fig. 7.24), Ganzhou County School Map of Qing Dynasty. Within the enclosed type of the temple, the axis structured the sequence of walls, gates, temples, houses, halls and, again, temple. It was flanked on both sides by narrower enclosures arranged by a sequence of pavilions, gardens or temples, all aligned in parallel axes. This typological arrangement is still recognisable in the 1965 aerial view. The same arrangement is recorded in another map (Ganzhou Fu Zhi) illustrating the Ciyun Confucian Temple in Qing Dynasty, Tonzhi period (1861–75, Fig. 7.25), where a couple of small towers are also inserted into the Temple. Unfortunately, because the iconography focusses only on the single complex, the Ciyun Pagoda and the disappeared Jingde Temple are not represented until the drawing by Han (1992, Fig. 7.25).

If we analyse the temples axes, their width and codified patterns, we can assume that also the disappeared Jingde Temple's symbolic and structuring axis followed this orientation, which may shed some light on the underlying traces still readable in the traditional fabric northward of the Pagoda. The analysis of the morphological structure still readable in the 1965 aerial map, before the fast development caused by the Reform and Open-door Policy and the demolition and chaotic arrangement caused by the new constructions to relocate the school buildings, shows a clear correlation between the temples' dimension, the old pedestrian street behind the temples, the Ciguling Street and the traditional buildings' patterns (Figs. 7.28, 7.30 and 7.31).

The whole core of the block corresponding to the religious-cultural and educational facilities had its own orientation, corresponding to the symbolic Fengshui axis, in the highest part of the terrain. In correspondence to the Wen Temple, the axis extends as far as the road by the ceremonial Pan Pond (with a bridge, a distinctive component of the Confucian temple type), the Lingxing Gate, and a large empty area (Figs. 7.22, 7.23 and 7.24). Besides, by comparing the state of existing buildings with the temples' codified patterns and the traces on the ground in 1965, we can decode four regular patterns (about 40 m) corresponding to the various temples' enclosures which altogether form almost a square into which the figure of the three temples is inscribed. This *latent form* and its four partitions define not only one specific level of the urban order but also the enclosed *urban figure* of the temples' morphology, which is other than the aggregative logic defining the residential and commercial fabric (Fig. 7.28).

The southeastern corner of this figure lays directly in correspondence to the small alley cut out between the Nanshijie courtyard houses, which connects with Ciguling Old Street in the adjacent district (Fig. 7.28). Therefore, the two districts of Ciguling and Zao'erxiang should be considered in strict urban relation with Nanshijie urban form (Figs. 7.12d and 7.21). The independence of the temples' layout from the Nanshi block's form and its autonomy compared to the residential and commercial courtyards' fabric allowed us to read them in terms of "primary elements", as Rossi (1966) defined architectures that act as autonomous and polarising elements of the urban form and structure. This is consistent with the role of the temples and their

frontal area as a form of public space in the Traditional Period and with the urban landmark configured by the high-rise pagoda of Buddhist temples, as the precious view of Ganzhou drawn by Nieuhof (1665) confirms (Fig. 7.26). Therefore, beyond the cultural differences, we can recognise similar principles in both the European and the Chinese blocks.

7.4.4 The Bordering Fishbone Texture: The Courtyard Type

If temples and pagoda are *singular buildings* arranged autonomously, the courtyard type is the *invariant* of traditional fabric morphology (although with significant regional variations) and defines the block by aggregation. Its basic configuration is formed by the three Kai system hall-yard-wings around a narrow patio, displaying variations related to its extension in axial series (one, two or three Jin-yard modules) or in parallel, both contained within the "Matouqiang" fire-sealing walls (Figs. 7.30, 7.31 and 7.32). Sky well variations are also connected with the size of the patio and the status of the owner. Their composite style reflects the diversity of cultures attracted by the commercial prosperity of the river port in the past.

The two sides of Nanshijie feature the "half-side-street" phenomenon: the western side, bordering the original block is higher and richer in dwellings while the eastern is lower and simpler, mostly used for shops, workshops and inns. With the decline of the Street and modernisation, the dark buildings fell in a state of abandonment and decay, awaiting for restoration and reuse.

As it was still visible in the USA Military map in 1965 (Fig. 7.17), the fabric formed by the old courtyard houses developed orthogonally along the traffic roads of the time bordering the blocks and forming a fishbone pattern. The courtyard houses were narrow (11–13 m wide), hence followed organically the road tracks, stretching deep into the block (15–40 m long) while keeping at a distance from the temples' enclosures. This distance determined their possibility of growth from one Jin to three Jin courtyards along Nanshijie while even more along the northern boundary.

We can state that the presence of the temples and pagoda types in the heart of the block produced a notable variation in the urban form, preventing the formation of the typical organic morphology within the block, thus interrupting the bi-univocal relationship between type and morphology.

Despite the construction of some modern linear buildings, this serial associative principle clearly defined the eastern, western and northern borders of the block until 1965. Some late traditional buildings with or without courtyards had already infilled the space between Nanshijie Street and the temple-school area (Figs. 7.19 and 7.20).

The degree of morphological transformation induced by the tumultuous and uncontrolled development can be assessed in the 2001 aerial view and in the mapping between the 1920s and 2020 (Figs. 7.19 and 7.20), where we can observe the widespread transformation of the fabric and the erasure of all bordering courtyards except for Nanshijie and other few isolated cases. The first modern buildings replaced the courtyard type with a multi-storey linear type that bordered mechanically the main

roads in parallel. Yet, as the two analytic and interpretative maps reveal (Fig. 7.29), they continued to build onto old tracks as they kept the footprint and spacing of previous courtyard plots while reversing ninety degrees into a new building type.

As these courtyards disappeared and in the absence of cadastres, those surviving topographical traces enlighten the site matrixes, plot structure, narrative, readability, identity and meaning. Regeneration should take these patterns into due consideration.

Besides, as the western half of the block is compromised by the tabula rasa, the conservation boundary needs to be related to the surviving historic space. It should correspond to the composite morphological semantic unit formed by the three traditional building types and determined by overlaying all of the previous analyses: through historical routes, the Nanshijie unit should be in relation to the adjacent blocks' units; the courtyard-type arrangement reflects the shape, the depth and *parti* of the original outer boundary; the inner boundaries are defined by the historic streets and Fushougou jointly and the type of the temple encodes the surviving and inferred topographical traces to be assumed by interpretative design.

7.5 Conclusions

Nashijie block and its *morphologic semantic unit* is a representative case for studying the urban form of those "city parts" in the Chinese historic city presenting the collision between serial residential fabric and nodal primary elements. Through the reading of the structuring principles of typology and morphology, combined with the hermeneutic work of decoding hidden traces and absences, the research has revealed the site's composite *latent structures* (Pezzetti 2019, 2020b) and hidden orders that still inform the site's readability and potential *rewritability*. The cognition of these composite latent structures and the principles of their assemblage within the block reveal an unusual complexity for the Chinese City, which should not be ignored any longer.

Typo-morphology was confirmed as decisive instrumentation for investigating both tangible and disappeared signs of urban form. Below the modern erasures and chaotic development, the research has uncovered a twofold latent structure that has shaped the block according to two distinct principles and roles: those pertaining to the tissue formed by the local courtyard-type, defining only the block boundary, and those set by the primary elements formed by the temples' enclosures and Pagoda, polarising the centre autonomously. The first aligned to the road system according to a serial fishbone pattern, thus defining the block by aggregation; the second to the relation at a distance with geographical landmarks, producing its own axes and patterns, resulting in a self-defined spatializing square. Their composition resulted in an assemblage of figures and collision of grids, which recall theoretical principles from Villa Adriana to Collage City (Koetter and Rowe 1979) and beyond, quite relevant for the iconology of urban form.

Finally, the Fushougou, underground drainage system, in conjunction with the city's topographical levels, has been recognised as a key to understanding the logic underlying the sinuous planning of blocks in the Song Dynasty.

The interaction among these three essential components and formal orders of urban morphology should be considered as the starting point for any action, be it delineating conservation area boundaries, regeneration or rewriting principles between continuity and variation, suggesting the potential of integrating them into the rewriting of a co-evolutionary urban form.

Acknowledgements The topic of Ganzhou was chosen in cooperation with Prof. Dong Wei, Director of the UNESCO Chair of Southeast University and started in the International Workshop between the Schools of Architecture of Southeast University and Politecnico di Milano, Department ABC, in spring 2020, directed by professors Laura A. Pezzetti and Li Bao. Thanks to our Double Degree students in China, it was possible to conduct extensive onsite surveys and research. It was then continued in two theses and in the Collaborative Classroom between the two universities supported by AUIC School of Architecture Urban Planning Construction Engineering, Politecnico di Milano, in the academic year 2021–22.

References

Aymonino C (1970) La città di Padova: Saggio di analisi urbana. Officina, Rome

Canella G (1965) Sulle trasformazioni tipologiche degli organismi architettonici. Istituto di Composizione della Facoltà di Architettura del Politecnico di Milano, Milan

Caniggia G, Maffei GL (1979) Composizione architettonica e tipologia edilizia: Lettura dell'edilizia di base. 1. Marsilio, Venice

Conzen MRG (1960) Alnwick, Northumberland: a study in town-plan analysis. Institute of British Geographers Publication 27, Georg Philip, London

Cultural Relics Conservation and Research Center of Guizhou: Conservation, Repair and Renovation Design of Historic Buildings along Nanshi Street in Nanshi Street Historic and Cultural Area (2017)

Derrida J (1986) Point de folie - maintenant l'architecture. In: Tschumi B (ed) La case vide - La Villette. Architectural Association, London

Han ZF (1992) Ganzhou Confucian temple. Cult. Relics 10:51–55, 98, 103–104

Han ZF (2001) The historical changes of Ganzhou City. Relics Form South 4:77–79

Han GF, Huang YR (2013) Study on the construction of drainage system of the historic city. In: Perspective of urban safety: case study of Fushou ditch. Modern Urban Research, vol 12, pp 72–76, 85

Hou B, Wei X, Zhou B (2021) Ganzhou urban regeneration: cultural space integration and reconstruction of Ciyun Pagoda Area. Master thesis, supervisor Prof. Laura A. Pezzetti, AUIC School of Architecture, Urban Planning Construction Engineering, Politecnico di Milano, Italy

Huang Y, Wang J (1999) A preliminary study on the characteristics of urban planning and design of the ancient city of Ganzhou. Huazhong Archit 17(3):108–113

ICOMOS (2008) The ICOMOS charter for the interpretation and presentation of cultural heritage sites. Quebec. http://icip.icomos.org/downloads/ICOMOS_Interpretation_Charter_ENG_04_10_08.pdf. Accessed 21 June 2022

Lynch K (1960) The image of the city. The MIT Press, Cambridge, MA

Lynch K (1972) What time is this place? The MIT Press, Cambridge, MA

Koetter F, Rowe C (1979) Collage city. The MIT Press, Cambridge, MA

Muratori S (1960) Studi per una operante storia urbana di Venezia. Istituto Poligrafico dello Stato, Rome
Pezzetti LA (2019) Layered morphologies and latent structures: reading, decoding and rewriting to enhance historic rurban landscape. Tongji University Press, Shanghai
Pezzetti LA (2020a) Continuare a scrivere nel paesaggio storico: Lettura, interpretazione, figurazione. LetteraVentidue, Siracusa
Pezzetti LA (2020b) Rewriting Urban Strata in China: reading, interpreting, recoding Xi'an Xiaoyan Ta's Historic Urban Landscape. Il Poligrafo, Padua
Rossi A (1966) L'architettura della città. Marsilio, Padua
Samonà G, De Carlo G (1994) Lettere su Palermo di Giuseppe Samonà e Giancarlo De Carlo per il piano programma del centro storico, 1979–1982. Officina, Rome
Shanghai Tongji Urban Planning and Design Institution, National Historical and Cultural City Research Centre of Tongji University, Urban Planning and Design Institute of Ganzhou: Conservation Plan of the Historical and Cultural City of Ganzhou (2009)
Wei Y (1989) Ganxian Zhi, vol 964 (1872, 11th year of Tongzhi Period, Qing Dynasty). In: Zhongguo Fangzhi Congshu. Cheng Wen Publishing Co., Ltd., Taipei
Wei Y, Zhong Y (1989) Ganzhou Fu Zhi, vol 100 (1873, Tongzhi Period, Qing Dynasty). In: Zhongguo Fangzhi Congshu. Cheng Wen Publishing Co., Ltd., Taipei
Wu Y (2016) The development and spatial morphology evolution of the ancient city of Ganzhou. Unpublished PhD thesis, South China University of Technology, China
Ye-Shuang X, Shui-Long S, Yue L, An-Nan Z (2018) Design of sponge city: Lessons learned from an ancient drainage system in Ganzhou, China. J Hydrol 563:900–908
Zhang K, Chen J (1946) Ganxian Xin Zhi Gao. Gazetteer Bureau of Ganxian, Ganzhou

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 8
From Maps to Diagrams. A Morphological Tool to Unravel Transitional Processes

Rossella Gugliotta

Abstract Studying the regeneration and revitalisation of urban tissues involves addressing transitional changes as processes occurring over time. Traditional methods in the Italian morphological theory aim to develop a qualitative and conjectural approach to uncover transitional laws within the city. In these methods, maps play a fundamental role in studying the process providing a first interpretation of what changes and what remains fixed inside the city. However, a gap exists between traditional studies and emerging quantitative methodologies. This research investigates maps developing their diagrammatic components to bridge traditional approaches with new perspectives in the field. The starting point is the analysis of maps of the cities of Venice (Saverio Muratori), Como (Gianfranco Caniggia), and Turin (Augusto Cavallari-Murat). By decomposing these three maps, it becomes possible to define the temporal, symbolic and diagrammatic components that make these maps a tool for studying urban change with a forward-looking perspective. The research enhances map components that can help visualise the qualitative method, working on diagrammatic elements of the tool. This approach is a starting point for developing a methodology and a tool to read morphological transitional events. The final output is a diagram that bridges the gap between traditional methods and innovative AI tools.

Keywords Regeneration · Tools · Urban morphology · Diagram · Italian school

8.1 Introduction

The regeneration process of the urban tissue aims to preserve memory while embodying new significance within the urban environment. The concept is defined as a multidisciplinary space merging different dimensions of the urban environment across scale and agency (economy, social, norms) involved in the process. In disciplinary literature, urban regeneration is defined as area-based interventions targeting

R. Gugliotta (✉)
Architecture and Design (DAD), Politecnico Di Torino, Turin, Italy
e-mail: rossella.gugliotta@polito.it

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_8

places and communities affected by a state of decline intended to produce ongoing improvements in social, economic and physical conditions (Trisciuoglio et al. 2021). The concept of urban regeneration, like the concept of evolution, is based on the possibility of reusing some aspects as potential tools that can be adapted to new functions. According to Francois Jacob, evolution behaves like a bricoleur who continuously modifies his work over a very long time. Similarly, urban regeneration processes can be based on long-term processes or sudden developments in a specific area of interest (Pievani 2008). Together with the term regeneration, another aspect of urban change is brought to light: the dynamicity of urban transformation (Trisciuoglio et al. 2021). Two basic terms come into play in this context: the transition of form as a process and time as a parameter (Pievani 2008). The concept of transition, quite different from transformation, is understood as a passage from one state to another through two different states of equilibrium (Kemp et al. 2001). Viewed in this way, the term describes a process that occurs through a non-linear and dynamic transition supported or hindered by an external system of forces (Easterling 2019). In summary, a transition is a transformation process between points A and B. In this analysis context, there is a continuous passage from one state of equilibrium to another. A balance that is not defined as an exact moment in time (Neyant 2019). On the other hand, the concept of time is a constant of reality affecting various fields of study. The continuous temporariness of human life is reflected in the need to construct and experience space through time. Time is a variable that intersects with and measures space, defining its evolution, detecting its limits and conditioning its changes (Ulisse 2022). The city defines itself through multiple times in which past, present and future intertwine. Together, these three moments make up a fourth moment, the simultaneous time, within which design operates by designing between the synchronic and diachronic phases (Mei 2015). In the impossibility of defining a synchronic time as a single event, questions arise regarding the human being's ability to read what is not explicit in reality but remains latent and can be found within mechanisms of relationships. For this reason, it is necessary to expand the study to tools able to show the complexity of the urban transformation and read the transition of urban form as a matter of time and space. Within this framework, the definition of time is intrinsic to the space's construction process (Ulisse 2022) and to the concept of transition. This perspective can already be found in the morphological school that studies the city's shape and transformation on a different scales. Both the English, French and Italian schools define the concept of transition as central to studying the urban fabric (Marzot 2002). Specifically, the Italian school, with Saverio Muratori, defines the study of the morphological aspects of the city as operational. It aims to identify the stratifications and changes of an urban system (Muratori 1959), introducing the concept of the typological process (Caniggia and Maffei 1979). On the other hand, the study of forms, as defined by Goethe and cited by contemporary morphologists such as Kropf (2009) and Batty (2018), focuses on the study of the transition of forms, identifying invariants and permutations. The main objective of reading this succession over time is to discover the "laws of continuity within a transformation process" (Marzot 2002) from a design perspective. Morphology is the study of a form in the making, looking at tools capable of reading, representing and visualizing

the city and its dynamism. The diagram prefigures itself as a valuable tool for this type of reading. Rather than considering the diagram as the image representing a specific aspect of the urban transformation (and consequently its regeneration), the diagram is seen as a tool grounded on a specific logic. By interrogating this tool, the expected output is not strictly project-related. Instead, it contributes to constructing a theoretical/methodological matrix capable of revealing the multiple configurations that the project might have.

Within the city's vision as a collection of possible configurations, the research enters into the domain of complexity theory (Morin 2011). If the city is considered a complex system, the diagrammatic representation can show the multiple possibilities of transforming the urban environment without prescribing a specific solution. The interrogation of the tool does not take place in the classical direction of the term: from descriptive analysis to project. However, from project to descriptive analysis, there is a process of continuous exchange. By definition, there is no single visualization of the diagram but many spatial visualizations. In this case, the tool should be understood and conceived as something other than functional to the project. However, during the design process of transformation, the tool is questioned, shifting the direction of the arrows that go from analysis to design and vice versa. The ultimate goal is not a prediction but a visualization of the possibility of different scenarios in a single urban regeneration project.

The diagrammatic reasoning applied to the urban analysis and with it to design future urban regeneration leads to defining a specific study frame. In the research presented in the following article, using the map in urban morphology study is a starting point for a brother investigation in representing the transition process.

8.2 Background

The main field in which the analysis is conducted is the Italian morphological study, focusing on the maps used to represent the urban transition. The map, in the reference bibliography, can be understood as a cartographic object representing both the built and natural landscape (Hall 2006). Each map is a unique story composed of its authors, methods and information (Brown 1979). It represents one of the fundamental objects through which we make sense of the world by shaping a part of scientific discourse (Hall 2006). The map does not directly imitate of the object nor return a certainty of representation; instead, it constitutes dynamic images of the same object. The map, therefore, has an operative purpose, serving a specific functional objective (Palma 2001). However, in a certain sense, it can also be understood as having a propulsive value. Analyzing the term "transition", variables emerge that can be used to read and understand the map. First, time and its systematization: what time frame can be used to study the transition? Second, the scale of representation: at what level is the transition studied, and what information is recognizable? Third, the deviations: how are changes and transformations made explicit from an initial and final state? Fourth, the structure of the urban layout: how is the fixed part of the

transformation identified? Finally, the point of view: what is the position of the map maker concerning the transient phenomenon.

The maps of Venice (Saverio Muratori) and Como (Gianfranco Caniggia) establish the theoretical foundations and the development of operational tools for morpho-typological analysis, forming the foundations of the Italian morphological school (Moudon 1997; Sheer 2016); in the same way as Muratori's map of Venice, the work done by Augusto Cavallari-Murat for Turin is also credited with having elaborated the theoretical foundations that led to the development of operational tools for the representation and reading of urban organisms (Merlo 2021). Although they use different approaches in the way of understanding and representing the transition of urban systems, commonalities exist in the objectives and essential references. Together, the three cases are emblematic taken as a whole because they allow us to see the map as a tool but above all to see it concerning the transition. Each of these maps addresses the real city and its transition differently, identifying three approaches or transition variables: successions, deviations and relationships. These approaches define a degree of diagrammatic thought of the growing map (starting from Venice up to Turin) as they incorporate the diagrammatic component and the concept of the city in transition in a different way, as well as aiming to achieve a different objective in each cases.

Each of the three case studies above mentioned (Venice, Como and Turin in specific, San Bartolomeo, Via Rovelli and Piazza Palazzo di città) deals with and defines specific behaviors with respect to these variables. They interrogate the map not only on its application but also on the information it conveys in order to be able to understand, expand and delineate the characteristics necessary for studying of permanence and permutations, that is, of the transition of the urban fabric. Therefore, it is essential to specify that each graphic contribution is accompained by an explanatory methodological text in the cases analyzed.

8.2.1 Case 1: The Map of Venice by Saverio Muratori

The maps of San Bartolomeo were drawn up for the study of Venice contained in the book "Studi per una operante Storia Urbana di Venezia" (Muratori 1959) in which the expansion of the city was systematized from the parish nuclei to the late Byzantine settlements, up to the years of the study.

By defining the first time variable, it is possible to identify that the transformation of San Bartolomeo has been reconstructed in relation to the four phases of Venice's expansion:

- Phase I. Considering the eleventh and twelfth centuries, diring which the parish building and the late Byzantine expansion were realized.
- Phase II. Between the thirteenth and fourteenth centuries, when the late Byzantine settlements were consolidated, and expansions in the northern part of the island were set up.

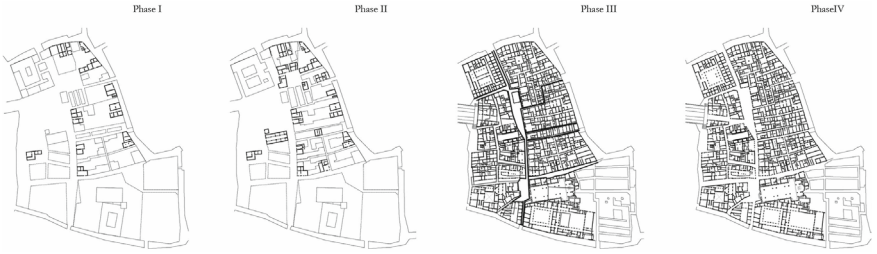


Fig. 8.1 San Bartolomeo in Venice remake from the study of Saverio Muratori, Studi per un'operante storia urbana di Venezia, 1959 (drawn by Gugliotta 2023)

– Phase III. Considering the eighteenth century, during which there was the replacement of medieval constructions with masonry structures.
– Phase IV. The current survey phase from the 1950s.

The four phases are represented on a scale of 1:1000, which is the scale designated to describe the districts of Venice, including San Bartolomeo (Fig. 8.1). The other scales of representation vary from a scale of 1:10,000, in which the districts are represented, to a scale of 1:4000, in which the systems by urban sectors are identified. Further in-depth studies on a scale of 1:500 present the buildings' plans, sections and elevations to provide typological restitution of their transformations over the centuries. The deviation between the initial and final state of the four phases under analysis is obtained by the overlapping of layers of the different maps, each representing a specific moment of development. The process is conducted by deduction and is not immediately readable as no summary map brings together the four development phases. However, each phase represents the state of the art at the time of the survey and retrieval of cadastral sources. The result of this overlapping is the deviations (i.e., what changes over time) and the structure (i.e., what remains fixed and recognizable) of the urban layout in order to define what, for Muratori, are the "constants of change" (Muratori 1959, p. 37). Moreover, in the reconstruction of each phase, each map was drawn up, looking directly at the predetermined phase without relating it to another. The reading perspective conveyed on the individual map also depends on the sources used to make it and the strong relationship Muratori wants to create between the individual and society by acting on the structural component (Pigafetta and Muratori 1990). This led to the need for further reading to identify relationships, recurrences and changes.

8.2.2 Case 2: The Map of Como by Gianfranco Caniggia

The maps of Como and Rovelli Street were drawn up for the study "*Lettura di una città: Como*" (Caniggia 1963). Also, in these maps, the temporal definition is given through the identification of a succession of phases defined concerning the degree

of organicity and the position of reciprocity in the unitary process of the city's development (Caniggia 1973). Three cycles city development are thus identified for homogeneous characterizations:

- Cycle I. This concerns the phase of the city's implantation within the city walls. Within the cycle, five expansion phases are in turn identified, dating from 196 B.C. to the fifth century A.D., which make up the complete analysis contained within the study:
  - Phase I. Considering the Roman settlement or Castrum Marcello phase.
  - Phase II. Considering the Roman implantation or phase of the Castrum of Cn. Pompey or colony of C. Scipio.
  - Phase III. Identifying the Novum Comum.
  - Phase IV. Defining the polarization towards the lake or imperial complexes.
  - Phase V. Highlighting the presence of the early medieval belt.
- Cycle II. This concern the hypotheses on the development of villages, the definition of religious cores, the replacement of specialised buildings with mercantile buildings between the sixth and thirteenth centuries.
- Cycle III. This concerns the hypothesis of reinforcement of the conventual nuclei, the intense industrialisation and the multipolar city-territory between the thirteenth and twentieth centuries.

The maps of Como and Via Rovelli are temporally located in Cycle I and Phase II (Fig. 8.2).

Unlike Muratori, Caniggia's study of Como is more organic and continuously relates to different scales. Each map is drawn at a decreasing scale. However, the ones analysed for this study are the 1:1000 scale representing the ground plan structures of the various development phases and the 1:500 scale sampling the urban

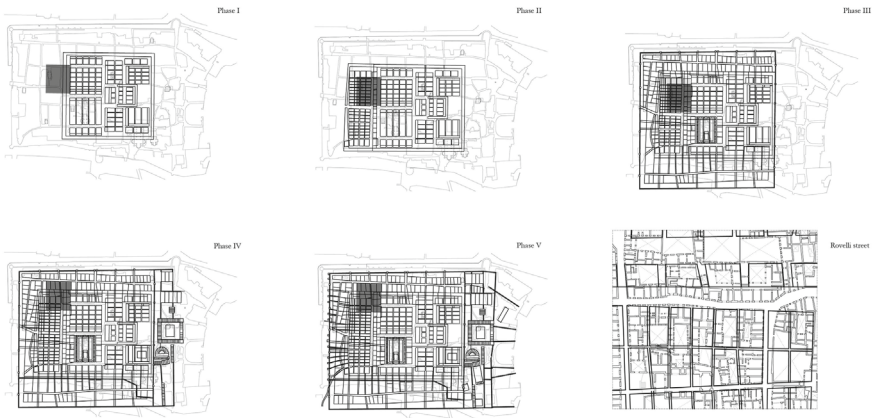


Fig. 8.2 Como and the case of Rovelli street remake from the study of Gianfranco Caniggia, Storia di una città: como, 1963 (drawn by Gugliotta 2023)

fabric of five transformation areas of the city corresponding to the five temporal development phases listed above. Specifically, the Como map of the various phases is related to the 1:500 scale map of Via Rovelli representing the transformation area of the city's second development phase. The deviations are therefore identified as dynamic in which the purpose of overlapping the maps is to define how a specific extension of Como's Roman phase influenced the future development of the urban fabric and how some elements remain within the city and can be reconstructed through analogies and archaeological surveys. The structure, in this case, is well identified through the use and direct overlapping of the Roman extensions with the road layout of the late 18th-century survey of Como. This also defines a specific point of view concerning which the map was drawn; in fact, the construction of the map compares each time the current phase of the city's development with various phases of expansions with a retrospective look on the city. The diagrammatic character takes on greater significance than the Muratorian construction of the map. In addition to the evidence theorized within the books, it is possible to frame the two methodologies as process studies that aim to bring to light the transitory character of the urban fabric at different scales of representation.

8.2.3 Case 3: The Map of Turin by Augusto Cavallari-Murat

The map of Piazza Palazzo di Città was drawn as part of the study entitled "*Forma urbana ed architettura nella Torino barocca*" (Cavallari-Murat 1968) conducted by the Institute of Technical Architecture of the Polytechnic of Turin, whose referent is Augusto Cavallari-Murat. The fabrics analyzed within the maps refer to three different expansion phases:

- Phase I. Considering the existing urban fabrics in Turin between 1719 and 1750.
- Phase II. Defining the urban fabrics within the city walls in the last quarter of the eighteenth century.
- Phase III. Considering the urban fabric of the nineteenth century in the south-east area of the city.

The map of Piazza Palazzo di Città analyzed for this study only includes Phase I and II of the transformation of the urban fabric (Fig. 8.3).

The scale of representation is 1:1000 and is always constant between the phases of comparison, resulting in a diagram of relationships. The deviations between one phase and the next are therefore not made explicit through the map. However, the mathematical construction of the graphs makes it possible to identify the relationships between the parts. The settlement's development structure can also be indirectly reconstructed from the system of relationships and the comparison between phases. The maps of Piazza Palazzo di Città, on the other hand, also define the altimetric development of the fabric and its ornament of the façade. Finally, the aim of the map is to reconstruct through the use of primary sources the development of a specific phase. Therefore, the points of observation are always different, thus identifying

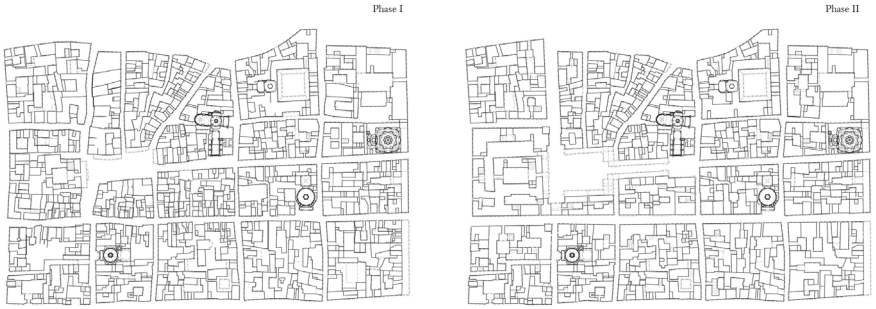


Fig. 8.3 Piazza Palazzo di Città in Turin remake from the study of Augusto Cavallari-Murat, Forma urbana ed architettonica nella Torino Barocca: dalle premesse classiche alle conclusioni neoclassiche, 1968 (drawn by Gugliotta 2023)

variations that cannot be attributed to the transformation of the fabric but rather to the use of documents.

Each of the three case studies has a different approach to the map as a method of analysis and as an output for future intervention in the city. Moreover, the study of Muratori will be taken into account in his design proposal for the design competition of Barene di San Giuliano (even if not directly), and the work of Caniggia was essential for developing the regulatory plan of Como in 1970 (Piano regolatore urbanistico generale, Variante Città murata) and more in general for the study on the city of Como and its surroundings. However, the first two analyses were used later on for other projects in the same city; only the study of Augusto Cavallari-Murat on Turin had, from the first glance, the intention of building a tool useful for a future development of a norm (UNI norm 7310/74).

Moreover, all the examples have the aim of abstracting and synthesizing the information on the urban environment (Fig. 8.4). These approaches are recognizable from its specific identification of the maps as a diagram representing through signs and symbols more information than a topographic space can show.

8.3 Methodology

Starting from the Italian school of urban morphology (Saverio Muratori, Gianfranco Caniggia) and the maps of Venice and Como that have been used to read the evolution of cities, the study questions the possibility of representing and visualizing a transitory process in continuous development. Simultaneously, with its Turin maps, Cavallari-Murat is interested in defining the relationship between the city's elements in a changing process.

This first modality of graphical investigation is applied to the case studies to decode the reading that Muratori, Caniggia and Cavallari-Murat give of the city, understood as a concrete and material fact, breaking it down into parts that can be

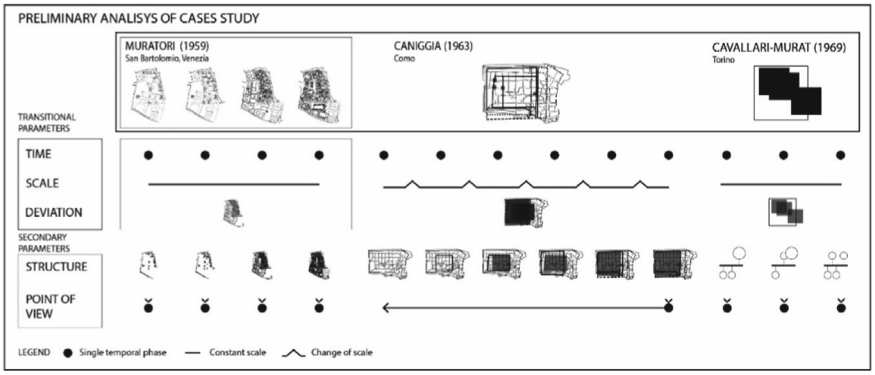


Fig. 8.4 Preliminary analysis of case studies. The dynamic component in the map (Gugliotta 2023)

named and individually examined to understand the multiple appearances of urban transition phenomena: permanences and permutations. From the point of view of typological analysis, attention should not be lost on the deformability of the type, questioning deviations in the process of continuous adaptation to the environment, which is also in movement (Viganò 1999). This position aligns with those of Muratori and Caniggia. They probe the deformations of the type and the modifications in directions secondary to the main ones and use the map to investigate these components. The main objective of the maps under analysis is to "understand whether beyond apparent randomness there is a system of consonances" (Caniggia 1976). There may be no specific order, but a relationship always determines a structure, whether or not it is made explicit. In this context, redrawing is an operative instrument for a critical vision of the map that, combined with a new symbolic translation, identifies a different way of reading reality that has already been filtered at the moment of the map's realization. The object of the new reading is not just the city and its transition mechanisms but the map used to represent it. The instrumentation and the code for this further reading must allow the understanding of the object, the map and how it is made. Redesigning thus allows the object of study to be clarified and made evident. This inevitably subjective process also makes it possible to initiate a new comprehension process through reading as an interpretation of the object of study, but also through the reworking of the maps to construct a diagrammatic tool of the transition map that subverts the pre-established terms that are immediately understandable from the maps to highlight latencies.

Each of the three case studies mentioned above contributes to constructing the diagram with specific parameters to apprehend and direct the study of the urban transition. The work of Muratori and Caniggia, with the maps of Venice and Como, defines the multiscale approach to urban morphology. The reading on the urban tissue and its transition is done considering different information scales: from the building print to the urban tissue representing the ground floor and the internal distribution through the city scale and the territory. Both Caniggia and Muratori, also Cavallari-Murat, conduct their analysis on a large scale, identifying the relationship, the history

and the reason behind a specific urban distribution. The study of territory, city and their development gives the reader of the maps a complete vision of the phenomenon. The choice of studying the city on different scales highlights the connection between the change in the building and territorial scales. However, to understand how to read the transformation process it is not necessary to compare each case study with the same level of consistency; moreover, it is necessary to apply the same rule of reading the urban tissue.

The process of reading transition is composed of fixed elements, the permanence that can be easily identified through the maps and the permutation (the changes) that remain in the background. The variable "time" in the reading of the city leads to interpreting the continuous evolution of "urban facts" and the constant relationship between permanences and permutations in such a way as to offer a new research tool to the discipline of architectural and urban design, which must confront and measure itself with the becoming of the contemporary city and thus its transition. In both Muratori and Caniggia maps, it is possible to read the permanence of the urban tissue. The analysis carried out on Venice and Como and their maps show directly the relationship between the urban tissue and the fixed element such as the street or, as Caniggia defines, the "special buildings" (Caniggia 1976). On the other side of permanence, it is possible to consider the permutation. These are not defined directly in Venice and Como maps but can be understood and read in the methods' books. It is a concept that leans into the theory of the morphological study but is not directly challenged in the maps. This particular observation in the case study defines the construction of a line of results in the diagram reading the transition.

Another helpful element employed to read the transition, more in the contribution about Turin by Cavallari-Murat, is the study of the relationship between the elements of the city. Although the links defined in the study about Turin are between the neighbouring elements, connecting the elements in different scales (from territory to building) is more than just something to leave to the reader's interpretation. The relationship to the urban environment mentioned can be translated into weak and strong connections relating to the different urban scales and the process of transition that occurs in other parts of the sample analyzed.

The translation from the map to the diagram can be done in three steps leading to a construction of a method.

In the first "interpretation" phase of the analysis, knowledge of the object to be studied takes place. In contrast, in the second phase, the salient points are critically identified in order to be able to work through a diagrammatic translation (Fig. 8.5). In this context, it is possible to refer to the map not as a single object but as a relationship between different representations. Moreover, also the writings (considering that both the map of San Bartolomeo by Saverio Muratori, that of Como and Via Rovelli by Gianfranco Caniggia and the one of Turin by Augusto Cavallari-Murat, as previously mentioned, are part of a methodological collection in which the written apparatus accompanying the map is of particular importance for the understanding. Furthermore, the tools and codes used to read the processes help understand how the city presents itself as a mutation condition. In this context, the need arises to overlap

the map's operational method (valid for defining what is known) with the diagram (helpful in defining what is hitherto unknown).

In the second phase of "re-elaboration", it becomes crucial to understand the information reconstructed from interaction with the map and the text. The problem can be examined by working through the definition of relationships and decomposing the problem into a micro-problem. From the phases identified in the previous section, further micro-steps can be identified (Fig. 8.6). Once the micro-phases of transformation (or fields of interest of the transition) have been identified, the operation to be carried out will be to identify their relationships in temporal and scalar terms. As Caniggia defines the reading of building structures and relationships, the process is carried out on four distinct dimensional scales: type, fabric, urban organism and territory.

Fig. 8.5 Definition of the microphases of the morphological map in the case study of San Bartolomeo (Gugliotta 2023)

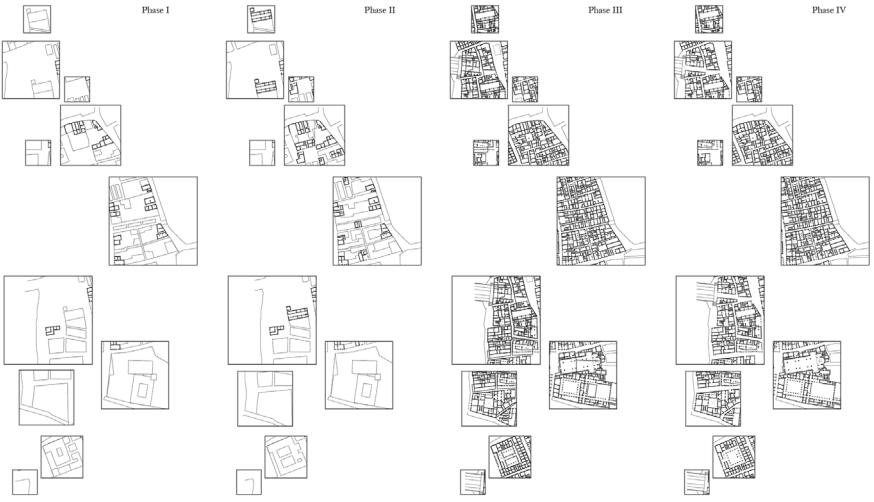


Fig. 8.6 Decomposition of the morphological map in the case study of San Bartolomeo (Gugliotta 2023)

Similarly, a multi-scalar approach has been identified to translate the maps of San Bartolomeo, Via Rovelli, and Piazza Palazzo di Città. However, the representation typically associates its meaning with its origin. In a trans-scalar diagram, origins are irrelevant; what matters is how the relationships between the parts are ultimately attributed (Padoa Schioppa 2015). As a result, the time within which the consolidated fabric is transformed is not only dilated because it defines a transition but, in the long run, is also dilated in the transition narrative.

By decomposing the maps, it is possible to define the temporal, symbolic and diagrammatic components that make these maps a tool for studying urban change from a future perspective on the project. The next step for translating the maps into a more diagrammatic representation of the complexity of the urban transformation is to put each micro-phases into a final matrix.

In order to keep as much information as possible, the diagram is developed considering the notion that Muratori, Caniggia and Cavallari also set in their maps. First, the diagrammatic tool needs to be based along two axes declaring the dimension of the transformation process (time and scale). Transition is used to relate the plurality of contemporary city times that move between past, present and future to define a new character. The mutations that can be found can therefore be described as diachronic if they occur in the same cultural area in the same period; if, on the other hand, the mutations occur in the same instant, taken as an abstraction, they are identified as synchronic. The x-axis contains the diachronic variation in time and thus the succession by phases of changes within the city (diachrony represented by the invariants), the z-axis contains the synchronic variations, and the scalar vertical y-axis contains the variations of the scale. The axes are composed to obtain diagrams inspired by Halprin Lawrence's motion diagram analogy. The time variable in the Halprin-Lawrence is defined as the movement of the people around the city is unfolded within a diagram (analysis tool) to operate through synchronic and diachronic points of view (the axes mentioned above).

Another aspect developed in the construction of the diagram is its use as a tool to understand the relationship between different parts of the city. The continuous and dotted lines that connect the urban tissue define the direct and indirect relationship answering the question of how a change in a part of the city can interact with another, affecting each other and how different configurations of the past are related to the future. The direct one defines the relationship between the same part of the urban tissue but at different times; the other the relationship between different parts of the urban tissue in time and space.

The diagrammatic result can relate the formal component to the relational component by examining the actions and reactions that occur at the urban level. The aim is to identify invariants and permutations not as specific to individual case studies but as a general rule to be traced within the diagram (Fig. 8.7).

The decomposition of the results of the morphological analysis into invariants and permutations and the reading thought the diagram is done through the critical reinterpretation of the three case studies: Venice (Saverio Muratori), Como (Gianfranco Caniggia) and Turin (Augusto Cavallari-Murat).

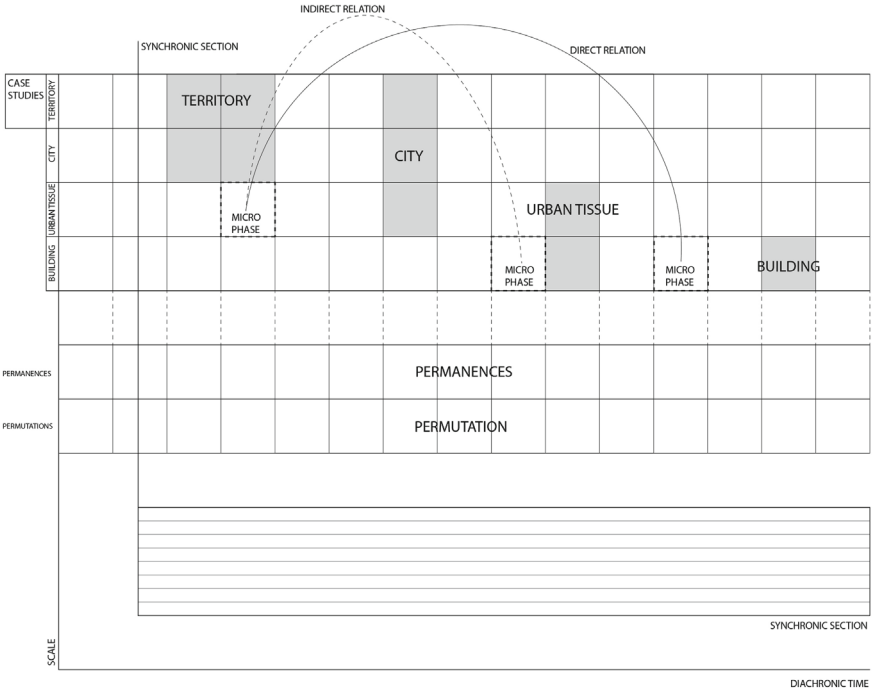


Fig. 8.7 Example of diagram to read the urban transition coming from the principles of Italian morphological school (Gugliotta 2023)

The diagram reasoning process is based on the construction of some formed induction having given rise to the initial symbol's pre-diagrammatic interpretation, then there is the construction of the diagram based on the continuous interaction between the object and the pre-diagrammatic interpretation. After repeated transformation and manipulation coming from continuous observation and reconstruction there is a final status of the diagram. "To sum up, the overall picture of the diagrammatic reasoning process is that it forms a formal deductive reasoning core, embedded, on each side, in the trial-and-error of abductive trials and inductive tests" (Stjrnfelt 2011, p. 105) (Fig. 8.8).

The graphic-synthetic elaborations that come from the morphological reading return the salient theoretical features (Parisi 2015). In attempting to reconstruct the process that led to the definition of the method through the use of the maps of San Bartolomeo, via Rovelli and Piazza Palazzo di Città, of isolated cases within a system of maps, the tool of drawing makes its first appearance. The drawing became a critical design. The rereading of the transition maps is schematized through the elaboration of two main steps: the identification of the key factor provided by the reading of the map and its critical re-elaboration. To complete the experimentation on maps, the analysis process is in turn divided into subways that allow the map to be fragmented and reassembled through a new visualization medium, the diagram.

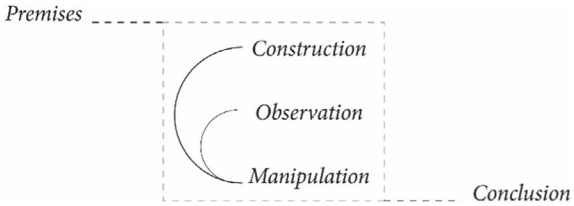


Fig. 8.8 The diagrammatical reasoning process, remake from Stjrnfelt, Diagrammatology: an investigation on the borderlines of phenomenology, ontology, and semiotics, 2011 (Gugliotta 2023)

8.4 Results and Discussions

Complexity theory was born as a systemic theory that goes beyond the analytical-reductionist view, where universal laws are deduced by a linear procedure of summing up the effects of individual components. While it is possible to understand their behaviour, this approach overshadows the emergent properties of systems, thereby reducing attention to their intrinsic capacity to generate new forms of life. In the evolution of a system, complexity is characterized as the intermediate state between stable equilibrium and chaos. In this particular condition, a system manifests intelligent behaviour of adaptation to environmental stresses, exhibiting emergent properties. It is not possible to give an exact definition of complexity; instead, it is possible to describe the attributes of complexity (Padoa Schioppa 2015). The analysis of the urban morphological fabric densifies with complexity, defining a change process. If previously it was sufficient to read a few factors, now the study of the form of cities is thickened with a substratum that interrelates several parts of the project and the city. Although carried out using analogue tools, the practical fallout of this type of analysis is in the discipline's digital realm. The diagram becomes a machine that, as in Cybernetics, mimics the functioning of the human brain, regulated by the circular and retroactive randomness proper of living organisms that are not subject to cause-and-effect regulation mechanisms. The diagram used in this research aims to declare and describe the complexity of urban transformation in the condition of continuous change in dynamicity.

As a result of this experimentation on the three case studies, three diagrams show the multiplicity of representations of urban change and the variety of information the maps offer. However, the aim of developing the diagram is not the final results as the image (the images presented are a draft of an ongoing study) but rather the definition of the logic of reading the urban transition as foundation for future urban regeneration.

The diagrammatic reconstruction of the maps is only one of the possible interpretation. Through decomposition and hypotheses of relationships, it provides a new point of view on the city while offering a starting point for methodological development.

The translation of the map of San Bartolomeo (Fig. 8.2) in a diagram shows the strong interaction between the system of the urban tissue. Furthermore, it gives information about each scale of intervention stressing the densification and the intense

transformation of the area during the four phases analyzed by the map of Saverio Muratori. By intregrating all the transformation stages and their relationships into one drawing, rather than overlapping maps, the reconstruction facilitates identifying both permanences and permutations in the area (Fig. 8.9).

The Rovelli Street maps address a gap in the Venice map: the direct relationship between the changes. Unfortunately, although the permanences can be easily deduced, this is not the case for the permutations that remain concealed in the map, even if they are made more explicit by the deviations between one transformation phase and the following (Fig. 8.3). Translation of the maps into a diagram helps to visualize not only the relationship of a single phase with the contemporary city of Como but, furthermore, highlights the relationship between each phase of transformation (Fig. 8.10). Permanence and permutation emerge not merely as deviation of individual phases but through synthesizing all the information into one diagrammatic tool.

The diagram of Piazza Palazzo di Città is built with less information than the other two case studies because only two macro-phase of transformation come from the map (Fig. 8.3). However, with the diagram translation, the change as the connection between the elements that shape the urban environment is defined, showing how urban elements change and which are the transformation pattern if they are present

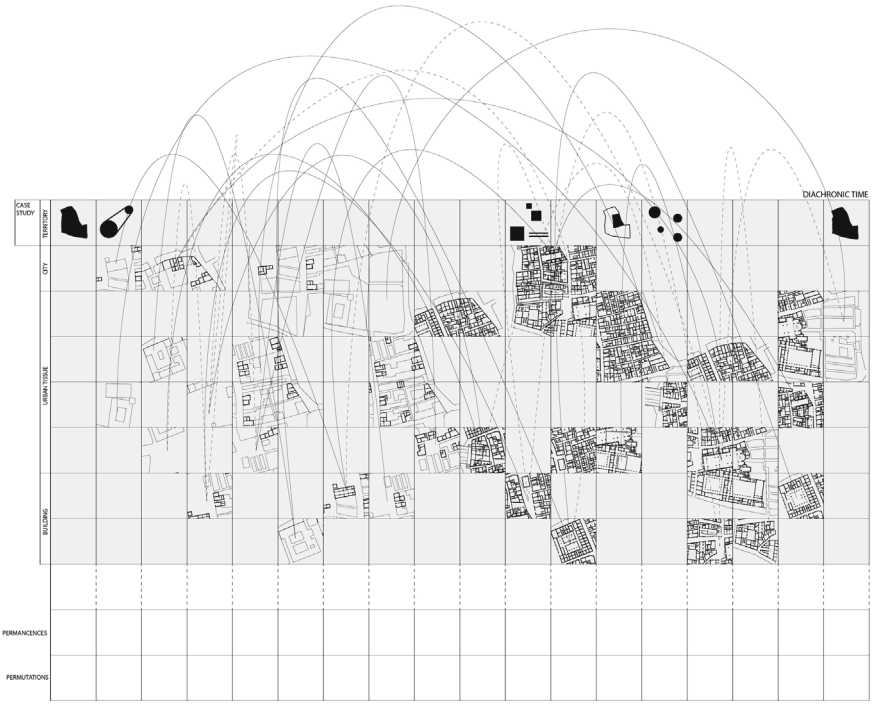


Fig. 8.9 Transitional diagram of San Bartolomeo, Venice (Gugliotta 2023)

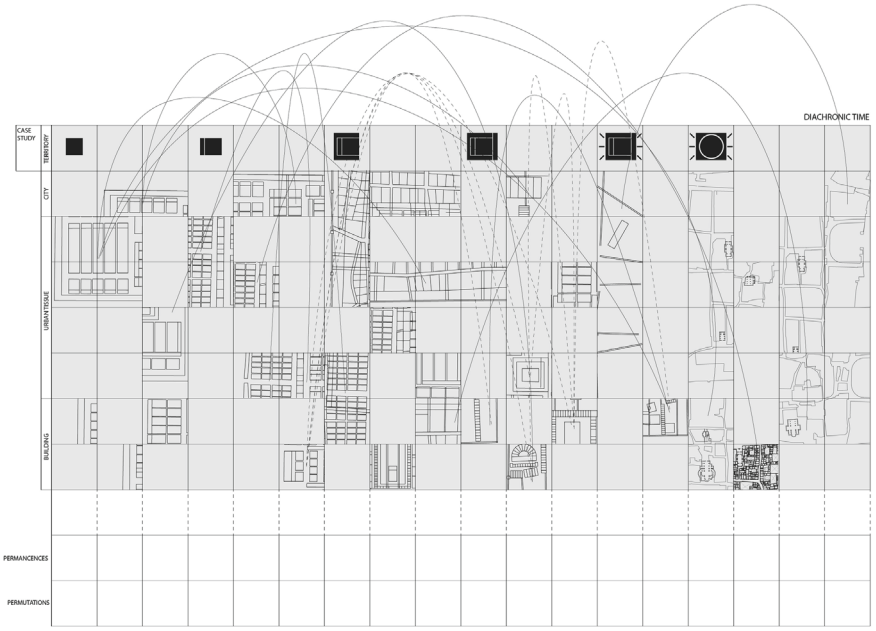


Fig. 8.10 Transitional diagram (in development) of Rovelli Street, Como (Gugliotta 2023)

(Fig. 8.11). This approach stresses the importance of the relations between parts of the city to understand permanence and permutation.

The results of the representations want to emphasize the variety of possibilities in analyzing the transition defining the logical frame of the method. At this initial stage, the diagram does not identify permanence or permutation. Also, the synchronic sections need to be graphically developed, but the principle has been used to structure the diagrammatic framework. In conclusion, the highlight is the logical construction of the diagram that led to a new vision of urban tissue. The diagram as a tool wants to be framed not as a result of software-based analysis but as an element helpful to preparing the construction of a method in urban morphology analysis.

8.5 Conclusions

According to Stewart Brand, the idea of architecture focuses on a specific concept: permanence (Steward 1994, p. 2). The whole idea of permanence is an illusion; however, the term architecture is often associated with the belief in a profound structure that is not prone to change; every object and every piece of architecture, when it comes into contact with time, changes. Architecture, and with it, the city, modifies and adapts even without any particular predisposition to change. This kind of architectural vision leads the architect to think of the complete building as the crystallization

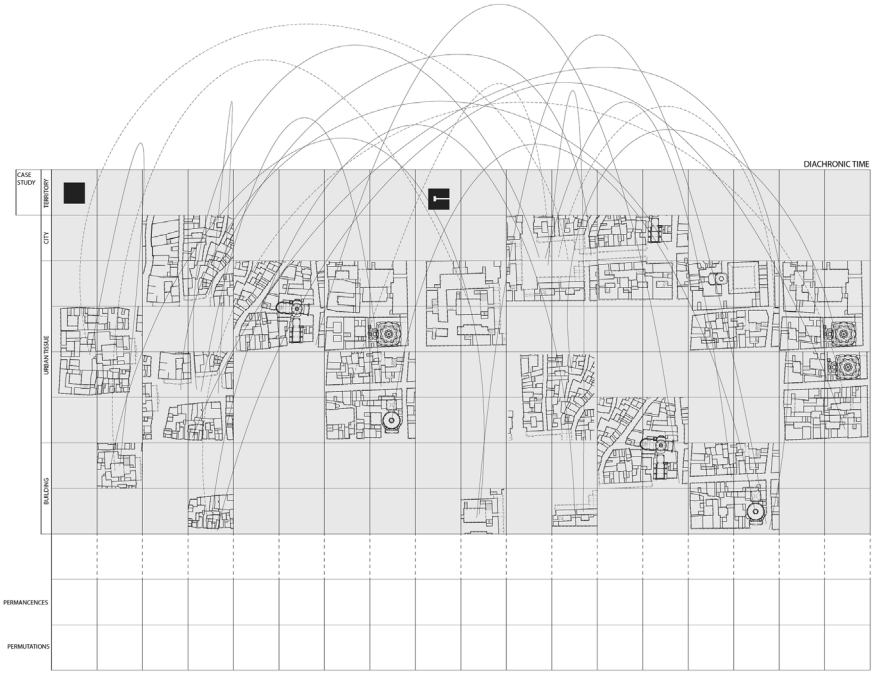


Fig. 8.11 Transitional diagram (in development) of Piazza Palazzo di Città, Turin (Gugliotta 2023)

of the project. Thus the project becomes architecture itself. However, buildings are part of the world, a world that unfolds in its innumerable paths of growth, decomposition and regeneration, leading to ever and continual deviations. Completion is an idealization (Ingold 2019). Instead, the possibility of variation opens up precisely because the replication mechanisms are not perfect (Ingold 2019).

Although the research results are still in development, even if partially covered by a PhD dissertation, some issues can be considered for future engagement with the tool in the regeneration process.

The presented research aims to improve map components that can help visualize qualitative method by working on diagrammatic elements of the tool. Maps are undoubtedly a good candidate for studying the diagrammatic approach to the city's transformation. The maps can be considered representations of the shape of phenomena and, for this reason, a diagram subcategory (Stjrnfelt 2011). Furthermore, the diagrammatic process has entered architectural design as a moment of transformation and generation of new forms of the imaginary. For this reason, the diagram can be considered a medium that allows the translation of perfect shapes into thought and vice versa (Gasperoni 2022). In recent years the fascination of the city for data controlling and AI tools keeps the attention on the possibility of considering the entire urban environment as a computer. However, the use of prediction for efficient city transformation is not considering a series of qualitative parameters

necessary for the definition of urban intervention. Developing a new tool to read and understand urban transition aims to give different points of view on morphological analysis overcoming the critics of the typological method as a prediction method for future development. Moreover, the diagrammatical logic introduces a new value to morphological study by enabling multidirectional exploration during the design process. The approach presented is a starting point for developing a methodology and a tool to read morphological transitional events. The final output is a diagrammatic logic that fills the gap between the traditional method and innovative AI tools.

References

Batty M (2018) Inventing future cities. MIT Press, Cambridge
Brown L (1979) The story of maps (Dover books on history, political and social science). Dover Publications, New York
Caniggia G (1963) Lettura di una città: Como. Centro Studi di Storia Urbanistica, Roma
Caniggia G (1976) Strutture dello spazio antropico studi e note (Biblioteca di architettura. Saggi e documenti 3). Uniedit, Firenze
Caniggia G, Maffei GL (1979) Lettura dell'edilizia di base. Marsilio, Venezia
Cavallari-Murat A (1968) Forma urbana ed architettura nella Torino barocca: dalle premesse classiche alle conclusioni neoclassiche. UTET, Torino
Easterling K (2019) Lo spazio in cui ci muoviamo. L'infrastruttura come sistema operativo. Treccani, Milano
Gasperoni L (2022) Experimental diagrams in architecture (Construction and design manual). DOM, Berlin
Hall P (2006) Else/where: mapping new cartographies of networks and territories. University of Minnesota Design Institute, United Kingdom
Ingold T (2019) Making antropologia, archeologia, arte e architettura (Culture e società 41). Cortina, Milano
Kemp R, van Marjolein A, Jan R (2001) More evolution than revolution: transition management in public policy. http://hdl.handle.net/1765/7672
Kropf K (2009) Aspects of urban form. Urban Morphol 13(2):105–120
Marzot N (2002) The study of urban form in Italy. Urban Morphol 6(2):59–74
Mei P (2015) Il tempo della simultaneità nel progetto urbano. Tra permanenza e permutazione. Maggioli, Santarcangelo di Romagna
Merlo A (2021) Le "scuole" italiane di rilievo urbano. Urban Form des 16:74–79
Morin E (2011) La sfida della complessità. Le lettere, Firenze
Moudon AV (1997) Urban morphology as an emerging interdisciplinary field. Urban Morphol 1:3–10
Muratori S (1959) Studi per una operante storia urbana di Venezia I. Palladio
Neyant F (2019) The unconstructable earth: an ecology of separation. Fordham University Press, New York
Padoa Schioppa C (2015) Transcalarità e adattabilità nel Landscape Urbanism. Aracne, Roma
Palma R (2001) L'immaginario cartografico dell'architettura. Tecnograph, Bergamo
Parisi O (2015) La realtà oltre l'utopia. La dimensione sotterranea nello scenario urbano. Celid, Torino
Pievani T (2008) Exaptation. Storia di un concetto, postfazione a Stephen J. Gould, Elisabeth S. Vrba, Exaptation. Il bricolage dell'evoluzione. Bollati Boringhieri, Torino
Pigafetta G, Muratori S (1990) Saverio Muratori architetto teoria e progetti (Saggi Marsilio. Polis). Marsilio, Venezia

Sheer B (2016) The epistemology of urban morphology. Urban Morphol 20(1):5–17
Steward B (1994) How buildings learn what happens after they're built. Penguin Books, New York
Stjrnfelt F (2011) Diagrammatology: an investigation on the borderlines of phenomenology, ontology, and semiotics. Springer, Berlin
Trisciuoglio M, Barosio M, Ricchiardi A, Tulumen Z, Crapolicchio M, Gugliotta R (2021) Transitional morphologies and urban forms: generation and regeneration processes—an agenda. Sustainability 13(11):6233
Ulisse A (2022) Le dimensioni del tempo metasemie tra memorie, strutture, frammenti ... e altre manipolazioni dello spazio. Lettera Ventidue, Siracusa
Viganò P (1999) La città elementare. Skira, Milano

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 9
Typology and Morphology: The Gene of Chinese Traditional Town Form

Laura Anna Pezzetti and Wowo Ding

Abstract This round table aims at the conceptual exploration of theories, tools and case studies for a comparative reading of Chinese Traditional Town Forms, focussing on how to interpret Chinese morphology and to view the relationship between Chinese traditional town forms and its building types. The main question of research epistemology and methodology is the contact point between analysis and design.

Keywords Chinese traditional town form · Urban Gene · Plot patterns · Typo-morphology · Topographical figures

9.1 Introduction

China urbanization process is coming into a period of urban renewal, while traditional towns and villages are now threatened by the new processes of development and tourism consumption turning from the city to the countryside, creating pressure for settlements' change. New development is generally indifferent to existing natural and cultural landscapes, erasing every topographical and morphological sign, while preservation is mostly focused on the reconstruction of the "original" and ideal types, insensitive to historical palimpsests and to the urban value of built heritage.

While the study of Chinese urban form has achieved prominence in recent decades, still little accurate, systematic and comparative fieldwork has been undertaken. Besides, most studies reflect a weak tradition of "reading" the built landscape in its syntactic and semantic relations among "built facts" and by ordering and interrelating the superposition of different historic traces, whether they configure a homogeneous accomplished town form or more often a composite broken one.

L. A. Pezzetti (✉)
Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milano, Italy
e-mail: laura.pezzetti@polimi.it

W. Ding
Nanjing University, Hankou Road 22, Nanjing 210093, Jiangsu, China

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_9

This round table aims at the conceptual exploration of theories, tools and case studies for a comparative reading of Chinese Traditional Town Forms, focussing on how to interpret the morphology and how to view the relationship between Chinese traditional town forms and its building types.

The main question of research epistemology and methodology is the contact point between analysis and design.

9.2 The Round Table: The Gene of Chinese Urban Form and Its Implications for the Urban Project

Wowo Ding invited first Professor Zhao to share his views and Professor Pezzetti to share her reading methods, so as to support them with her research project on Changting as an evidence.

Chen Zhao (Nanjing University)

Chen Zhao underlined that Chinese architects have approached the challenges of rapid urban development through Western theories. Reinterpreting architectural history and heritage through China's traditions, Chinese tectonic culture is represented by "Tumu/Yingzao (土木/营造)", a light and low-tech construction system above the ground, which entailed continuous reconstruction.

As "*Chinese civilization did not lodge its history in buildings*", the logic of historical reconstruction of ancient Chinese towns followed either reconstruction in a different location, or overlaying and expanding on the original site.

Official or public buildings were reconstructed more frequently compared to the residential fabric that has now become a significant cultural heritage for Chinese traditional cities. The historical and traditional scales of geographic elements, street networks, housing quarters, and the boundary of land ownership (地界) should be recognised as the key formal element of the traditional urban fabric.

Therefore, the issues of architectural history and heritage in modern China remain to be fully discerned as the Western construction and academic systems were imported, altering the tradition of building and urban form and developing from cities with rapid urbanization eventually to the countryside.

However, this change is still going on, the contemporary construction system has completely merged with International and Western systems and the tradition of cities continuous reconstruction has to be terminated (Zhao 2007). Most architectural heritage nowadays is a hybrid cultural phenomenon so we need to consider a *Relative Authenticity* for the evaluation of architectural history and heritage in China (Fig. 9.1).

Laura Anna Pezzetti (Politecnico di Milano)

Laura A. Pezzetti emphasised that the authenticity of historic sites should not be confined to the integrity of "original" built structures but should also encompass a framework for evaluating their coevolutionary layering. Sites contain also imprints,

Fig. 9.1 Nanjing South Town, analysis of urban fabric plots (*Source* Zhao C.)

fragile traces, crop marks, hidden substrata, fragments, incongruous alterations and significant debris. Signs that signify the "intelligence" of Built Facts and traces that hint to different times of towns.

Pezzetti highlighted the need of transforming analysis into interpretative reading and Interpretative Maps, advancing the concept of *Latent Structure* (Pezzetti 2019) to reveal both tangible and intangible meaning of Urban Form. Her research on Fenghuang Historic Town exemplifies three essential principles, which call for integrating conservation and regeneration:

1. the combined structural and formal interaction between the geomorphology of the river meander and the form of the settlement;
2. the biunivocal relationship between type and morphology where the Invariant courtyard type gave shape to an original radial *Morphotype*, extending the *matou* gable walls into walled vegetable gardens. In diachronic maps, the morphotype shades an architectural light to the "plot" and reveal diverse settlement forms, i.e morphotypes;
3. the Latent Structure, that is, the triple relationship between type-morphotype-farmlandpatterns and provides the hidden matrix of urban form. This structure can be deciphered only through synchronic maps.

The *Latent Structure* also revealed the iconism of the "whole" urban form as *Territorial Figure,* transcending the mere aggregation process of plots and types. This architectural "*mise en forme*" even provides a describable urban form and

topographical figure to the traditional principles of Feng Shui and Shan Shui. This *figure* expresses the triple relationship between the typological invariant, the morphotype and the topographical figure, offering a coherent matrix for any urban action (Figs. 9.2, 9.3, 9.4 and 9.5).

If Chinese sites begin to be understood as a *tabula plena*, design can no longer be considered as a self-referential colonisation of a void but rather a new *writing* on an existing text—often a composite one—that requires to be red, interpreted and consistently continued or instead critically transformed by thel act of design.

Wowo Ding (Nanjing University)

Wowo Ding supported Pezzetti's methodology of reading the Chinese typomorphology by applying it in a research on the courtyard house type in Changting, typical of western Fujian, with two to three courtyards for ordinary families, four to five courtyards for large families, and up to seven courtyards for a few large families.

The entire courtyard occupies the entire land boundary of the house, and only the front door of the courtyard is rarely indented, leaving a little space for the entrance to stay. The entrance has a beautiful gate as a symbol of the family and the compound are separated from the neighbouring compounds by a higher sidewall. The front

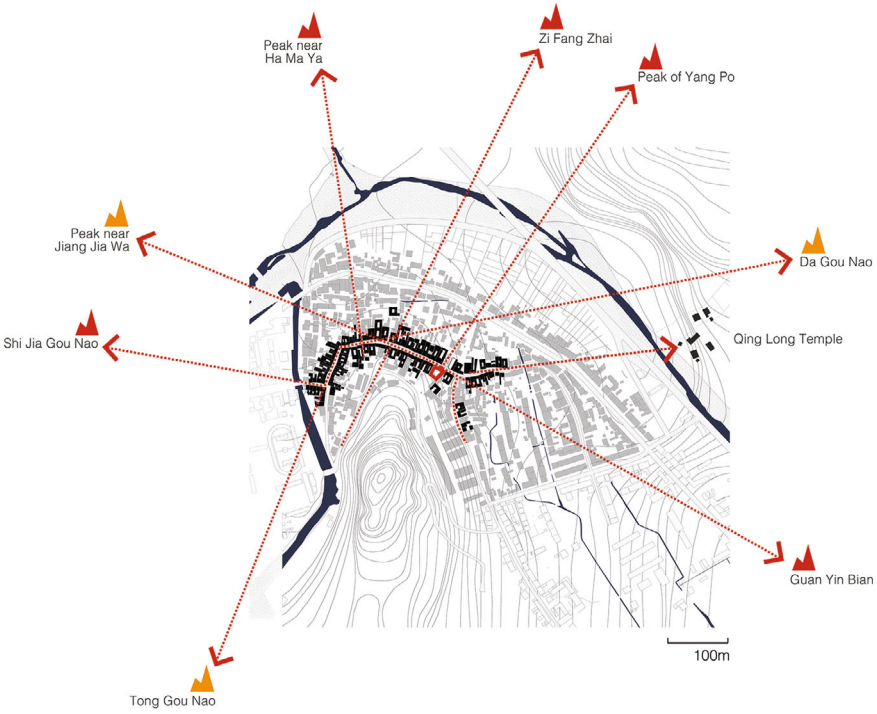


Fig. 9.2 Fenghuang (Shaanxi), correlation between urban structure and Feng Sui "mise en forme" (*Source* Pezzetti 2019)

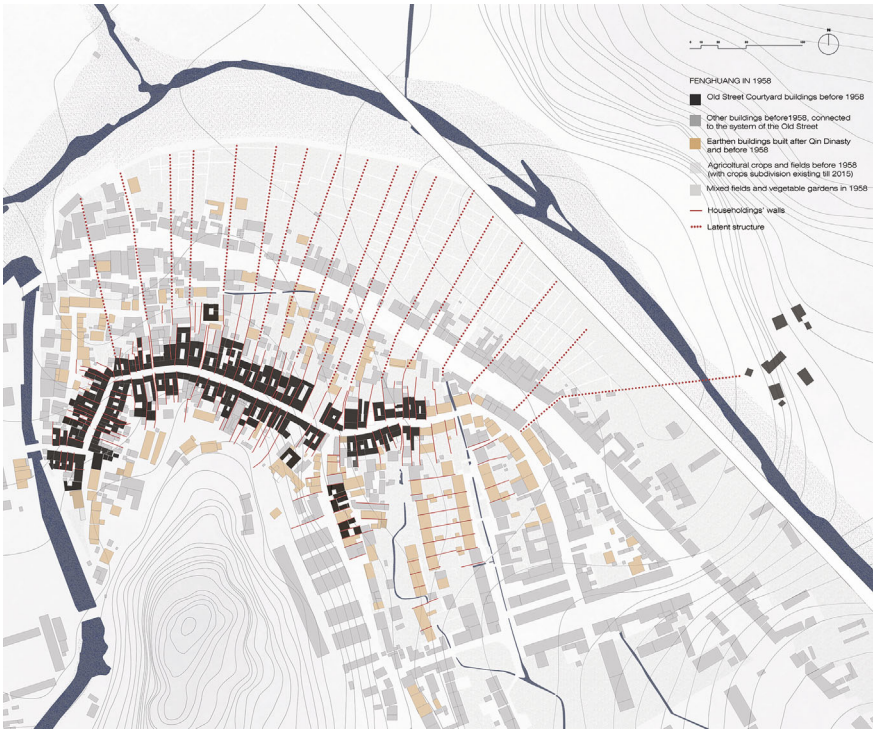


Fig. 9.3 Synchronic map of the radial Latent Structure in the present urban fabric (*Source* Pezzetti 2019)

gates of residential compounds generally spread along both sides of the main street, usually with an alleyway between every 5 and 6 compounds, which serves as a link between the main streets.

As the characteristics of this building type influence the town form and its structure, Ding assumed the building type as a key to read the morphological characteristics of the town (Ding 2021). For instance, the gable wall of the courtyard building clearly reflects the property plot of the building site, and the sizes of the block depended on the number of courtyard composition (Fig. 9.6).

Pezzetti gave the floor to Professors Han and Li to discuss case studies and interpretations.

Dongqing Han (Southeast University)

Han Dongqing discussed critically plot and plot pattern as one of the important concepts in the typo-morphological study, and relevant transformation links between city and architecture. As the basic unit of urban form structure and the dominant expression of property right, the plot has the dual attributes of physical space and social economy.

Fig. 9.4 Detail of the typo-morphological plan: *zhai yuan courtyard* types in their radial Morphotype

In the conservation and regeneration of Xiaoxihu Historic Area, the research and application of these dual attributes have played an important role. In response to the complexity of physical space and property rights relationship, a "property typological map" was developed to graphically present and record the ownership of each plot, building and even room as well as the owner's willingness, so as to adjust the planning scheme dynamically (Han 2022). Besides, a two-level planning management and control system was finally established, and the micro-regeneration guidelines of 127 units were prepared as the basic management tool for "small-scale and progressive" dynamic regeneration (Figs. 9.7, 9.8, 9.9 and 9.10).

However, although the property boundary of plots was clearly defined in the planning stage, the used boundary was flexibly adjusted in the architectural design. In the case of Xu's Family Self-renewal, the plot plays a relatively strong key role in the conservation and control of the overall urban form, while in the cases of Blossom Hill Hotel and Integrated Control Centre, the final built form clearly exceeded planning expectations. Han concluded that the constraints of the plot are important and effective, but cannot determine the design mechanically and rigidly.

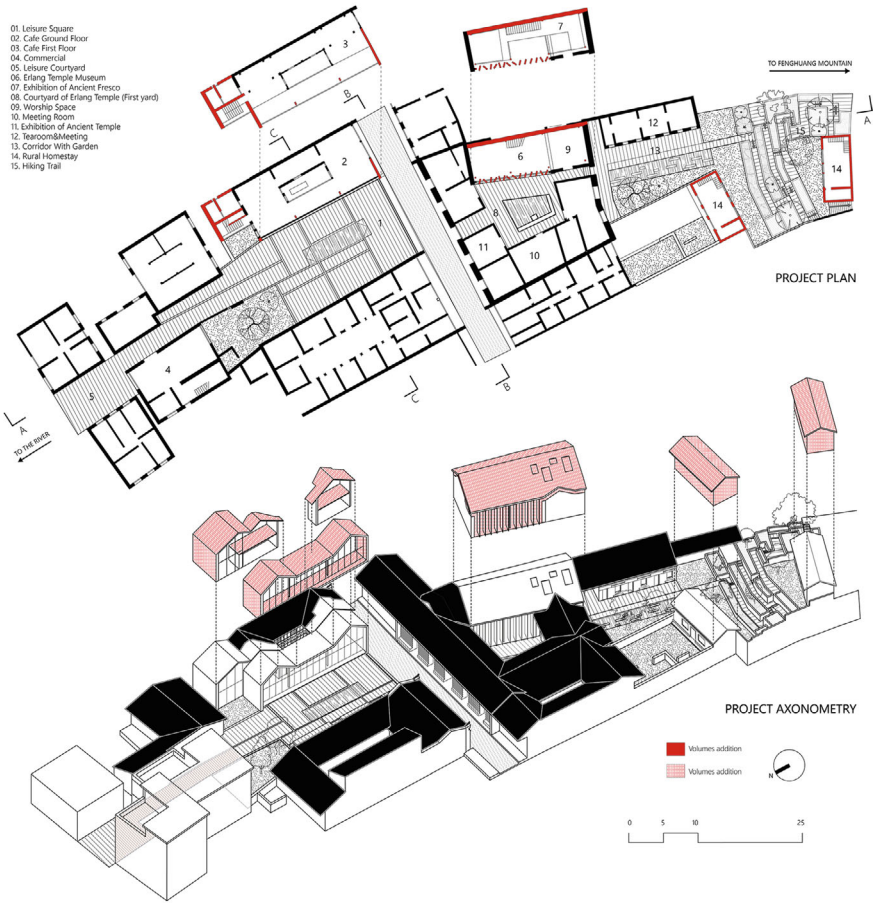


Fig. 9.5 Conservation and regeneration of the radial strip including the Temple and the "lacuna" formed by the collapsed courtyard (*Sources* Pezzetti 2019)

Li Bao (Southeast University)

Li Bao reflected that in urban studies the typo-morphological approach may have two different (maybe opposite) "souls": the *taxonomic soul* and the *dynamic soul*. According to the idea of type as a classificatory tool born in Western World, the morphologic thought is useful to put in order objects and create families based on analogies, similarities, vocations.

According to Bao, the *taxonomic soul* has a synchronic point of view on reality: all the special and ordinary buildings, the urban spaces, the adopted design solutions are in front of our eyes at the same time, without any idea of development or degeneration. On the contrary, the *dynamic soul* follows the timeline of a diachronic point of view which focuses more on the process (either development's or degeneration's processes). The order of things and its structure, in one word the reciprocal

Fig. 9.6 Changting (Western Fujian), Courtyard types (*Source* Ding W.)

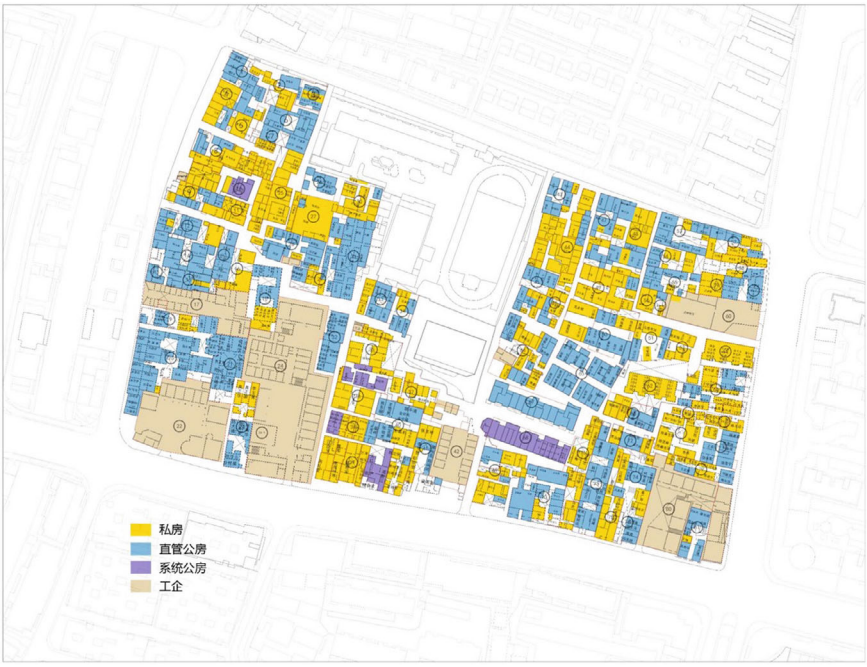


Fig. 9.7 Xiaoxihu Block (Nanjing), property typological map (*Source* Han D.)

Fig. 9.8 Xiaoxihu Block (Nanjing), one of the plots after reconstruction (*Source* Han D.)

positions of urban object in morphological hierarchy, is obviously relevant, but what is mostly important is the continuous changes of that structure in time, the restless metamorphosis of urban objects and spaces, in the essential interplay of tradition and innovation.

In order to read and understand (and even in order to design) contemporary urban spaces and neighborhoods, a new paradigm of "transitional morphologies" upon spatial–temporal approach can become really fruitful in the context of fast developing countries like China, where the urban form is less subject to permanence and fast changing, with an uncertain hierarchy of spaces and buildings (Trisciuoglio and Bao 2019). Through it, the traditional instruments of typo-morphological analysis can be applied to the Chinese cities in their past and present formal consistency, even trying to figure out their future (Figs. 9.11, 9.12 and 9.13).

Finally, Marco Maretto joined the final round table discussion reconnecting to an idea of typological continuity between the historic and the contemporary city.

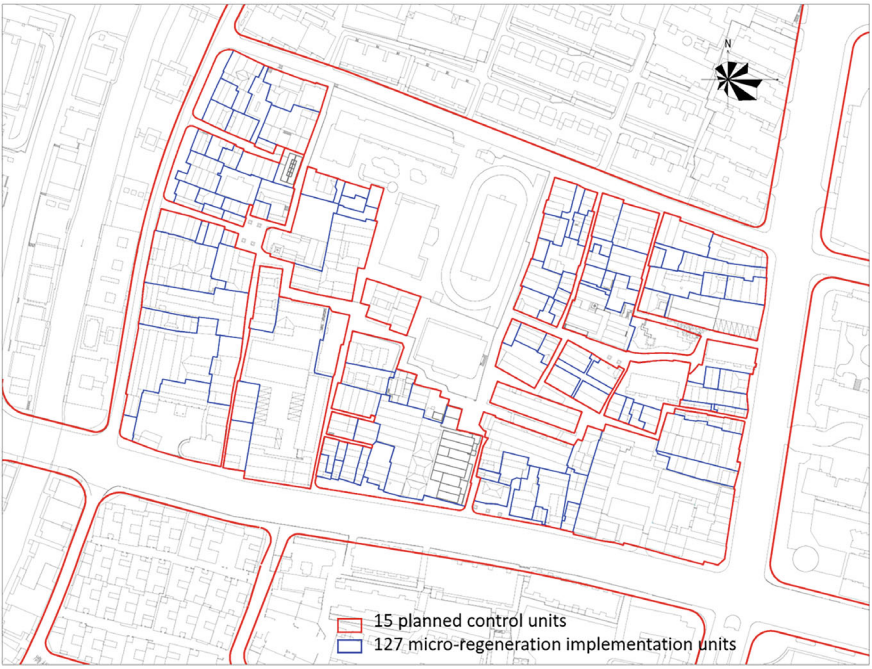


Fig. 9.9 Xiaoxihu Block (Nanjing), two level control system (*Source* Han D.)

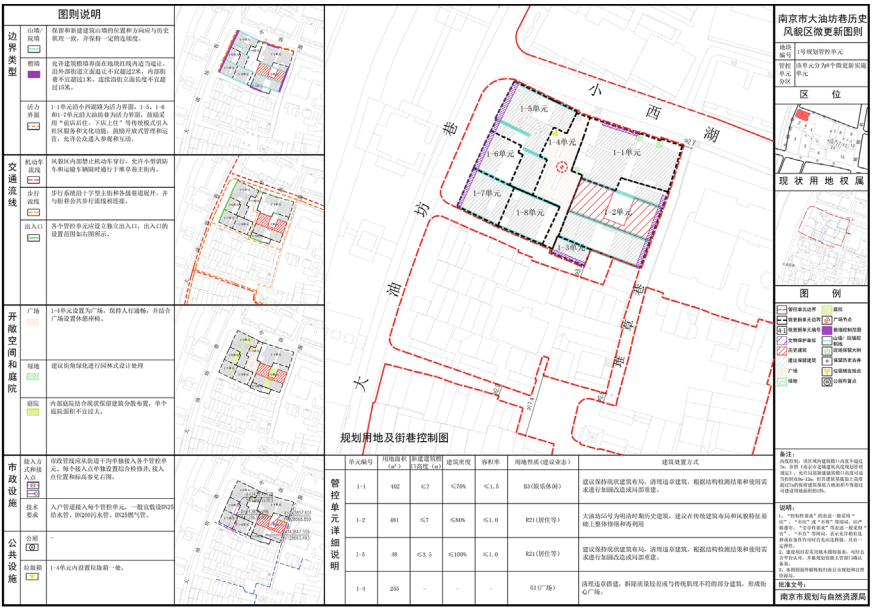


Fig. 9.10 Design guidelines for plots (*Source* Han D.)

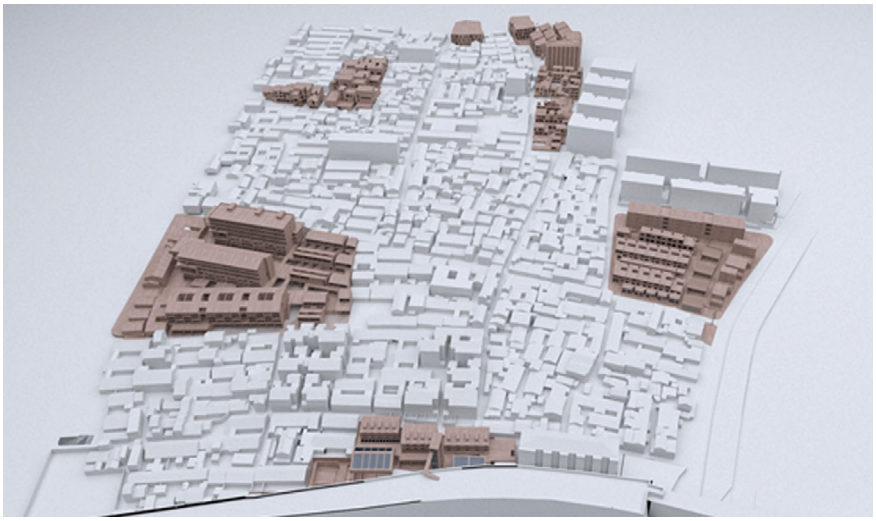


Fig. 9.11 Urban Project on Hehua Tang Traditional Block, Nanjing (*Source* Bao L., group work by SEU-PoliTo Joint Design Studio, 2021)

Marco Maretto (Parma University)

Marco Maretto recalled the concept of *Typo-morphological Heritage* in urban design, allowing a "structural" and "non-formalist" approach to the project, respecting history in the awareness of contemporary needs. He assumed that this concept goes beyond material evidence by placing the historical-morphological stratification of the Anthropocene in direct contact with the project of the contemporary city.

"Typological Congruence" and "Typological Preservation" are linked to it and contribute to the definition of that pattern, as result of a certain number of diachronic layers, on which any urban design strategy can be set.

In the broader concept of the City, there is no conceptual difference between the historic and the contemporary city.

9.3 Conclusions

By sharing a first archive of the historic towns surveyed, investigated and decoded by the panellists, the discussion enlightened the gene of Chinese Traditional Town Form, stressing its constitutive laws and potential in the perspective of co-evolutionary and culturally sustainable development. The integration of historic-structural studies and typo-morphological research on Chinese Towns promises to shed light on the wider significance of concepts and methods developed in Western schools while, symmetrically, contributing to stir new interpretative concepts for Western contexts as well.

Fig. 9.12 Urban Project in Hehuatang Traditional Block, Nanjing (*Source* Bao L., student Zixuan Liu, 2021)

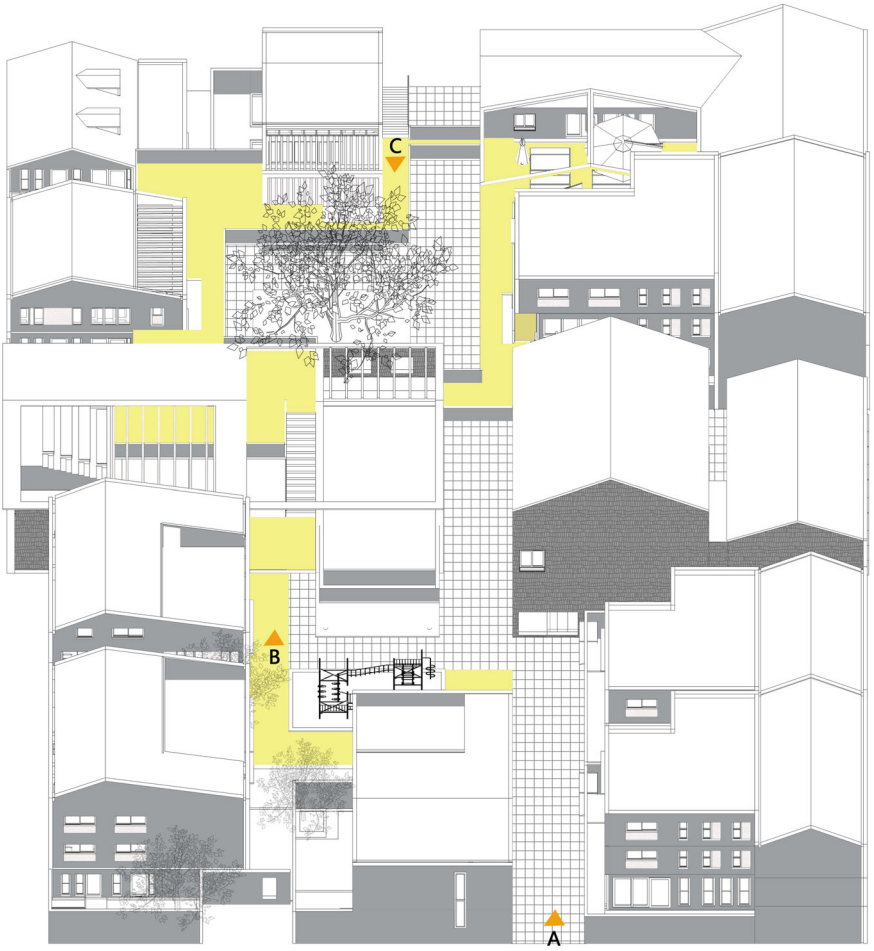


Fig. 9.13 Sharing Courtyard—Regeneration in Xiaosongtao Traditional Block, Nanjing (*Source* Bao L., student Haoyu Cheng, 2019)

References

Ding W (2021) Morphology and typology: a village as a cultural and environmental process. In: Oliveira V (ed) Morphological research in planning, urban design and architecture. Springer, pp 117–139

Han D (2022) 'Plot' in the conservation and regeneration of xiaoxihu historic area. In: Urban redevelopment and revitalisation: a multidisciplinary perspective. In: XXIX international seminar on urban form ISUF2022

Pezzetti LA (2019) Layered morphologies and latent structures: reading, decoding and rewriting to enhance historic rurban landscape. Tongji University Press, Shanghai

Trisciuoglio M, Bao L (2019) Transitional morphologies. A joint research unit between China and Italy. In: Charalambous N, Camiz A, Geddes I (eds) Cities as assemblage. Proceedings of the XXVI international seminar on urban form, vol 1. Tab Edizioni, Rome, pp. 191–202
Zhao C (2007) Misunderstanding of "Facade": architecture, theory, history. SDX Joint Publishing Company, Beijing

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 10
Typo-morphology in the Cognition of Traditional Landscape Region—Case Study of Urban Design Project in Changting Town, China

Yidan Liu, Lian Tang, and Wowo Ding

Abstract Typo-morphology can be seen as the research perspective and methodology of urban morphology. The terms typo-morphology are typological and morphological because they describe urban forms according to the detailed classification of building types, emphasizing the relationship between building types and overall form in the evolution of urban morphology. In order to better integrate urban morphological research with practice to identify traditional landscape region, it is worthwhile to apply the perspective and method of typo-morphology to deeply recognize the traditional landscape characteristics of the old town based on local types. This study examines the characteristics of GIS platform on the basis of the tradition of Conzen and Caniggia through the case of our urban renewal projects in Changting Town, a historic town in the south of China. First of all, investigation and learning of local building types with traditional characteristics are the tools to understand the basic unit of urban form preliminarily. Secondly, presenting traditional landscape characteristics from two aspects including characteristics of building composition and spatial perception, and doing some simple data overlay analysis helps us to clarify more scientific traditional landscape areas. Finally, we have determined the reasonable traditional landscape region by combining the discussion of other historical information in details. The paper concludes that the term typo-morphology are meaningful in delineating traditional landscape region, which makes an important contribution to the renewal and protection of old town in China.

Keywords Typo-morphology · Building type · Traditional landscape region

Y. Liu · L. Tang · W. Ding (✉)
Nanjing University, Hankou Road 22, Nanjing 210093, Jiangsu, China
e-mail: dww@nju.edu.cn

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_10

10.1 Introduction

The pioneering work of the British school of urban morphology. Conzen (1960) proposed three main constituent elements of urban morphology, namely building, plot (plot series), and street (street system). In 1979, Gianfranco Caniggia proposed that the hierarchical system of elements, structures, systems, and organisms could correspond to the architectural level (materials, structures, rooms, and buildings) and the urban level (buildings, tissues, districts, and towns), respectively. Thus, it can be seen that building is a key element as a constituent element of urban form. In 2014, Karl Kropf, after comparing and analyzing the theories of Conzenian and Caniggian, proposed a comprehensive hierarchical chart of eight constitutive elements, which include materials, structures, rooms, buildings, plots, street blocks (plot series), streets (simple tissue), urban tissue, and emphasizes that urban form should be analyzed systematically.

When analyzing the characteristics of the urban form, the Conzenian school uses the hierarchy method in a top-down logical order. Focusing first on the street structure from the point of view of urban functioning, with the main roads serving as access pointing to important urban centers such as churches, and organizing other roads to different destinations. Then, in the street blocks divided by the road network, the change in plots size within street blocks is analyzed according to the allocation and the value of plots. The final analysis of building within the plot shows that in general the size of a plot limits the size of a building from the traditional period to the beginning of urbanization. In addition to the focus on the town plan, the Conzenian school also combines the building fabric and land utilization complexes for the delineation of the morphological region (Conzen 1960, 1975; Barrett 1996; Barke 2003; Whitehand and Gu 2007b; Whitehand 2009; Gu 2010; Birkhamshaw and Whitehand 2012; Alsadaty 2021). The Italian school, represented by Caniggia, is based on the study of building types in a logical bottom-up sequence to perceive the entire urban form. They inherited Quincy's (2000) theory of studying building types based on the mechanism of thing's generation. They believe that in a traditional city, all communities living in the same place have the same living habits and cultural identities at a specific stage of time, follow their own daily trajectory or mode of activities, and eventually implement into a housing type, and then gathered into a kind of town form. At that time, people were able to obtain a piece of plot to build their own houses, and the size of the plot generally depended on lifestyle-based layout and construction methods such as structure, materials, windows, and doors. And these lifestyle-based houses are continuously clustered to form a compact cluster of street blocks. Then, according to walking habits and accessibility, the main roads are naturally created between different street blocks, while some branch roads are created within the street blocks (Muratori et al. 1963; Caniggia and Maffei 1979; Cataidi 1998, 2003; Hermida et al. 2020). In the daily life of the local people, the entire town form is also influenced by the topography of mountains and rivers. This compact form and nesting pattern is evident when the types evolve consecutively. However, as real estate developers invade to produce new types of apartments, the large plots that are

consolidated no longer limit the shape and size of the houses, which allows for a shift in the nature of the housing operation, not only for living but also for investment, etc. The traditional theory is no longer appropriate at this point. There are also other causes of typological variation that cause the correspondingly different kinds of building fabric areas to be separated from the traditional areas. Typo-morphology is a combination of two classical theories, reflecting the dialectic between building typologies and urban morphology. Many scholars discussed it (Moudon 1989, 1992, 1994; Kropf 1996; Samuels 1999, 2008; Romice and Chen 2009), among which the scholar with the most classic and clear explanation of typo-morphology is Moudon. She believes that "typomorphological studies reveal the physical and spatial structure of cities. They are typological and morphological because they describe urban form (morphology) based on detailed classifications of building and open spaces by type (typology)" (Moudon 1994). It can be said that typo-morphology integrates type and form, and can describe typical characteristics of urban physical and spatial forms changing over time according to their specific classifications.

The traditional settlements in China have their own unique types of houses. Although the building styles vary from the north to the south, the courtyard is the basic form common to most Chinese houses, and most of them are built using a timber-frame structure with their own set of layout and construction patterns influenced by rituals and morality (Liu 2003). Accordingly, each traditional Chinese town is a continuous aggregation morphology of traditional Chinese building types as society develops, and reflects the daily functioning mechanism of a town. The timber-frame material system of traditional Chinese houses necessitates that locals constantly renovate and repair their houses, and the change of dynasties brings about the reconstruction of the entire city, but this does not affect the intrinsic housing type and town structure based on local lifestyle, and this adaptability of timeless form and structure determines the way we perceive the morphology of Chinese old cities (Pezzetti 2019; Ding 2022). Therefore, the unique morphological characteristics of Chinese towns based on the aggregation of traditional building types are also worth studying.

There are many traditional courtyard houses in the old town of Changting, which is located in the western part of Fujian Province, China. Therefore, taking the Changting old town as an example, this paper tries to use local building types to analyze the town form, gain a deep cognition of it, and then delineate the traditional landscape region, so as to lay the foundation for further urban renewal practice. It is important to mention here that in China, some scholars have perceived the morphological region of the Guangzhou case based on the classical Conzenian approach and directly proposed some conservation strategies based on it (Whitehand and Gu 2007a; Whitehand et al. 2011). Some other scholars have also conducted a cognitive analysis of the existing building fabric forms based on building types (Gu et al. 2008; Li and Gauthier 2014). The classical morphological zoning map is able to express the distribution characteristics of the building fabric of a certain area developed in different periods, which can be used as a basis for formulating conservation strategies, and has certain value, but in the perspective of urban renewal, it cannot directly deduce the overall traditional landscape region. Formulating conservation strategies for Chinese ancient

towns with unique town formation mechanisms in this way leads to two in-depth problems. Firstly, the result of the delineation of the traditional landscape area based solely on the existing tissue is not necessarily a complete area, which will definitely be interspersed with some GAPs formed by the modern building tissue areas. This leads to a sense of continuity in neither the restoration of the tissue nor the walking experience through the streets, and there is no way to continue the historical fabric and culture. What's more, Chinese cities often lack sufficient historical information to produce detailed morphological zoning maps (Gu and Zhang 2014). Secondly, the original classical morphological zoning method has some more subjective factors and limited means to collect and count information on building types artificially, on the other hand, it lacks the presentation of morphological characteristics such as spatial perception based on planar analysis (Kropf 1996; Bienstman 2007). So, for a country like China, where building types are clustered into old towns, to what extent do types play a role in the delineation of traditional landscape region? How exactly can we find and draw the areas with traditional style in a complete way? These are the problems that will be focused on and studied in this paper.

10.2 Methods

The following four things are to be accomplished at the methodological level. Based on the purpose of finding and drawing the complete area with traditional landscape in the old town of China, this paper will start from the perspective of typology, firstly by investigating to know the local typology and extracting some characteristic elements of traditional landscape from it. Before the investigation, it is necessary to set some principles of building types to be included in the traditional landscape areas, so as to better advance towards the goal. After investigation based on the research principles, we loaded a GIS platform tool to help us integrate the data and present it in a clearer way when recognizing the local building types and morphological characteristics of the old town. Here, we present the characteristics in terms of building plan aggregation patterns and spatial perception structures. Then, based on classical morphological methods, a preliminary traditional landscape area based on data analysis is obtained by scientific data overlay analysis of relevant characteristics on a GIS presentation map. Finally, from an urban design perspective, some historical information that has not been presented will be discussed in detail and overlaid one by one on top of the morphological zoning of the GIS analysis. At last, the traditional landscape region of the old town was finally determined and reproduced (Fig. 10.1).

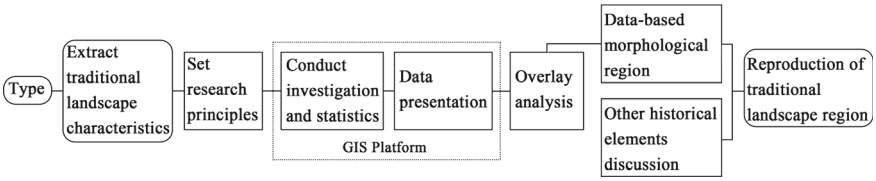


Fig. 10.1 Research methodology (*Source* Authors)

10.3 Investigation

10.3.1 Investigation Objects

About Changting old town. The ancient city of Changting was built in the 24th year of the Tang Dynasty (736), and the city wall expanded during its development, and gradually matured and settled in the Song Dynasty (960–1279). Most of the residents in the ancient city lived along the river and gradually spread to the west of the city at the foot of the mountain, while most of the houses in the ancient city are traditional residential functions in the form of courtyards, which were one-story buildings, mainly made of rammed earth and wooden structures. From Song to Ming and Qing dynasties (1279–1912), since commercial trade was frequent along the Ting River, the population grew dramatically and the urban area gradually expanded to a large area outside the city on the east bank of the Ting River. At this time, a number of courtyards with front retail stores and lower-store-upper-house building types appeared along some streets near the Ting River both inside and outside the city. So far, it was found that the ancient city is adjacent to Wolong Mountain in the north and the Ting River in the east, showing a pattern of Buddha hanging beads as a whole. In the period of the Republic of China (1913–1949), there appeared a form of the courtyard with a front arcade learning from Xiamen city on the east side of Ting River, where trade was also frequent. Then, due to economic constraints caused by national conditions and the reduction of family members during the planned economy (1950–1978), many complete plots of traditional courtyards began to accommodate multiple families. Therefore, some residents have begun to renovate traditional buildings with inexpensive materials by themselves such as concrete or tiled sheds and to open up the yards of privately owned traditional houses to create passageways that can be shared by multiple families. Since the reform and opening up policy (1979–), affected by the cultural diversity of the new era, the increasing living needs of residents, and the capital erosion of developers, more large-scale building types appeared on the combined parcels with more flexible functions, size, material and number of stories, such as apartments, schools, hospitals, and other public buildings, which have contributed to the promotion of modern civilized life for the residents (Huang 1967; Changting County Local Chronicle Compilation Committee 1993; Changting County Urban and Rural Planning and Construction Bureau 2008; Chinese Tingzhou Hakka Research Center 2010).

Investigation objects. To identify traditional landscape areas, we concerned with traditional courtyard houses and non-courtyard houses including other old traditional houses and renovated private houses that have been mutated from the original courtyard house plots. The area where these two types of houses are clustered should be classified as a traditional landscape area. Then a field visit to the area was conducted. The research scope of the old city is from Wolong Mountain in the north, outside the city wall site in the west, Baozhu Road in the south, and Ting River Island in the east, with a total area of 178.82 ha. Bounded by Ting River and Zhaozheng Road, the entire old town is divided into three large areas, and 58 numbered areas (Fig. 10.2a) were further divided according to the walkable streets, and 4819 building units within the area were investigated. Each building along streets was numbered and carefully inspected through map markings, photography, audio and video recording, and size recording to investigate its basic information. Then the information such as the floors, material of structure and facade, the form of wall, whether there is a door decoration or a yard, construction area, building ownership were recorded in a table for further reference.

First of all, for the traditional courtyard houses, 464 well-preserved traditional-style courtyards were identified, 153 in Area A, 210 in Area B and 101 in Area C. Among these courtyards, there are 14 courtyards with the wing-room. Most of these courtyards are distributed along the Ting River. Inside the city wall, they are distributed densely on the east part of Areas A and B, and scattered on the west part of Area B; outside the city wall, they are distributed densely on the whole of Area C (Fig. 10.2b, c). The width of each courtyard, the depth of 1 Jin, and the number of Jin were analyzed and counted (Fig. 10.2d, e). The traditional courtyards were

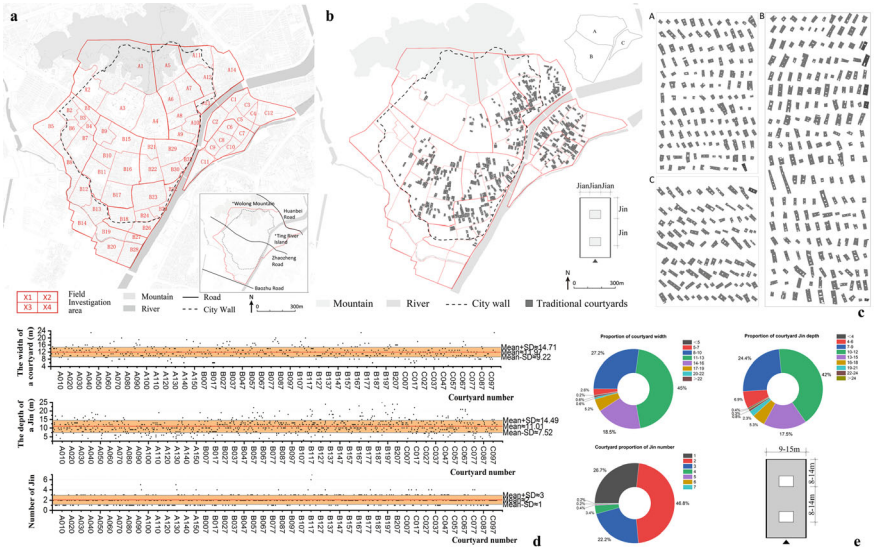


Fig. 10.2 Research and statistics of courtyard housing types (*Source* Authors)

found to be mainly 3 Jian, with a few wealthy families having 5 Jian. Nearly 80% of these courtyards are between 9.22 and 14.71 m wide, with an average width of 11.97 m, while those with a width of 15 m or more are primarily ancestral halls or houses of wealthy families. For the 1 Jin depth, nearly 80% values are concentrated between 7.52 and 14.49 m, with an average of 11.01 m. If the depth of the lower hall is smaller, the 1 Jin depth will be <7 m, and if the depth of the main hall is greater, the 1-Jin depth will be >15 m. The number of courtyard Jin in the street block ranges from 1 to 7, with the majority of courtyards having 1–3 Jin and an average of 2 Jin. The courtyards with 6 and 7 Jin are found in the largest B23.

As in Fig. 10.3, No. 17 house with 1 Jin (Fig. 10.3a) represents the basic extension unit. The Zhang's House (Fig. 10.3b) is a standard 3-Jian, 2-Jin courtyard. The Hui's House (Fig. 10.3c) is extended vertically into a 4-Jin courtyard with no front room and direct access into the front yard. It also has a half-Jin yard as the service space. Six-Jin and 7-Jin ancient courtyards appear in Area B23 (Fig. 10.3d, d–1). Li's family temple (Fig. 10.3e) is the total ancestral hall of the surrounding Li's family and the room size is much larger. It also has a front ancestral outside space. It often provides space for family members to attend rituals and accommodation for those doing business and studying (Chinese Tingzhou Hakka Research Center 2010). Qiu's House (Fig. 10.3f) has a front outdoor space, which is used for parking, livestock, activities, or a garden. The wing room and back room of the house also provide accommodation for students who come to the old town to study (Chai 2013). Lai's house (Fig. 10.3g) and Wang's house (Fig. 10.3h) are also characterized by the spatial arrangement of wealthy families. At the level of spatial perception, wall forms of traditional courtyards along streets are mainly cornice, and the cornice, gable, and yard wall are mixed in the whole research area. Building facades and structures are mainly made of brick, rammed earth and timber, and less stone. In addition, the entrances of courtyards are marked with distinctive door decorations with different materials to indicate the courtyard's hierarchy and to reflect the social status of the family. Distinctive door decorations are mostly located on the facades of traditional materials, cornice wall form facing the street, and are strongly associated with the traditional courtyard (Fig. 10.3i). In general, the basic expansion unit of courtyards in the town is the courtyard with 1 Jin, and there are two types of vertical and horizontal expansion (Fig. 10.3j). Besides, traditional types also include 1-Jin courtyards built by the government due to national policy, the courtyard forms of front-store-back-houses and courtyards with front arcades that arose due to commercial development (Fig. 10.3k).

Secondly, for the non-courtyard housing types, on the one hand, the traditional period produced housing forms that included lower-store-upper-houses, L-shaped houses, religious buildings and Western-style villas. Specifically, during the ancient period, the demand for more retail stores and the competing relationships led to more expensive land rents and a reduction in plot size, limiting the size of shop fronts, which were often half the size of traditional courtyard fronts. As a result, several independent stores were set up along the roadside. This also made some people live on the second floor of the store for the convenience of selling, forming a lower-store-upper-house building type (Fig. 10.4a1). Then, in the period of planned economy, restricted by

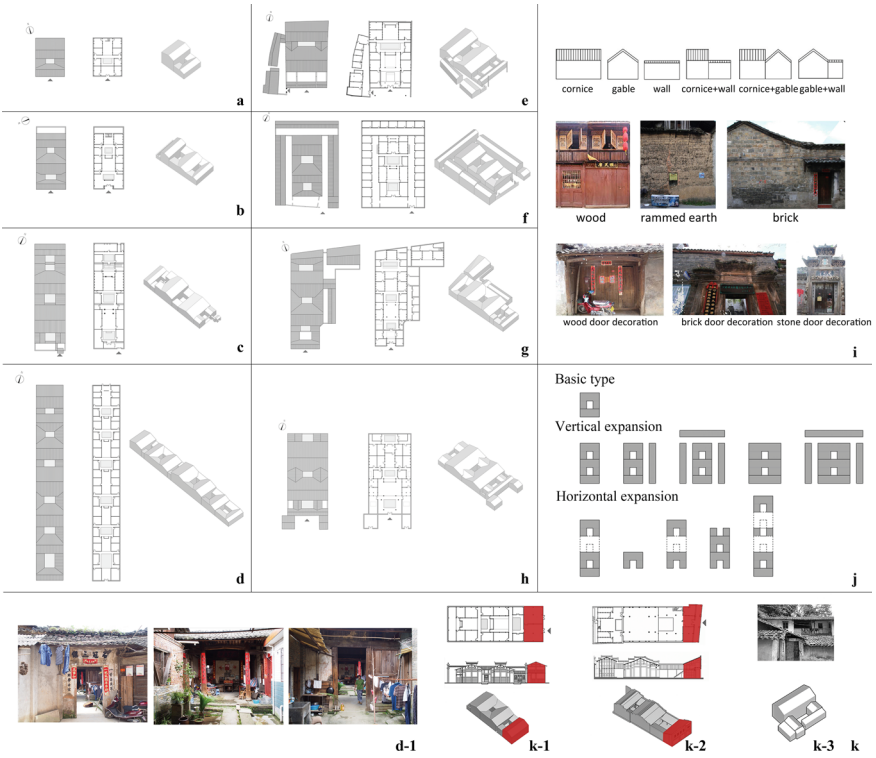


Fig. 10.3 Characteristics of typical courtyards housing types (*Source* Authors)

the plots, the government built a number of L-shaped courtyards made of bricks and mainly with two stories at the foot of the mountain and on the southern edge of the town, which has traditional and modern two construction ways (Fig. 10.4a2). In addition, during the Republican period, two types of buildings, churches, and villas, emerged under the influence of Western culture (Fig. 10.4a3, a4).

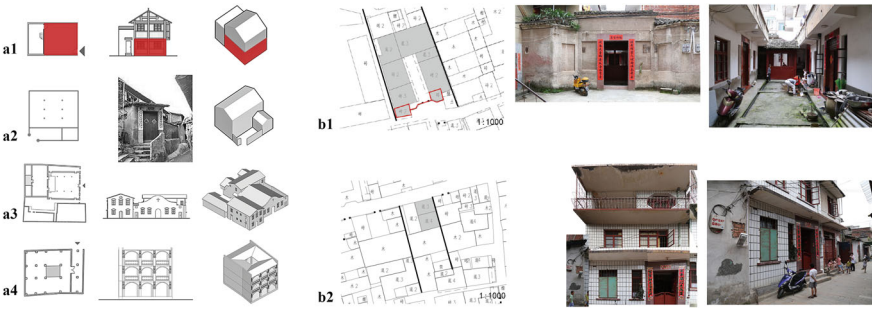


Fig. 10.4 Characteristics of non-courtyard housing types (*Source* Authors)

On the other hand, a study of destroyed traditional buildings and renovated private houses on the traditional courtyards plots revealed these self-built houses have a comparable footprint to traditional courtyards, except that they are refurbished with new materials and added additional stories on the plots of the original traditional buildings to form a more flexible layout. Among them, regarding the destroyed houses, the entrances and even the front part still retain their traditional forms and even retain their door decorations, except that the interior and the back part of the courtyard have been replaced by modern practices, and people have opened up the yards as a shared transportation use space for multiple families (Fig. 10.4b1). In addition to this, there are renovated private houses that have completely replaced the traditional courtyard and their construction ways are completely modern (Fig. 10.4b2).

Overall, the total number of traditional buildings surveyed, including the courtyards and traditional buildings in non-courtyards, was 3856. The total number of houses that were once traditional courtyards but are now replaced by renovated private houses on their original plots is 7639.

10.3.2 Investigation Data

Since some parts of the existing building tissue have been fragmented, we present the investigation results based on GIS platform in order to make the presentation of building tissue characteristics clearer and more scientific. Before the characteristics to be presented, we need to assign and transformed the investigation information. We have assigned values to two types of objects based on the database, one is the building attributes and the other is the building façade attributes along the street.

Assignment and meaning of building attributes. Using a single building as the assignment and presentation unit, this study assigns values to multiple aspects of building attributes and graphically presents the attribute values based on a GIS platform. The building attributes include the number of stories, building structure materials, courtyard type, etc. The specific contents, intervals, and meanings of the assigned values can be found in Table 10.1. Traditional building fabric has unique attributes that can distinguish modern building fabric in terms of the number of stories, building structure materials, and corresponding courtyard type.

Assignment and meaning of building façade attributes along the street. As shown in Table 10.2, based on the information collected from the pedestrian's perspective, we assign and present the attributes of the street facade as a unit to complement the individual building attributes. Building façade attributes along the street include the facade wall form, facade material, and door decorations along the street. Among them, the form of the wall along the street reflects the way the traditional building is connected to the street, the material of the façade reflects whether the building appearance retains its traditional style, while the door decoration reflects the distinctive characteristic of traditional houses in Changting.

Table 10.1 Assignment and meaning of building attributes (*Source* Authors)

Building attributes	Assignment content or interval	Assignment meaning
Building structures	Wood, brick, rammed earth, concrete	Express the main building structure type, of which wooden structure and rammed earth structure are the local traditional building structure type
Building stories	1–8	Assign values to the actual building stories and express the number of building floors
Courtyard types	Private, mixed, public	Express the nature of the courtyard in the building, according to the use of the courtyard to distinguish between private courtyard, public courtyard, and mixed-use courtyard

Table 10.2 Assignment and meaning of building facade attributes along the street (*Source* Authors)

Building façade attributes	Assignment content or interval		Assignment meaning
Wall form along streets	cornice, gable and yard wall, cornice+gable, cornice+yard wall, gable+yard wall	Assign values according to the wall form along the street	
Facade material	Traditional	Wood, brick, rammed earth	Assign values by building façade unit material to express the actual material. Traditional materials refer to red bricks, black bricks, rammed earth, wood veneer and other materials commonly used in traditional building techniques
	Modern	Face tile, paint, modern tile	
	Mixed	Wood+brick+paint, wood+paint, Wood+brick+face tile	
Is there a door decoration	Yes, No		
Distinctiveness of the door decoration	Excellent, above average, general	The door decoration is a typical characteristic of the traditional building entrance in Changting	

10.3.3 Characteristics Statistics

In this study, the B23 area will be selected as an example (Fig. 10.2a), and the investigated housing types will be presented in the GIS platform in terms of both building aggregation characteristics and spatial perception characteristics, and statistical and data overlay analysis will be conducted.

Presentation of basic characteristics. Through the investigation, we use the GIS platform to present the characteristics of building stories, building structure materials,

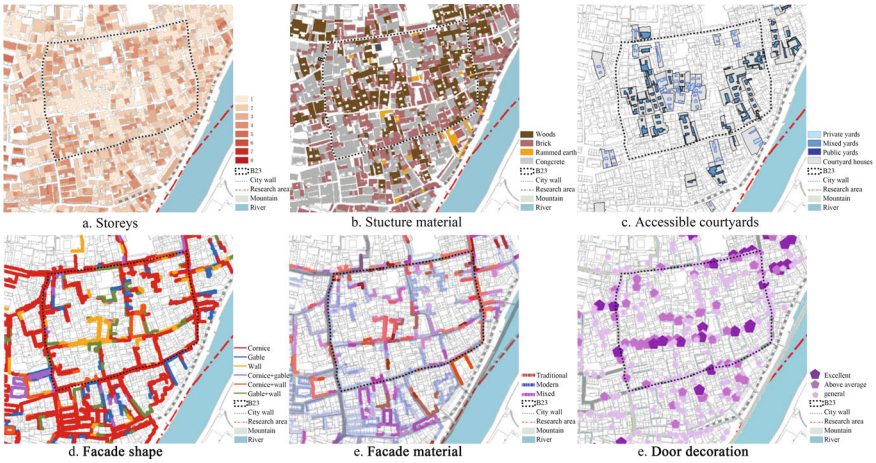


Fig. 10.5 Presentation of basic characteristics (*Source* Authors)

and accessible courtyards on the plane, and to present the characteristics of the facade wall shapes, the facade materials, and the door decoration along streets that we feel when walking in the streets on the spatial perception level (Fig. 10.5). According to the aforementioned set of building types to be included in the traditional style area, we should pay more attention to the area where the gathered buildings, with 1–2 stories, traditional structural materials including wood, brick and rammed earth, accessible courtyards, traditional façade wall forms, traditional façade materials, and buildings with traditional door decorations.

Presentation of overlaying characteristics. By overlaying some of the building attributes with the building façade attributes along the street, a richer analysis of the traditional style characteristics can be made (Fig. 10.6). The areas where the courtyards are clustered and the areas where the buildings with door decorations are clustered are both traditional areas. However, some buildings have been destroyed and renovated during the development process due to changes in the nature of use, and the back part of the building has even mutated in type, requiring other characteristic elements to support and help us identify a complete traditional building on the plot of a former courtyard house. Firstly, the area where the courtyard gathers must be a traditional area. In area B23, the door decorations distribution characteristics were overlaid on the courtyard distribution characteristics, and it was found that 86% of the door decorations fell in accessible courtyards, while some door decorations fell in front of non-courtyard buildings, but door decorations are one of the characteristics of traditional houses, so the non-courtyard buildings reconstructed on the original plots were once also traditional courtyards. Then, by overlaying the façade material characteristics on the accessible courtyard distribution characteristics, it was found that some traditional and mixed façade materials did not fall on the accessible courtyard, but the buildings corresponding to these façade materials

should also be included in the traditional style zone. Similarly, by overlaying the facade wall form characteristics with the courtyard distribution characteristics, the buildings corresponding to the façade wall form of the gable and cornice that did not fall on the accessible courtyards also need to be included in the traditional style area. Secondly, the area where the buildings with door decorations gather must also be the traditional area. Overlaying the building structure material characteristics on the door decoration characteristics, it shows that nearly 90% of the door decorations are located at the entrances of traditional structure material buildings, while some other door decorations are located at the entrances of modern structure material buildings, but these buildings that still retain their door decorations used to belong to traditional courtyard type buildings, while the area where the buildings with traditional structure material without excellent door decorations aggregate is also a traditional area, some parts of which are renovated with modern structure and material. Both kinds of buildings should be included in the traditional style area. Next, the façade material distribution characteristics are superimposed on the doorway distribution characteristics, and the largest metric area of the corresponding building of the two should be taken as the traditional style area. The type perception and the fabric analysis are reflected in Fig. 10.7h. And the next step is the scientific data analysis of the building fabric characteristics in the B23 area.

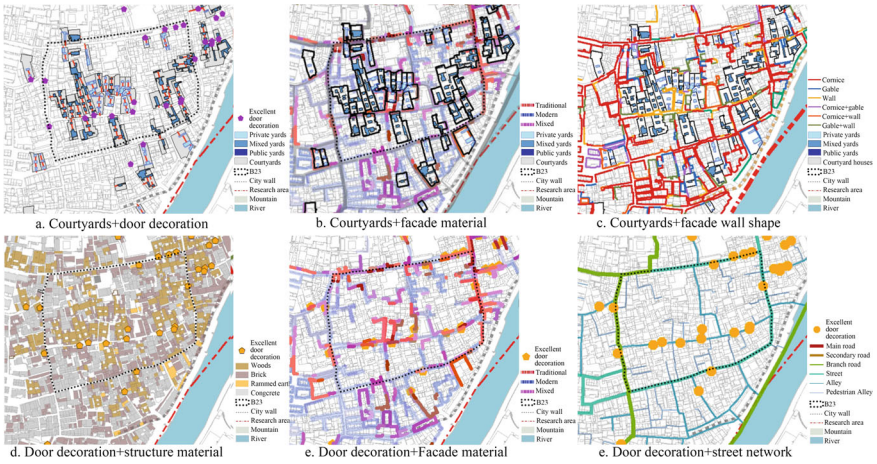


Fig. 10.6 Presentation of overlaying characteristics (*Source* Authors)

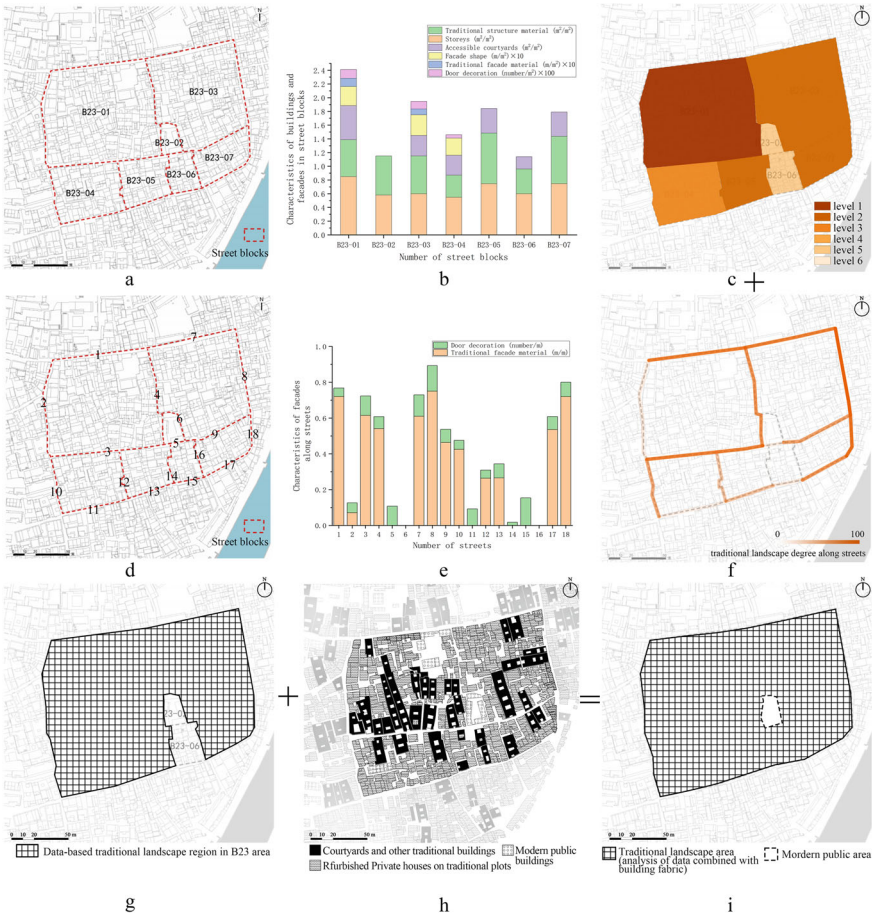


Fig. 10.7 An overlay analysis in area B23 (*Source* Authors)

10.4 Data Overlay Analysis of Morphological Characteristics

10.4.1 Data Overlay Analysis in Area B23

Some of the building attributes together with the superposition of the building façade attributes along the street constitute the cognition of information about the traditional landscape characteristics. What's more, to make the characteristic presentation more scientific, overlay statistical analysis of data is performed for different aspects of characteristics. Specifically, on the one hand, in the B23 area, further divisions were made based on streets to obtain subdivided street blocks from B23-01 to B23-07

(Fig. 10.7a), and different characteristics in each street block were counted to recognize traditional landscape style. These overlay analysis characteristics include the area of the 1 or 2-story building footprint on each block, the area of buildings with traditional structural materials, the footprint of accessible courtyard houses, plus the length of the façade wall shape, the length of the traditional façade materials, and the number of traditional door decoration in each block. Each of these six types of data is compared to the area of the street block and represented in a bar stack (Fig. 10.7b). Among them, it can be seen that more than 70% of the buildings in these seven blocks are kept at 1–2 stories in height, while more than half of the buildings in the B23-01, B23-03, B23-05, and B23-07 street blocks are made of traditional structure materials, and the number of accessible courtyards is also more than that of the other street blocks, reaching more than 30%; within the B23-01 and B23-03 blocks, there are also more branch roads with traditional landscape style. In this way, the street blocks with different degrees of traditional characteristics are shown in color block maps with different concentrations (Fig. 10.7c). We divided the index into six levels, index >2 for level 1, 1.6–2.0 for level 2, 1.2–1.6 for level 3, 0.8–1.2 for level 4, 0.4–0.8 for level 5, and 0–0.4 for level 6, and took the areas of 1, 2, and 3 levels as the traditional landscape style area based on data analysis. From the results obtained from overlay analysis, it can be seen that in the B23 area, the B23-01 street block has the strongest degree of traditional style characteristics, followed by street blocks B23-03, B23-05, and B23-07. The least traditional style characteristic is the B23-02 street block, which in actuality is a modern public service building, a kindergarten, and is also consistent with the analysis results. On the other hand, in terms of walking experience sense, each street around the subdivided street blocks in the B23 area was numbered, and this paper divided it into 18 roads (Fig. 10.7d), and the length of traditional façade materials on both sides of each road, and the number of traditional door decoration were counted. These two types of data were then compared to the length of each road and also accumulated on a histogram to see the degree of traditional landscape characteristics each road has (Fig. 10.7e). From this, it is found that the traditional facade materials including wood, brick, and rammed earth on both sides of roads 1, 8, and 18 are the most clustered, accounting for 72, 75, and 72%, respectively, while building surfaces along roads 5, 6, 11, 14, 15, and 16 have no traditional material facade at all and very few on road 2; and as for the number of door decorations on both sides of the road, the number of door decorations on roads 3, 5, 7, 8, and 15 has a density of more than 10%, compared to the number of door decorations on other roads. Then it is also reflected on the plan according to the relevant level of overlaying, which is represented by lines with corresponding different transparency (Fig. 10.7f). It can be seen that road 8 is the road with the highest degree of traditional landscape characteristics. Meanwhile, roads with a higher degree of traditional style characteristics than the average also include roads 1, 3, 4, 7, 9, 10, 17, and 18.

Then next, a more scientific traditional-style characteristics area can be obtained by combining the building aggregation characteristics and spatial perception characteristics (Fig. 10.7g). Such a current result has sorted out the modern and disorganized tissue of Changting Town into a more orderly traditional landscape area. On this basis,

it can be combined with the classical tissue analysis to be able to include the traditional building fabric that has been missed. Specifically, learning from the GIS presentation of investigation characteristics (Figs. 10.5 and 10.6), it is possible to summarize the distribution characteristics of the two main types of building fabric: traditional courtyard and traditional non-courtyard buildings, and private houses renovated along traditional house plots. As can be seen, it is still the B23-01 street block that has the most traditional courtyard buildings, but both parts of the area where traditional buildings and renovated private houses are gathered in a regular manner in the B23-01 and B23-03–B23-07 street blocks, should be included in the traditional landscape region. Based on this characteristic, the merged areas of these two types of building fabric and the remaining areas of modern building fabric were identified (Fig. 10.7h). After obtaining the results of the two kinds of traditional style areas of data overlay analysis and classical tissue analysis, and then combining them, a more accurate and scientific traditional landscape region is obtained (Fig. 10.7i).

10.4.2 Data Overlay Analysis in Whole Research Areas

Similar to the overlay analysis in area B23 above, the data overlay analysis of the whole research area (Fig. 10.8a) as well as the building fabric analysis can be conducted (Fig. 10.8c). As for data overlay analysis, the block areas with the first three index levels are densely clustered around the Ting Rive (Fig. 10.8b). In terms of the perception of the building fabric, several types of areas can be identified, including the traditional building type, the renovated private house type along the original house plot, and the modern building type. Most of the traditional fabric is also distributed along the Ting River. And finally, the combined morphology of the two types of traditional landscape areas is also presented (Fig. 10.8d).

10.4.3 Detail Discussion

The above analysis of traditional landscape regions can help us make an objective and scientific traditional landscape zoning according to the characteristics of data overlay analysis and building fabric analysis. However, from a practical perspective of urban renewal design, the recognition of traditional landscape areas should go beyond the scope of traditional areas delineated by type alone. This is because, with the development of society, many traditional houses have been destroyed, some refurbished with new and cheaper materials and more convenient modern construction methods on the original housing plots, and developers have even merged several plots to build public buildings or apartments for real estate development due to the invasion of capital. Thus, the analysis of the existing traditional fabric is not a complete help for the renewal and restoration of traditional landscape areas.

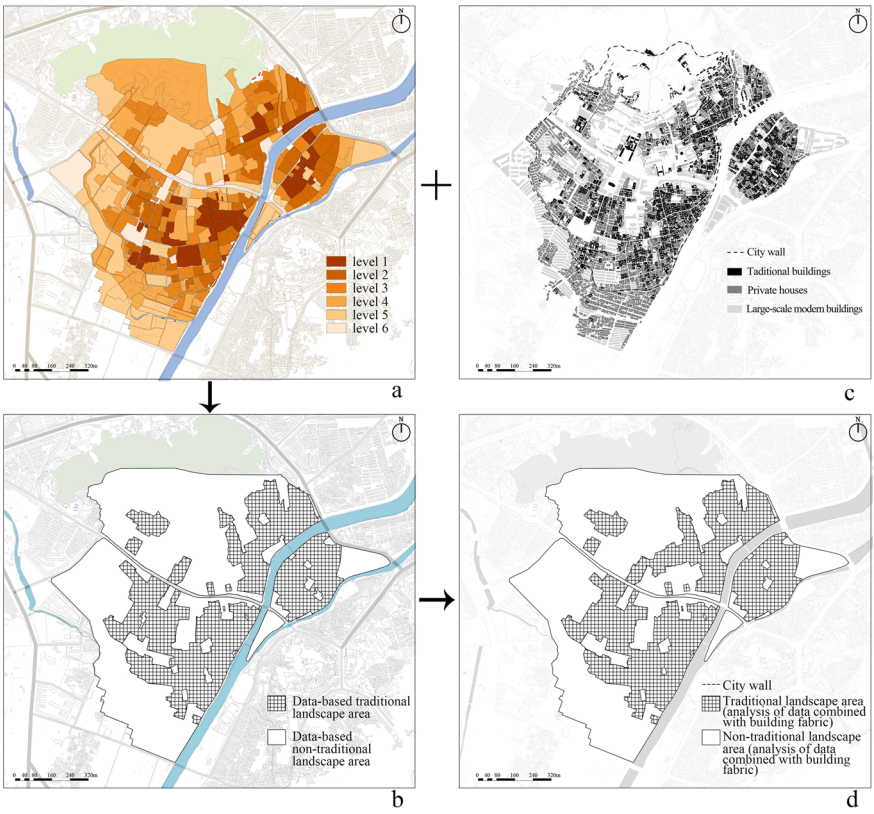


Fig. 10.8 Overlay analysis in whole research areas (*Source* Authors)

As shown in Fig. 10.8, besides the traditional and renovated private houses areas where the rules were first set in this paper to be included in traditional landscape areas, the GAP areas between them also need to be carefully explored to see if they are valuable and should be included in the traditional landscape region, which includes some public buildings destroying the integrity of traditional building fabric. Our purpose is to protect and renew all the historical elements that have played a role in urban development. Therefore, it is necessary to discuss in more detail the relevant historical traces, including historical axes, the four historical streets, historical environmental elements, and the retention of modern public buildings.

Historical axes. From historical maps, it was possible to extract information on the historically important public buildings (Huang 1967), some of which constitute the two historical axes in the area (Fig. 10.9a). Within the city, the Beiji Pavilion, the Dizang Temple, the Tingzhou Examination Institute, the Sanyuan Pavilion, and the Baozhu Building form a central historical axis parallel to the Ting River from north to south. The other axis, perpendicular to the Ting River, starts from Rushi Temple on the hill, passes through Cangjie Temple and ends at the Chaotian city gate. The

historic buildings on these two axes are of great traditional style importance, and the surrounding area should be included in the traditional landscape area, although there is also a lot of non-traditional building fabric around the axes.

Environmental elements. Besides the city walls as a reference factor in the designation of the traditional landscape region, the naturally formed river is a vital element of environmental resources. Although the original development of the old city was expanded along the central historical axis within the city wall, the river was also a factor in the development of thriving commercial trade, so local daily life gradually expanded eastwards, even spreading to the island of Ting River Island outside the city wall. Therefore, from the point of historical development, the renewal of the town is not limited to the city wall. Whether inside or outside the city wall, areas developing along the river, including Tingzhou Island, should also be included in the traditional style area. In addition, the part of the Ting River between areas A and C and the Taiping Bridge, the Jizhou Bridge (now the Shuidong Bridge) and the Tai'an Bridge (now the Tiaoshi Bridge) above it can also become protected elements, making the traditional landscape region more complete (Fig. 10.9b).

The integrity of traditional urban tissue. It is found that in the south area, the zoning method according to different morphological periods is to classify the hospital building fabric as the unit of the non-traditional period (Fig. 10.10a). This area is the core of the old town, which was once historically a complete traditional urban tissue. However, at a certain period in history, it was interrupted early and turned into a county government office, which developed into a contemporary hospital built on the site as a public facility for social service (Fig. 10.10b). Although the hospital belongs to the contemporary building fabric, if the hospital is zoned as a non-traditional style area, the large volume of the hospital will separate the small volume of the traditional

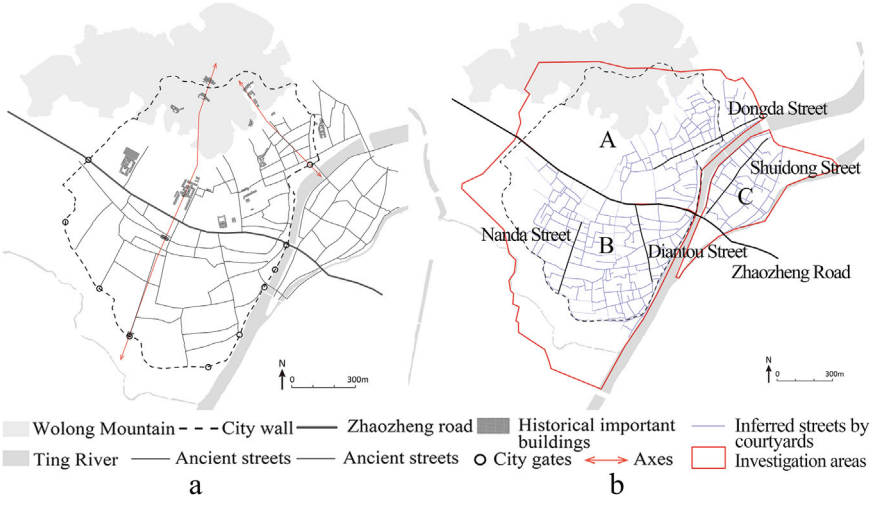


Fig. 10.9 Historical axes and four important traditional streets (*Source* Authors)

Fig. 10.10 Discussion of hospital fabric (*Source* Authors)

homogeneous fabric into two parts, destroying its integrity throughout the renewal process and interrupting the traditional streets. Therefore, from the perspective of urban design, for the integrity of the town renewal, it is recommended that this area be included in the traditional landscape area, the hospital be relocated, and then the area be woven with traditional tissue forms. In the words of Whitehand and Gu Kai et al., this area should be called the "Principle Traditional Unit" (Whitehand et al. 2011). Besides, the internal streets in the area are further inferring to connect the traditional street structure. There is still a need for the development of modern civilization in the town, so it is reasonable that building like schools in the area can remain.

10.4.4 Delimitation Result of the Traditional Landscape Region

So far, the edge of the traditional landscape region can be determined based on the GIS data analysis, the classical building fabric analysis, and the backtracking of historical information in detail (Fig. 10.11).

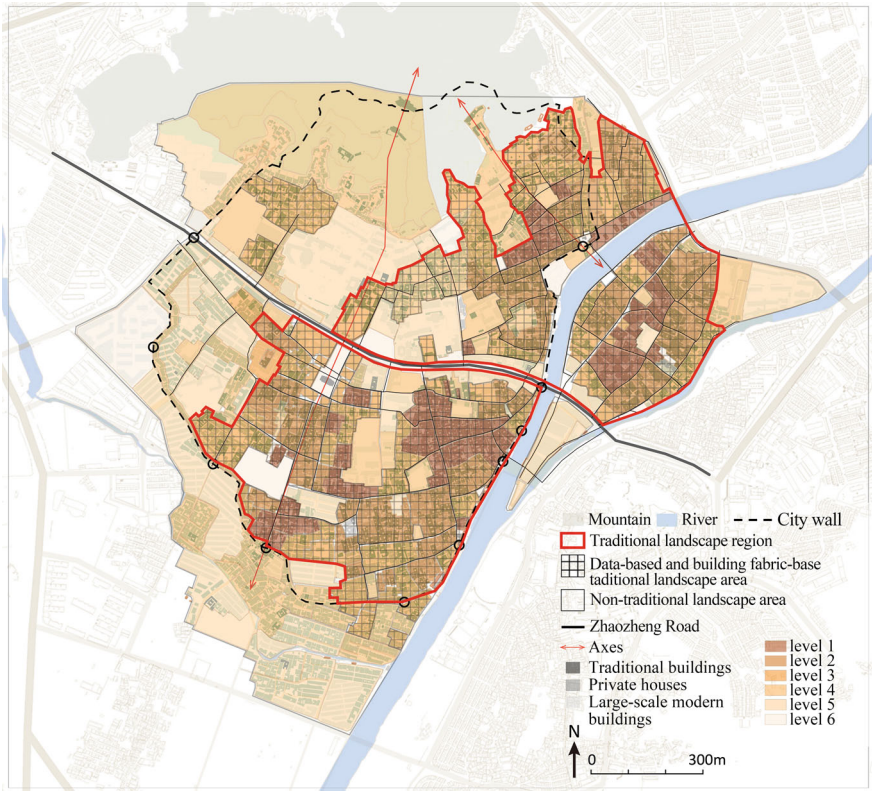


Fig. 10.11 Traditional landscape region (*Source* Authors)

10.5 Conclusion

Typo-morphology are meaningful in delineating traditional landscape region. Meanwhile, type plays a certain role in delineating traditional landscape regions. This is reflected in both the setting and investigation of the traditional types to be included in the traditional landscape region, and the cognition of the characteristics of the building fabric made up of these building types. For the setting and investigation of traditional building types, it includes courtyards and non-courtyards types influenced by the economy and culture produced during the traditional period, as well as private houses renovated with new materials and construction ways along the original plot boundaries. In the cognition of traditional style building tissue characteristics, it is further reflected in two aspects. One is the building aggregation characteristics, including building heights, structural materials and accessible courtyards, and the other is the spatial perception characteristics of building interfaces, including the facade materials, facade wall forms, and door decorations on both sides of the street.

The traditional landscape areas identified by combining data overlay analysis and classical building tissue analysis can integrate more valuable information on the basis of the original classical Caniggia type identification and Conzen morphological region drawing method, making the delineated areas richer and able to present the traditional landscape areas of Chinese old cities in a more scientific and rational way. As there are unique housing types in Chinese old towns, their aggregation into the town form also has unique characteristics of China. And its spontaneous growth and development into modern times have destroyed much of the texture. And its development to modern times, many parts of building fabric have been destroyed. At the same time, the relevant traditional documents are insufficient. If we follow the classical morphological zoning and building tissue analysis, on the one hand, we will be confused by the very fragmented fabric, and sometimes the delineated area has a certain subjectivity; on the other hand, there is no way to identify a traditional landscape area just based on the basic analysis of building fabric and morphological region to provide a better reference for urban renewal. Therefore, this paper firstly uses data statistics and presentation methods for regional regularization of building fabric in old towns to solve this problem scientifically, and then combines classical morphological region and building fabric analysis methods, so then a more accurate and scientific traditional landscape region can be delineated. We pay special attention to the basal area of one and two-story buildings, the basal area of traditional structural materials including wood, brick and rammed earth, and the basal area with accessible courtyards in the building aggregation characteristics, as well as the length of wall forms along the street, the length of traditional façade materials and the distribution density of door decorations between and within each street block.

However, from a perspective of urban renewal, the above analysis is not enough to determine the boundaries of the traditional landscape region, so it is necessary to take a design-oriented approach, combine the analysis of the historical axes, the four ancient streets, the environmental elements, and the integrity of the traditional urban tissue, in order to protect the traditional areas that are valuable for the future development. The final traditional landscape boundaries are determined by overlaying all of the previous information. In other words, the more information superimposed, the more accurate, scientific and reasonable the traditional landscape region will be, which in turn will lay a better foundation for urban renewal.

Acknowledgements This study was financially supported by the National Natural Science Foundation of China (Nos. 51538005 and 51708274). The authors would like to thank seven master's students, Donglin Jiang, Mengjun Yao, Xinlu Shao, Wenzhuo Lin, Ben Wang, Yuerong Liu, and Yanting Xu, for their assistance with the courtyard data.

References

Alsadaty A (2021) Applications of morphological regionalization in urban conservation: the case of Bulaq Abulela, Cairo. Urban Morphol 25(2):137–149

Barke M (2003) Urban landscape regions and conservation: new approaches and problems in Antequera, Malaga province, Spain. Urban Morphol 7(1):3–13
Barrett HJ (1996) Townscape change and local planning management in city centre conservation areas: the example of Birmingham and Bristol. University of Birmingham, Birmingham
Bienstman H (2007) Morphological concepts and urban landscape management: the cases of Alkmaar and Bromsgrove. University of Birmingham, Birmingham
BirkhamshawAJ, Whitehand JWR (2012) Conzenian urban morphology and the character areas of planners and residents, Urban Des Int 17(1):4–17
Caniggia G, Maffei GL (1979) Composizione architettonica e tipologia edilizia: 1. Lettura dell'edilizia di base. Marsilio, Venice
Cataldi G (1998) Designing in stages: theory and design in the typological concept of the Italian school of Saverio Muratori. In: Petruccioli A (ed) Typological process and design theory. AKPIA, Harvard University and MIT, Cambridge, MA
Cataldi G (2003) From Muratori to Caniggia: the origins and development of the Italian school of design typology. Urban Morphol 7(1):19–34
Chai W (2013) The tectonic research of Hakka house in Changting ancient city. Huaqiao University, Quanzhou (in Chinese)
Changting County Local Chronicle Compilation Committee (1993) Changtingxian Zhi [Changting county chronicle]. Sanlian Bookstore Press, Beijing, p 416 (in Chinese)
Changting County Urban and Rural Planning and Construction Bureau (2008) Guyun Tingzhou [Ancient charm of Tingzhou]. Xiamen University Press, Xiamen, pp 36–43 (in Chinese)
Chinese Tingzhou Hakka Research Center (2010) Zhongguo lishi wenhua mingcheng—Changting. Kejia shoufu [Chinese famous historical and cultural city—Changting. The capital of Hakka]. Xiamen University Press, Xiamen (in Chinese)
Conzen MRG (1960) Alnwick, Northumberland: a study in town-plan analysis Institute of British Geographers Publication 27. George Philip, London
Conzen MRG (1975) Geography and townscape conservation. In: Uhlig H, Lienau C (eds) Anglo-German symposium in applied geography, Giessen-Würzburg-München. Lenz, Giessen, pp 95–102
Ding W (2022) Layered morphologies and latent structure—theories and methods for historic rural-urban conservation. Archit J 2022(11):120–124 (in Chinese)
Gu K (2010) Urban morphological regions and urban landscape management: the case of central Auckland, New Zealand. Urban Des Int 15(3):148–164
Gu K, Zhang J (2014) Cartographical sources for urban morphological research in China. Urban Morphol 18(1):5–21
Gu K, Tian Y, Whitehand JWR, Whitehand SM (2008) Residential building types as an evolutionary process: the Guangzhou area, China. Urban Morphol 12(2):97–115
Hermida MA, Juca-Freire N, Carvallo-Ochoa JP (2020) Urban tissues and residential types in Cuenca (Ecuador). Urban Morphol 24(1):5–20
Huang C (1967) Tingzhoufu Zhi [Tingzhou Prefecture Chronicle]. Chengwen Press, Taipei, p 27 (in Chinese)
Kropf KS (1996) An alternative approach to zoning in France: typology, historical character and development control. Eur Plan Stud 4(6):717–737
Li Y, Gauthier P (2014) The evolution of residential buildings and urban tissues in Guangzhou China. Morphol Typol Perspect Urban Morphol 18(2):129–149
Liu D (2003) Zhongguo gudai jianzhu shi [History of ancient Chinese architecture]. China Architecture & Building Press, Beijing (in Chinese)
Moudon AV (1989) The role of typomorphological studies in environmental design research. In: 20th meeting of the environmental design research association, pp 41–48
Moudon AV (1992) A catholic approach to organizing what urban designers should know. J Plan Lit 6(4):331–349

Moudon AV (1994) Getting to know the built landscape: typomorphology. In: Franck KAS, Lynda H (eds) Ordering space: types in architecture and design. Van Nostrand Reinhold, New York, pp 289–311
Muratori S, Bollati R, Bollati S, Marinucci G (1963) Studi per una operante storia urbana di Roma. Consiglio Nazionale delle Ricerche, Roma
Pezzetti LA (2019) Layered morphologies and latent structures—reading decoding and rewriting to enhance historic rurban landscape. Tongi University Press
Quincy Q (2000) "Type" in Encyclopédie Méthodique, vol 3, trans. Younés, S. reprinted in The Historical Dictionary of Architecture of Quatremère de Quincy. Papadakis Publisher, London
Romice O, Chen F (2009) Preserving the cultural identity of Chinese cities in urban design through a typomorphological approach. Urban Des Int 14(1):172–197
Samuels I (1999) A typomorphological approach to design: the plan for St Gervais. Urban Des Int 4(3–4):129–141
Samuels I (2008) Typomorphology and urban design practice. Urban Morphol 12(1):58–62
Whitehand JWR (2009) The structure of urban landscapes: strengthening research and practice. Urban Morphol 13(1):5–27
Whitehand JWR, Gu K (2007a) Extending the compass of plan analysis: a Chinese exploration. Urban Morpholo 11(2):91–109
Whitehand JWR, Gu K (2007b) Urban conservationin China: historical development, current practice and morphological approach. Town Plan Rev 78:643–670
Whitehand JWR, Gu K, Whitehand SM, Zhang J (2011) Urban morphology and conservation in China. Cities 28(2):171–185

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Part II
Economic, Functional, Infrastructural Changes and Political, Legal, and Administrative Conditions for the Redevelopment and Renewal of the Urban Tissue

Chapter 11
The New Urban Agenda in Urban Redevelopment: The Central Role of Public Space Networks

Michael W. Mehaffy

Abstract Public spaces, and their intimate structural relationship to private spaces, have long been a central interest of urban morphologists. Recent developments in network science have shed new light on the complexity of public space networks, with specific implications for policy, education, and practice. These developments come at a historical moment when all 193 member states of the United Nations have recently adopted by acclamation the New Urban Agenda, a landmark framework agreement for global urbanization through 2036. As it happens, the New Urban Agenda has much to say about public space networks, their structure, and their importance—but implementation remains a historic challenge.

Keywords New urban agenda · Habitat III · Public space · Network science · Urban redevelopment

11.1 Introduction

In October 2016, delegates from the member states of the United Nations joined stakeholders from civil society, government, academia, business, and the professions to conduct the Habitat III conference in Quito, Ecuador. This third conference of the Habitat series would, like its predecessors, set an agreed global policy framework for urban development for the next 20 years. The conference produced an outcome document, known as the New Urban Agenda, which was agreed upon by a vote of the delegates to the conference. In December of that year, the New Urban Agenda was adopted by acclamation by all member states of the UN at the General Assembly (United Nations 2016). As such, the New Urban Agenda represents a landmark global agreement in urbanization policy through 2036.

M. W. Mehaffy (✉)
Sustasis Foundation, The Dalles, Oregon, United States
e-mail: michael.mehaffy@gmail.com

School of Geographical Sciences and Urban Planning, Arizona State University, Tempe, USA

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_11

The New Urban Agenda was developed at a time of unprecedented rapid urbanization around the globe—particularly in the Global South—as well as a time of growing challenges affecting cities: environmental threats (climate change, resource depletion, ecological destruction) as well as threats to the well-being of urban residents (inequality, poverty, fragmentation, geopolitical instability). Lurking behind these other problems were economic challenges: the need to create a more equitable and more sustainable prosperity, and the need to avoid disruptive economic events.

Accordingly, the New Urban Agenda sets goals for human development, opportunity, health, and well-being, for all urban residents (rich and poor, young and old, healthy and infirm, etc.). It recognizes the need for new and more sustainable models of urbanism and urbanization, including more sustainable urban forms. It also recognizes the need for new digital technology to support urban development. However, as the document makes clear, this is a technology that must be supporting, not replacing, the organic city of physical contacts—and importantly, of public spaces.

More broadly, as this paper will show, the New Urban Agenda calls for a radical reform in the ways we think about urban form, and in particular, what Jane Jacobs called "the kind of problem a city is." There is a strong critique of business-as-usual urban policy and practice and its sprawling, high resource-consumption forms of urban development. There are echoes in the work of Jacobs and other leading urban reformers of the late twentieth century, as we will explore.

11.2 Background

The New Urban Agenda, subtitled "Quito Declaration on Sustainable Cities and Human Settlements for All," contains 175 paragraphs running over 30 pages, and contains a preamble, a section titled "Our shared vision," another titled "Our principles and commitments," and another titled "Call for action." The next major section is titled "Quito implementation plan for the New Urban Agenda," with subheadings "Transformative commitments for sustainable urban development," "Effective implementation," and "Follow-up and review."

The document is notable for its normative emphasis on certain urban forms, including "well-connected," "polycentric," "urban spatial frameworks," "compactness and density mixed use," "public transportation walking and cycling," and "public space networks."

Indeed, public space is discussed extensively in the document, and is the subject of no fewer than nine separate paragraphs. Public space is emphasized not only as a mere amenity, but more fundamentally, also as a pervasive and necessary component of urban morphology. Its network structure, including the structure of street and sidewalk paths, is given particular emphasis:

> We will support the provision of well-designed networks of safe, accessible, green and quality streets and other public spaces that are accessible to all and free from crime and violence, including sexual harassment and gender-based violence, considering the human scale, and measures that allow for the best possible commercial use of street-level floors, fostering

> both formal and informal local markets and commerce, as well as not-for-profit community initiatives, bringing people into public spaces and promoting walkability and cycling with the goal of improving health and well-being. (United Nations 2016, para. 100)

11.3 The "New Paradigm" of Public Space Networks

Note the emphasis on "networks of… streets and other public spaces." There is also emphasis on "the human scale," "the best possible commercial use of street-level floors," and "promoting walkability and cycling." Thus, we see that the New Urban Agenda conceives of urban space as an interconnected, multimodal network, with an intimate relationship between the public and private realms.

This is a view of cities that is consistent with recent developments in network science. The so-called "science of cities" emphasizes the understanding of cities as complex adaptive systems that are not only partly planned but also partly evolved (Batty and Marshall 2012).

This view of cities also stands in stark contrast to earlier, dominant theories of city planning, as many authors have pointed out going back at least to Jacobs (1961), Alexander (1965), and Hillier et al. (1976). These authors point to a functionally segregated model, articulated in seminal documents such as the 1933 Athens Charter, developed by a highly influential group of architects known as the Congrès Internationaux d'Architecture Moderne, and later published (Le Corbusier 1943).

As shown by Mehaffy and Low (Fig. 11.1, 2018), the New Urban Agenda differs from the earlier Athens Charter in several fundamental ways: the zoning of urban elements, the treatment of streets, the treatment and placement of buildings, the treatment of historic structures and patterns, the role of specialists in relation to other co-producers, and the role of time and evolution in the city. In these six respects, at least, the two documents are almost diametrically opposed.

In fact, a number of key collaborators in the development of the New Urban Agenda have pointed specifically to the contrast between these two documents. Joan Clos, Secretary-General of Habitat III and a key shepherd of the New Urban Agenda, joined prominent sociologists Saskia Sassen and Richard Sennett, and Professor of Urban Studies Ricky Burdett, to author *The Quito Papers,* a series of essays on the New Urban Agenda. Regarding the continued influence of the Athens Charter, and the need for its repudiation, they could not be more clear:

> …Many of the 94 recommendations of the 1933 Charter of Athens still determine the generic forms and physical organization of the twenty-first century city. The patterns of urbanization today require a re-framing of the discourse and practice of planning. (Sassen et al. 2018).

The New Urban Agenda, in fact, represents a "new paradigm" according to Clos (2011). In place of the model of public space as a complex zone of mixing and interaction, public space is simply one more functionally segregated amenity or pathway, amid a rationally segregated scheme of all such urban objects. The entire scheme manifests what Jane Jacobs called "decontaminated sortings." Yes, the problems of

Topic	Athens Charter of 1933	New Urban Agenda of 2016
1. Zoning of Urban Elements	Segregated according to use and "Functionalism"	Mixed uses are encouraged while regulation focuses on form
2. Treatment of Streets	Streets are strictly segregated by vehicle speed, and pedestrians are prohibited	Streets are places of multi-modal transportation and public spaces, welcoming pedestrians
3. Treatment and Placement of Buildings	Buildings are removed from edges of streets into "superblocks"	Buildings align with and enclose streets and other public spaces
4. Treatment of Historic Structures and Patterns	Most historic structures are demolished, while a few representative monuments are retained; knowledge of traditional patterns is regarded as obsolete	Both tangible (buildings, monuments) and intangible (knowledge, patterns) heritage is conserved and re-used, often combined with new technolgies and approaches
5. Role of Specialists in Relation to Others	The city is a creation of specialists (economic, political, technical, design)	The city is a co-creation of many actors at many levels, including informal processes
6. Role of Time and Evolution in the City	The city is a static work of art and engineering, aimed at pre-defined human needs at a fixed point in time	The city is a complex adaptive system that must be continually engaged by design to transform toward more preferred states

Fig. 11.1 Comparison of the key urban concepts in the Athens charter of 1933, and the new urban agenda of 2016. Adapted From Mehaffy and Low (2018)

overcrowding, disease, and dangers from vehicles are resolved through this segregation; but the baby of urban vitality is thrown out with the bathwater. It is, in fact, the death of public space, as a vital zone of interaction and encounter—a point vividly illustrated by a 1948 drawing by Adolf Bayer (Fig. 11.2).

By contrast, in the New Urban Agenda, "Public space" can be seen as the foundation of a broader system of urban form and urban spatial networks, containing a complex mix of public, private, and in-between spaces—and creating, or conditioning, a broad range of human and natural impacts. Public space is, according to this view, the foundation of urban connectivity.

11.4 A New Recognition of the Benefits of Public Space Networks

The New Urban Agenda also explicitly identifies a number of benefits provided by public space, which do in fact have support in the research literature. Among them:

- "Social interaction and inclusion"
- "Human health and well-being"
- "Economic exchange"
- "Cultural expression"

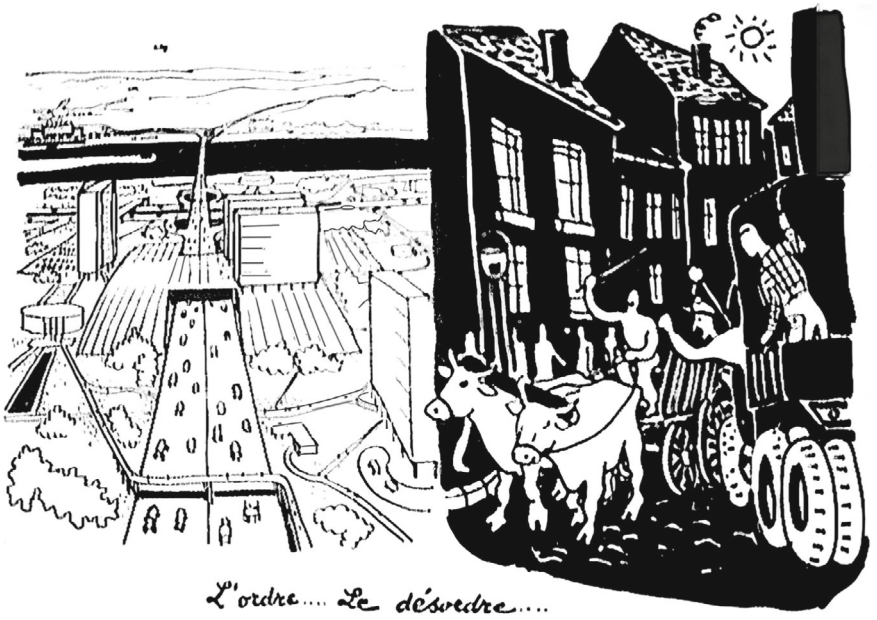


Fig. 11.2 "Order and disorder," by Adolf Bayer, 1948. The problems of the older cities are solved through functional segregation—but the result amounts to the death of public space, replaced by long, isolated pedestrian paths and loose swirls of anti-space (*Source* Public domain)

- "Improving the resilience of cities to disasters and climate change"
- "Physical and mental health"
- "Household and ambient air quality, to reducing noise"
- "Promoting attractive and liveable cities [and] human settlements"
- "Prioritizing the conservation of endemic species"

There is also linkage between the public space language in the New Urban Agenda, and a very similar provision in the UN's Sustainable Development Goals (United Nations 2015). The New Urban Agenda states, "We commit ourselves to promoting the creation and maintenance of well-connected and well-distributed networks of open, multipurpose, safe, inclusive, accessible, green and quality public spaces." The Sustainable Development Goals' Target 11.7 also states: "By 2030, provide universal access to safe, inclusive and accessible, green and public spaces." This mirroring of language was not an accident, but was an explicit aim of our colleagues at UN-Habitat to tie the language on public space together in the two documents.

As noted, the recent research literature does bear out the vital importance of healthy public space networks in the life of a city. We are now learning of the importance of so-called "weak ties" formed in public spaces and adjoining semi-public ones, versus "strong ties" formed at home or work, and in most social media relationships (Granovetter 1973; Henning and Lieberg 1996). The weak ties play a key role in producing new social contacts, new knowledge, and new opportunities.

By contrast, strong ties tend to reinforce only what or who is already known. Thus, weak ties, and the public space networks in which they predominantly occur, play a key role in fostering innovation, knowledge spillovers, and economic productivity.

Roche (2020) finds confirming evidence for this idea, She explores how "how the physical layout of cities affects innovation by influencing the organization of knowledge exchange," and finds that "variation in street network density may explain regional innovation differentials." This extends right down to Jane Jacobs' "lowly" sidewalk contacts, an essential part of the public space network of the city. As Jacobs put it, "Lowly, unpurposeful and random as they may appear, sidewalk contacts are the small change from which a city's wealth of public life may grow" (Jacobs 1961, p. 72). It now appears that other important forms of literal wealth also grow from the weak-tie contacts.

Other researchers have found important benefits from well-structured public space, including other economic benefits, improved health and well-being, ecological benefits, ecosystem services, heat island mitigation, and support for lower-carbon lifestyles (Low 2022; Litman 2022; Mehaffy 2015; Mehaffy and Low 2018; Kelbaugh 2019).

New findings from interdisciplinary researchers echo these benefits. Luis Bettencourt, a physicist turned urban research and external professor at the Santa Fe Institute as well as director of the Mansueto Institute for Urban Innovation says that "public space is central… It creates networks of interaction, jobs, and institutions" (quoted in Mehaffy 2021).

A particularly striking finding was by Klinenberg (2015) concerning the resilience of neighborhoods in the presence of stress events such as heat waves. Analyzing the Chicago heat wave of 1995, he found that one of the four "key conditions" that led to significantly greater levels of death was "the degradation and fortification of urban public space." It seems that well-structured public space networks are not only highly beneficial, but in some cases, they can be a matter of life and death.

11.5 The Terra Publica Database of Public Space Research

In 2013, UN-Habitat formed a partnership with the Project for Public Spaces and the Ax:son Johnson Foundation to operate a series of conferences with a focus on the particular role of public spaces (Centre for the Future of Places 2021). The "Future of Places" conferences contributed some of the specific language and conceptualization of public space in the New Urban Agenda (Mehaffy 2021). Following the Habitat III conference and the adoption of the New Urban Agenda, Ax:son Johnson Foundation established the Centre for the Future of Places at KTH Royal Institute of Technology in Stockholm and entered into another partnership with UN-Habitat to focus on implementation mechanisms for the New Urban Agenda, particularly in its emphasis on public space networks.

One of the projects of the new center was a compilation of research literature into a database of research. Known as *TerraPublica,* the curated database contains over 500

papers from a range of disciplines including sociology, anthropology, environmental psychology, economics, geography, urban planning, urban design, and other fields. From the actual archived copies of the papers, its team of researchers drew abstracts, methods, and key findings, distilling them down to a series of key conclusions for policy and practice. Importantly, they also identified gaps in the literature, or lacunae, that indicated where further research was needed, particularly in translating the partial knowledge into effective practical action and policy.

Well-published public space researchers were involved in the project, including Vikas Mehta and Setha Low, with a team of advisers including Ali Madanipour, Matthew Carmona, Emily Talen, Julian Agyeman, and others. Among the team's conclusions:

- There is a large but incomplete body of literature on public space, with many gaps.
- It is scattered across disciplines, and the picture is fragmented.
- Nonetheless, there are clear impacts from variations in public space structure as it relates to larger patterns of urban form and regional structure.
- There are particular impacts in the relation between public space and adjacencies of private spaces.
- These structures have impacts on urbanization pathways for resilience and adaptation, among other impacts.
- The field is dynamic, with exciting new developments.

These findings serve as the outlines of a new research agenda for urban public space, with a focus on the implementation tools and methods for the goals of the New Urban Agenda and the Sustainable Development Goals.

11.6 Lessons from the COVID-19 Pandemic

This comes at a time when there are important lessons emerging from recent events—none more salient than the COVID-19 pandemic. There were many early and tentative conclusions in the pandemic, none more erroneous than the idea that public space would no longer be important in the age of Zoom, home deliveries, the "retail apocalypse," and other transformations. On the contrary, it seems clear that most people deeply missed access to public spaces and their adjoining "third places," and as the pandemic waned, they returned to these places in throngs. Moreover, as the work of Klinenberg and other researchers has shown, public space will continue to play a truly vital role in human affairs.

Another early fallacy, later disproved, was that density was the enemy of human health and well-being, and that dense cores of cities might even become artifacts of the pre-pandemic past. On the contrary, it is not density, but the pattern of connectivity, that is the issue—as the figure below demonstrates. Each of the three urban and building forms below (Fig. 11.3) has the same density, 75 units to the hectare (40 units to the acre). But the potential for viral transmission is far higher in the tall building

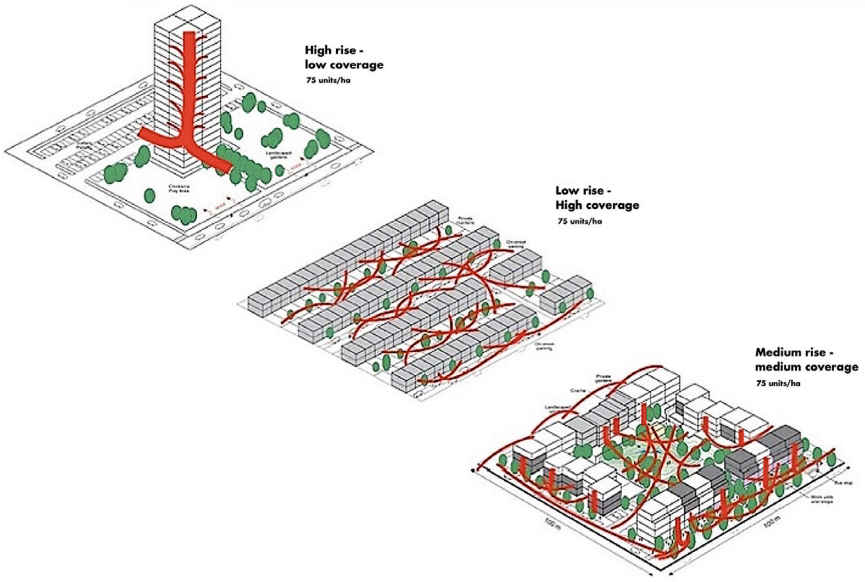


Fig. 11.3 Three urban and building forms, each with the same density, but very different patterns of connectivity and potential transmission of pathogens. *Source* the author, adapted from the UK Urban Villages Forum (1999)

(upper left), with its centralized lifts or elevators, lobbies, and entrances, than in the more dispersed rowhouse typology (middle). The perimeter-block typology at lower right has a somewhat higher potential for transmission, but still significantly lower than the tall building. Density is not the enemy.

Another important lesson is that public space can connect even as it protects—as it must always do. We might replace the idea of "social distancing" (staying away from others) with the idea of "*sociable* distancing"—remaining connected to others, even as we maintain safety (Fig. 11.4).

11.7 Place Networks: The Complex (and Self-Organizing) System of Public and Private Spaces

This point bears repeating: all public space must protect us as well as connect us. It must protect us from dangerous vehicles, natural hazards, crime, disruption, and other threats to our well-being. Moreover, it must provide affordances to us to vary these structures, so that we ourselves can "dial in" our level of contact and seclusion, exposure, and comfort.

We do this routinely in the rooms of our houses: we open or lock doors, close windows, draw blinds, invite others in or not, depending on our needs and desires

Fig. 11.4 The author demonstrates "sociable distancing" with his daughter and grandchildren, as they occupy a classic American front porch, and he can continue to interact with them safely from the street (*Source* The author)

for contact, and with whom and under what circumstances we choose. This is what our buildings are, after all: private spaces claimed out of the formerly public ground on which they sit, and defined (and controlled, in their degree of privacy) by walls, doors, windows, locks, blinds, and the like.

In the example of the porch above, we still occupy a room-like space, but the enclosure is a bit more ambiguous. Here, however, there are tacit rules for those who may occupy the space, and under what circumstances. A visitor may walk up to the door and knock. We may then receive them into the house, invite them onto the porch, or turn them away. If we do not answer, they are not free to sit down on our porch and enjoy themselves for an indefinite period of time!

The same is true to a lesser extent with other kinds of spaces, along the gradient from the most private (e.g., our bedrooms and bathrooms) to the most public (e.g., a public park). Even in the most public spaces, there are still methods of operating as quasi-private spaces, with some measure of control of our contact with others. For example, if I and my family spread out a picnic blanket in a park, and perch on it, someone might inadvertently step on a corner of it. They would then almost certainly apologize, and be on their way. But imagine if that person walked into the center of the blanket and sat down! This would be an obvious violation of our privacy, and an act of aggression. Indeed, it would almost never happen, unless there was some kind of altercation—or soon there would be, perhaps. Yet the picnic blanket is in a public park, the most public kind of space!

The same thing happens to other degrees in other kinds of spaces. Consider, for example, the sidewalk café. I walk past, and see you at a table. I stop to chat briefly, and a waiter might come up to take my order. If I decline, and then you leave, the waiter might come back and gently remind me that I need to order, or leave. Yet the waiter doesn't own the space—it is a public sidewalk. The waiter very likely does

not even own the restaurant! Instead, a series of legal and tacit agreements defines who can use the spaces and under what circumstances. This informal set of rules is echoed in the urban form, in the group of sidewalk tables (perhaps demarcated by a planter or parklet structure), or from the picnic blanket, or form other physical structures.

11.8 The Dizzying Place Networks All Around Us

From all these examples, it can be seen that public space is an immensely complex network of people, places, institutions, governance rules, tacit rules, and much else. It is, as sociologist Bruno Latour (1996) put it, an "actor network" that contains "actors" of all kinds: human, spatial, institutional, etc.

Consider the photo in Fig. 11.5, a fairly ordinary "high street" in London, near where the author happened to live for several years. It contains literal rooms (bedrooms, living rooms, etc.) as well as "urban rooms"—yards, stoops, sidewalk or pavement areas, rooftop terraces, etc. All of these room-like spaces provide various kinds of connections: movement, sight, sound; sight but not sound or movement (the glass window); sound but not sight or movement (the hedge); sight and sound but not movement (the upper terrace); and so on. And in many cases, the degree of connectivity is controlled by one or more of the people: they can open gates, draw blinds, reposition chairs, and so on. It is a dizzyingly complex web-network of places, only some of which are indicated below with the red circles and lines.

In effect, this entire network forms a kind of "urban connectome" that brings all of the private spaces together into an immensely complex network, united by their public space foundations. Furthermore, all of these spaces are undergoing a slow self-organizing transformation, at many scales of space and time. People open doors, close blinds, remodel homes, open new shops—and build new buildings. Only

Fig. 11.5 A montage of a fairly ordinary "high street: in London (*Source* The author)

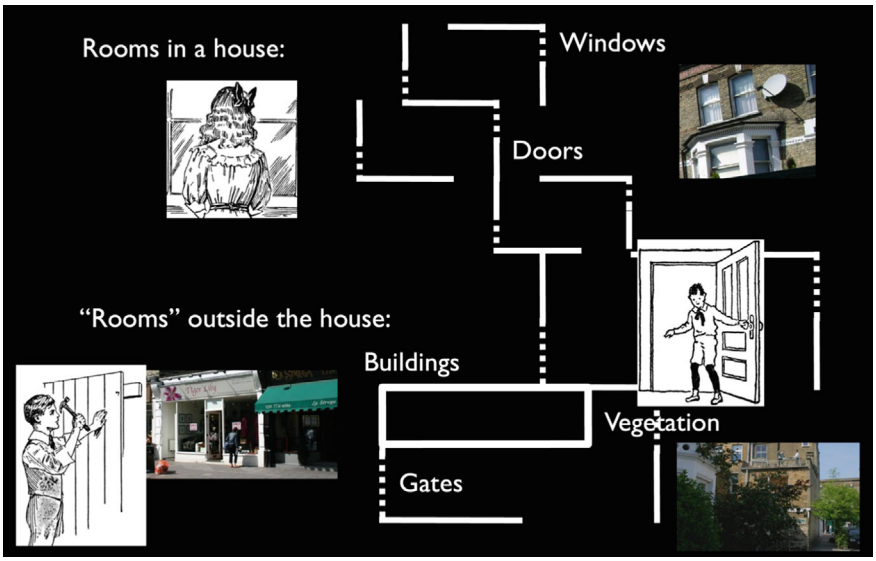


Fig. 11.6 The "place network" of a city, extending from the most private rooms of a house, to the urban "rooms" of the street and the city (*Source* The author)

some of this is performed by large collective institutions (e.g., city governments). Much of it is performed by individual citizens going about their business during the course of a day, a year, or a lifetime (Fig. 11.6).

It is this complex network, partly self-organizing, that allows the people of a city to interact, to consume and exchange resources, to create, and to generate high levels of creativity and wealth. In effect, cities are "socio-spatial reactors" that allow catalytic processes to operate at many scales of space and time—right down to the scale of sidewalks, frontages, and entry doors.

The transformation of this place network also extends from the time scale of days to years, decades, and centuries. I went back to the same street 7 years later (Fig. 11.7) and the transformation was remarkable. In addition to the obvious change of several businesses, and some cosmetic differences, there were other transformations in the place network and its edges. The two upper roof areas received fencing, the business entrance at lower right received two planters to demarcate its stoop area, and the sidewalk café to the lower left went away.

We can see very similar processes occurring in the formation of some of the world's great cities over many decades or centuries. Figure 11.8 shows a portion of Venice over about 100 years, in a famous study by Muratori (1959). The original cadastral plan was quite simple and grid-like, but the actual pattern that evolved was far more complex and even more complex in three dimensions. That complexity evolved as the result of countless actions by countless actors, following rules, seeking permissions, pursuing economic opportunities, making local agreements between

Fig. 11.7 The same segment of street in 2005 (left) and 2012 (right) (*Source* The author)

adjacent owners, and applying the models and patterns of the local culture (Hakim 2008; Ben-Hamouche 2009).

We can see similar dynamics operating in the formation of informal settlements too, and in the complex order that they often manifest. Their form arises from countless iterative cycles of rule-based action and adaptation, not unlike the iterative processes found in biological growth, and in the complex patterns of fractals and other natural structures.

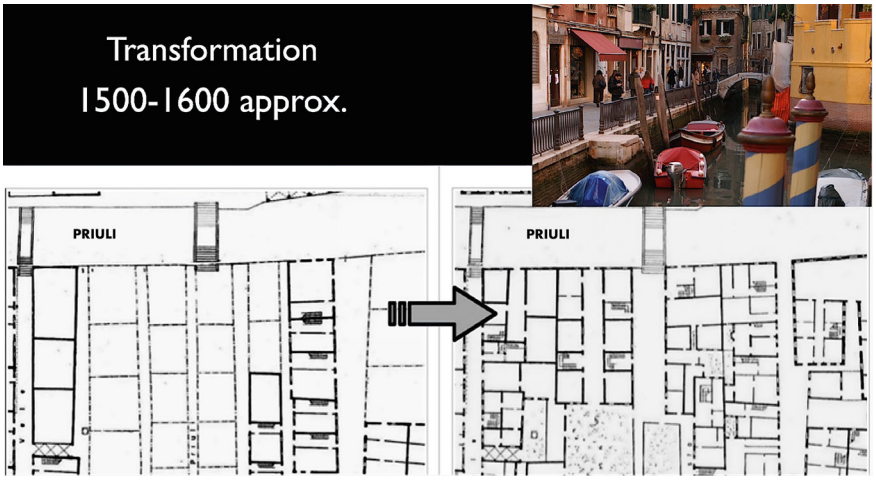


Fig. 11.8 The evolution of a portion of Venice, Italy, over about 100 years. (*Source* The author, adapted from Muratori, 1959)

11.9 The Role of Perception and Experience in Places

There is an important reason that place network theory uses the term "place" instead of "space" or another similar term. The emphasis is on *place,* the human phenomenon as it is experienced by human beings, with both structural and experiential components. Abundant research in a number of fields is demonstrating the essential relationship between structure and experience, particularly as they play out in the human brain, and in human perception.

Indeed, we observe an important dimension of human experience and human impact in the structure of these place networks. Research demonstrates that we humans have a highly evolved ability to detect the conditions that are likely to promote our own safety and well-being. The neuroscience of aesthetics demonstrates this (Zeki 2019) as do other fields, such as the emerging topic called "biophilia"—our innate preference for naturalistic environments and geometric patterns (Kellert and Wilson 1993). My own recent research has also delved further into the aesthetic aspects of place networks through the ancient, and newly relevant, topic of symmetry theory. It seems that we humans have a basic need to be able to read our environments, and to perceive their deep symmetries—not only mirror symmetries, but rotational, translational, scaling, and other kinds (Mehaffy 2020).

11.10 Changing the "Operating System for Growth"

All of these processes—all of the rules, laws, codes, standards, models, incentives, disincentives, and other formal and tacit rule-based processes—constitute a kind of "operating system for growth" that governs what can be built and what cannot, and what complex structures will ultimately evolve under the actions and judgments of human beings, operating at many scales of institution, time and place. This is an immense and breathtaking kind of process, and it is really the heart of cities and their dynamics. And it is also one we must understand if we are to meet our current urban challenges, and do so with the kind of truly "new paradigm" that is needed—informed by the new understanding of the evolution of complex adaptive systems that is emerging from many fields of the sciences today.

All of these processes also deal with the essential relationship between public space and private spaces—which, as Secretary-General Joan Clos put it, is "the essence of cities." As he told a reporter:

> In general, the urban community has become lost in strategic planning, masterplanning, zoning and landscaping … All these have their own purposes, of course—but they don't address the principal question, which is the relationship in a city between public space and buildable space. This is the art and science of building cities—and until we recover this basic knowledge, we will continue to make huge mistakes (Clos 2016).

11.11 A Note About Climate Change and Urban Form

One area where these findings are especially relevant today is the issue of climate change, as it relates to the contributions of urban form to greenhouse gas emissions—the subject of my own doctoral research. Once again, it seems that density is not the whole story. Density is indeed a major factor in the reduction of greenhouse gases per person—but it is far from the only factor. As the research demonstrates, other factors are also very important, including interconnected street patterns, walkability, mix of transport modes, mix of uses, and other factors (Mehaffy 2015). All of these factors are also closely related to the character of public space, and the characteristics of its place networks.

Once again, the qualitative and experiential aspects of place are essential. The aesthetic character of a city's place networks seems to play an outsize role in whether people will walk, linger, interact, and otherwise engage within the critical realm of public spaces. There is also evidence that the aesthetic character of public spaces plays a role in levels of stress, health and well-being. As we have also seen from Klinenberg's work, the activation of public spaces may also play a critical role in the resilience of a neighborhood or a city.

This implies an ethical imperative for architects: to use their art in service to this basic set of human needs, and not as a kind of arrogation of gigantic sculptures as "product packaging" over what too often seem to be toxic oil-age industrial products. That certainly applies to the climate "greenwashing' that happens far too often—or, just as problematic, the careless imposition of artistic extravagance in place of human and ecological imperatives. This places the design professions squarely into a relevancy crisis of their own making, with the responsibility—the imperative—to find their way out.

11.12 Conclusion: The Challenge of Implementation at a Critical Time

The New Urban Agenda comes at a time of unprecedented rapid urbanization, coupled with the alarming fact that public space is currently in decline around the world. Instead, we are seeing a surge of automobile-encapsulated lifestyles, with their many heavy externality costs, and clearly unsustainable impacts; gated communities, exacerbating inequality and lack of equitable opportunity for human growth and well-being; inward-turning pseudo-public spaces, cut off from the surrounding city; and sprawling, resource-intensive (and unsustainable) land use patterns, in which public space is all but non-existent.

How can we address this challenge?

I think we must recognize the agenda before us: the actions and outcomes identified in the Sustainable Development Goals and the New Urban Agenda, and the tools,

tactics and strategies that have been developed toward their implementation. It is time to redouble our efforts to reform our ways of doing things—our "operating system for growth." That includes all the laws, rules, standards, codes, financial incentives and disincentives, and especially, the mental models we use. We must finally replace the vestiges of a failed model, the "CIAM paradigm" of functional segregation, with a more polycentric, diverse, and self-organizing urban model, the paradigm outlined by the New Urban Agenda. And we can take great comfort, I think, in the availability of public space as a central platform for urban reorganization—offering us a place to get to work, a place to focus our efforts, and to apply the hopeful tools and strategies that have emerged in the last few decades.

To quote the last hopeful line of Jacobs' masterwork (1961, p. 448): "Lively, diverse, intense cities contain the seeds of their own regeneration, with energy enough to carry over for problems and needs outside themselves." We might say the same about their public spaces.

References

Alexander C (1965) A city is not a tree. In: Mehaffy M (ed) A city is not a tree: 50th anniversary edition. Sustasis Press (2015), Portland

Batty M, Marshall S (2012) The origins of complexity theory in cities and planning. In: Complexity theories of cities have come of age, pp 21–45. Springer, Berlin, Heidelberg

Ben-Hamouche M (2009) Complexity of urban fabric in traditional Muslim cities: importing old wisdom to present cities. Urban des Int 14(1):22–35

Centre for the Future of Places (2021) TerraPublica (website database). https://terrapublica.org/. Accessed 30 Oct 2022

Clos J (2011) Join us in quest for better cities, Clos tells students (website news article). UN-Habitat. https://mirror.unhabitat.org/content.asp?cid=10585&catid=657&typeid=6. Accessed 30 Oct 2022

Clos J (2016) We have lost the science of building cities. (Interview with M. Herd.) The Guardian, 18 April 2016. https://www.theguardian.com/cities/2016/apr/18/lost-science-building-cities-joan-clos-un-habitat. Accessed 30 Oct 2022

Corbusier L (1943) The Athens charter. Grossman Publishing, New York

Granovetter MS (1973) The strength of weak ties. Am J Sociol 78(6):1360–1380

Hakim BS (2008) Mediterranean urban and building codes: origins, content, impact, and lessons. Urban des Int 13(1):21–40

Henning C, Lieberg M (1996) Strong ties or weak ties? Neighbourhood networks in a new perspective. Scand Hous Plan Res 13(1):3–26

Hillier B, Leaman A, Stansall P, Bedford M (1976) Space syntax. Environ Plann B Plann des 3(2):147–185

Jacobs J (1961) The death and life of great American cities. Random House, New York

Kelbaugh D (2019) The urban fix: resilient cities in the war against climate change, heat islands and overpopulation. Routledge, London

Kellert SR, Wilson EO (eds) (1993) The Biophilia hypothesis. Island Press, Washington, D.C.

Klinenberg E (2015) Heat wave: a social autopsy of disaster in Chicago. University of Chicago Press, Chicago

Latour B (1996) On actor-network theory: a few clarifications. Sociale Welt 369–381

Litman (2022) Economic value of walkability. (Research Report.) Victoria B.C.: Victoria Transport Policy Institute

Low S (2022) Why public space matters. Oxford University Press, New York
Mehaffy MW (2020) The impacts of symmetry in architecture and urbanism: toward a new research agenda. Buildings 10(12):249. https://doi.org/10.3390/buildings10120249
Mehaffy MW (2021) Health and Happiness in the new urban agenda: the central role of public space. Sustain 13(11):5891
Mehaffy MW, Low SM (2018) The resurgence of public space: from the charter of Athens to the new urban agenda. J Public Space 3(3):1–24
Mehaffy MW (2015) Urban form and greenhouse gas emissions: findings, strategies, and design decision support technologies. A+ BE| Arch Built Environ (14):1–192
Muratori S (1959) Studi per una operante storia urbana di Venezia. Instituto Poligrafico dello Stato, Libreria dello Stato, Roma
Roche MP (2020) Taking innovation to the streets: microgeography, physical structure, and innovation. Rev Econ Stat 102(5):912–928
Sassen S, Sennett R, Burdett R, Clos J (2018) The Quito papers and the new urban agenda. Routledge, London. https://doi.org/10.4324/9781351216067
United Nations (2015) Transforming our world: the 2030 agenda for sustainable development. United Nations, New York. https://sdgs.un.org/2030agenda. Accessed 30 Oct 2022
United Nations (2016) Resolution adopted by the general assembly on 23 December 2016, 71/256: New Urban Agenda. https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_71_256.pdf. Accessed 30 Oct 2022
Zeki S (2019) Beauty in architecture: not a luxury—only a necessity. Archit des 89(5):14–19. https://doi.org/10.1002/ad.2473

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 12
From Feudalism to Socialism: Socialization Process and Changes in Political Meaning of the Built Environment in Traditional City Central Areas

Xueqi Chen and Feng Song

Abstract Institutional plot refers to the built environment with relatively strong political and power attributes in Conzenian School. Under the background of urban development and political change, the spatial organization and social relations of institutional plot changes with the use and accessibility, which has specific performance in core element, crowd flow, element organization and structure, reflect a lot of the political control of the city. It can be expressed in the following three forms: (1) Breakthrough of function, (2) Breakthrough of town plan and (3) Breakthrough of the accessibility. In this paper, two case studies corresponding to the above breakthrough processes were carried out in Beijing, which were located in the central location of traditional cities, the most representative expression of political space in China, experienced the historical change with political meanings from feudal to modern society. We believe that the findings can reflect the relationship between morphological transformation and urban political and social reform. In the process of socialist China's transformation, the institutional plot and monumental space under the original feudal system have been transformed accordingly, which are long with the reshaping of society and citizens. A mechanism of influence should be established between the renewal of the institutional plot and the political, social and cultural conditions.

Keywords Institutional plot · Socialization process · Political meaning

X. Chen · F. Song (✉)
Peking University, Beijing 100871, P. R. China
e-mail: songfeng@urban.pku.edu.cn

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_12

12.1 Introduction

Among all the urban components, relatively political spaces in the urban built environment, often reflect the most political control of urban planning and construction, reflecting symbols of national and local power over a period of time. The changing spatial pattern of such plots is thus often a materialized reflection of the spatial order and political meaning, testifying to the adaptability of space in different historical periods. In the context of the Conzenian School, institutional plots refer to the major categories of land use, including educational, medical, military, central and local government, research, recreational and religious. As J.W.R Whitehand said, institutions are an often ignored but extensive category of urban land use, but they are vital to the functioning of city (Whitehand 1972). Among them, spaces with relatively strong political and power attributes, dominated by institutional plots, tend to be more pervasive in the socialization process.

From a geographical point of view, it is the process of cultural infiltration, institutional change and personification that transforms the sacred place or place of power in ancient times into a monumental space with political meaning (Rubén et al. 2016), thus becoming a witness to the social history. From a sociological point of view, institutional plots can be seen as a special type of monumental space, also known as ritualized space. It was first described by the French sociologist Lefebvre as a spatial expression of people's collective identity or shared national beliefs (Lefebvre 1972). In cities, especially in traditional city centres, this kind of institutional plots is often an important part of the urban structure, in the form of monumental sites, large decision-making bodies, monumental axes or streets, network patterns, etc. In particular, as the axis of the spatial organization planning, it is used to express the centralized attribute of politics and power in the city. Since such spaces tend to have strong stability and permanence, they have a special significance in shaping urban culture, constructing collective memory and guiding urban development, which can provide a dynamic perspective for understanding the political meaning of the built environment and analysing the adaptation of old cities in different stages of social development.

12.1.1 As a Category of Primary Elements

From the perspective of urban morphology, all the institutional plots with political meaning can be studied as a category of primary elements, as proposed by Aldo Rossi.

Contrary to the Conzenian School, which was more concerned with settlements composed of the building block-plan, plot and street (Conzen 1960), the Italian School of typology focused more on the architecture itself, on the relationship between architecture and the city.

In Rossi's context, primary elements are urban elements of a dominant nature, and a specific type of architecture, that '*have functioned as nuclei of aggregation*'. In particular, Rossi proposed that '*monuments are always primary elements*' (Rossi 1982), which means that monumental space is an important category of primary elements. In contrast, another representative of the Italian School of typology, Caniggia, proposed the concept of 'basic buildings' with the focus on settlements. In Caniggia's definition, dwellings form the basic type of any urban fabric, which are called basic buildings (Cannigia and Maffei 2001). Churches, city halls and other special buildings are derivatives of basic buildings, with a similar process of development and evolution. It can be seen that they are opposite in the understanding of the city and architecture.

From the perspective of urbanization process, although basic buildings occupy most of the space in the city, residents' lives, social organization and public order cannot be separated from the support of primary elements. They play a key role in the development and structure of the city, and are likened to the 'catalyst' of morphological acceleration. In terms of temporal characteristics, due to their high functional value and political status in the urban components, institutional plots are characterized by the permanence of the plan and building, and '*participate in the evolution of the city over time*' (Rossi 1982). It can therefore be said that monuments with political meaning, primary elements and urban texture complement to each other and that the dynamic balance between the three is an important driving force in the development of the urban landscape.

In this context, the so-called institutional plot is no longer a concept of a single building or a collection of buildings, but is given a new 'soul of the city' based on its original material spatial characteristics, uniting the three elements of time, space and memory (Norberg-Schulz 1980), thus reflecting the historical, political and social processes of different periods. Thus, both the concept of typology in the Muratori School and the concept of morphology in the Conzenian School are no longer neutral structural frameworks, but rather tools of perception and analysis that operate in different periods.

In the Chinese context, although the concept of 'primary elements' is less frequently used in studies of urban morphology, there are many cases and conceptual studies of institutional buildings and monumental spaces (Hou 1987; Yue 2006; Zhang 2010). In the particular context of feudal and socialist China, these spaces, not only play an important role in shaping and guiding urban morphology but also reflect national consciousness and Chinese culture, especially in Chinese old cities, which fully demonstrate that the changes in political focus can be reflected in spatial adaptation, in turn, are reflected in the socialization process of institutional plots.

12.1.2 Institutional Plots Between West and East

Looking at the ancient and modern world, this kind of institutional plot is an important symbol to highlight the urban power structure and construct political intention, which

has a distinct spatial structure and hierarchical system. The most typical of these is the monumental space with political meanings, as it is often a direct reflection of the ruling ideology of the emperor of the time.

In Western countries, the concern for monumental spaces is represented by religious and public facilities in institutional plots, where divine space and divine right were placed first. This can be seen as early as in the humanist view of the Ancient Roman, as expressed in *The Ten Books on Architecture* by Vitruvius. In this book, temples, theatres, squares, stadiums and other places for civic gatherings were first mentioned as the framework elements in urban space, which were always used to discuss matters of national importance (Vitruvius 1999). In particular, the divine space represented by temples occupies a large space for discussion. The proportions of the plot, the scale of the building, the arrangement of the decoration and other requirements concerning the construction and hierarchy of the institutional plot were also documented. In this context, the practice of urban construction and institutional plot by architects and planners through the generations, has paid attention to the relationship with other areas, the social background and the urban historical process, and from this comes the recognition of the characteristics of historical continuity.

In China, the palaces, squares and the important central location of traditional Chinese cities became the representatives of monumental space with political meanings. However, unlike in the West, in ancient times, such spaces were mainly used by the royal family and were centralized to the imperial city, had a greater degree of exclusivity and the idea of the feudal imperial power, which was the embodiment of the king's power placed first. The choice of a central location and the concentration of imperial power were the principles of location and power for institutional plots in this period. It was only with the transformation of socialist China that it was gradually made accessible to citizens, made public, and became as a place for gathering or visiting. It is therefore necessary to explore the socialization process of the institutional plot in China, in the context of the contrast between Eastern and Western cultures, especially in traditional city central areas.

In this study, we will analyse the socialization process of institutional plots in terms of morphological transformation and urban social reform, through the case study of Tiananmen Square and Shouhuang Palace on the important central location of Beijing, which is a typical means of expression and organization of political space in China, and is also an important testimony to the history of China's imperial society and the development of China during the period of socialist democracy. We will explore what distinguishes the morphological evolution of traditional urban neighbourhoods from Western countries, in the cultural and institutional context of China, as well as the particularities of old city transformation and urban renewal under the socialist system.

12.2 Socialization Process of Institutional Plot

Although institutional plot has a certain degree of permanence compared to other spaces due to the stability of its own function, it has also evolved into a new model due to the development of the society and the growing demand for space. According to scholars' studies on the primary elements of Chinese cities in Qing Dynasty, such spaces were often acquired long-term institutional support, and thus maintained a strong permanence. However, in societies undergoing revolutionary change, primary elements tend to be the most vulnerable to reform (Dai 2017).

In the context of urban development and social change, the spatial organization logic of institutional plot changes with the change in usage and accessibility. In addition to the functional changes of the buildings themselves, the activities, events and characteristics of people, have also changed greatly in the socialization process and changes in the political meaning of the built environment. In terms of specific performance, it can be divided into core element, crowd flow, element organization, structure and so on, which are closely related to the change of use.

In terms of social functions, throughout the world, monumental spaces with political meaning in the early ancient cities were all based on religious worship and ritual respect, characterized by the unity of God and power, and thus generally had a strong sacredness (Liu and Xu 2017). Over time, under the influence of human civilization and social institutions, such spaces have become more secular, with their functions and objects reflecting the characteristics of compounding and diversification. Essentially, it is the transformation of theocratic and monarchical spaces into urban public spaces. The German scholar Gerhard Curdes summarized such a process of landscape reconstruction as an 'Adaptation Process'. It is to change the function and use mode of urban landscape without changing the morphological framework, and then to change the structural relationship of spatial elements, so as to present new functions to meet the new development needs (Curdes 1993).

Throughout China and the West, the socialization process of the institutional plot is similar in terms of function and commemorative behaviour, but very different in terms of social institutions. In Western countries, the socialization of traditional spaces from feudalism to capitalism has tended to focus on the existence of a mass gathering place, often as a continuation or deepening of previous social functions, with a more singular and explicit agent. For example, the Roman Temple of Augustus in Pula, Croatia, has been transformed since the Middle Ages into a church, a granary, and a museum. In addition, many large theatres with great acoustics are still in use today. In the case of socialist countries, the particular path from feudalism to socialism determines its own particularities. The socialization process of the change in political meaning tends to be more complete and changes much faster than in traditional Western countries, where different issues of interest can lead to the renewal of spatial patterns, architectural texture and land use functions to take place in a short period of time.

As Ivor Samuels' research on post-socialist cities in Belgrade and Krakow has shown, the interest-driven process of local government, new housing supplied by

the local authorities, was the main characteristic of socialist urban space (Kantarek et al. 2021). In post-socialist or so-called capitalist cities, due to the stability of the morphological framework of the city, the influence of the built-up spatial pattern of the previous period tends not to disappear completely, but retains a certain socialist character. In contrast, the process of socialization of traditional Chinese cities has also been influenced by the Western concept of modernity, represented by capitalism. The traditional urban space, which was originally created, developed and gradually refined within the Chinese vernacular, is also responding to and transforming itself to meet the urban construction needs of Western society, reflected in an increasing tendency towards liberalization and marketization. Institutional plots are also undergoing the same socialization process, which is reflected in the physical spatial elements such as housing units and urban morphology, as well as in the logic of spatial management and governance, and is the materialized expression of the political thought of the period.

Particularly in China, the evolution of institutional plot and its political meaning is influenced not only by the factors mentioned above but also by the involvement of the government and other mandatory stakeholders, who dominate the evolution of town plans. In recent years, large-scale urban renewal has been carried out in various historic cities in China, which has brought about a dramatic change in the institutional plot in the traditional city central area. The original self-built houses, settlements and commercial activities in the institutional plot have been completely relocated, and the archaeological excavation and cultural preservation work has been carried out and opened to the public after in situ display restoration. In terms of spatial organization logic and social relations, we proposed that it can be systematically summarized in the following three forms: (1) Breakthrough of function, (2) Breakthrough of town plan and (3) Breakthrough of the accessibility. All of them can be seen in the following case study, to explain the socialization process of institutional plot in Beijing, China.

For Beijing, as the capital after the founding of New China, one of the fundamental tasks in the development of its urban landscape is to preserve the special appearance of the old city and its ancient buildings, while discarding the ideas and main spaces associated with feudalism, which have long been outdated, and giving them a new spirit and function of the times. This feature is particularly prominent in the reconstruction of the central axis and the old city of Beijing, which reflects the process of reconfiguring the political spatial order in Beijing.

12.3 Methodology

The study adopts the Conzenian approach, or morphogenetic approach, to analyse the urban morphology of the typical traditional city central areas in Beijing during the transition from feudalism to socialism. The study also adopts a socialization process perspective, combining geography and sociology. By relating the town plan and the function of the institutional plot to the events and collective memories that

took place, the spatial practices of different periods are explained. Its main approach is twofold.

The first is the restoration of morphogenetic process, i.e. based on an evolutionary perspective, looking back at the history of the existing form, exploring and interpreting the underlying evolutionary process. Based on the method of morphological period, the study aims to identify the unique landscape remains of different periods, combined with the interpretation of the underlying mechanisms to restore the morphological process of the landscape.

The second is the interpretation of intrinsic mechanisms, i.e. the economic, social and institutional contexts of each period are taken into account, to identify the key factors of townscape change from feudalism to socialism. The study relates urban physical space and social relations from the perspective of development and evolution, and to highlight the characteristics in the context of socialism with Chinese characteristics.

In terms of the specific analytical framework, the study integrates the Conzenian morphological and Rossi's typological theories, emphasizes on the particular geographical location of the central areas in the traditional city, emphasizes the association with locus and event, and incorporates the analysis of institutional plot into our proposed framework of three forms of breakthrough.

In terms of the case, the study chose two of the most representative traditional city central areas in Beijing, China. Both of them are typical institutional plots in function, and are important for centralized rule and social governance during the feudal period and the current socialist period. Tiananmen Square and Shouhuang Palace were built on the central axis of Beijing, on the south and north sides of the Forbidden City. In feudal times, both were forbidden royal places. Today, after more than a hundred years of development, Tiananmen Square is a place of popular assembly, while Shouhuang Palace has become a place of cultural exhibition. The two cases are different in terms of crowd, function and spatial organization, but both have undergone the same socialization process at the same time, as reflected in the three 'breakthrough' processes we have proposed. As a world-famous institutional plot, the evolution of Tiananmen Square is closely related to the Chinese social context. Therefore, the study of it is an opportunity to understand its socialization process, as well as to deepen the understanding of Chinese history and culture, preparing for the following case study of Shouhuang Palace.

12.4 Case Study: Tiananmen Square

Tiananmen Square, the largest city square in the world, covers an area of 440,000 m^2 and is the most prominent and representative institutional plot in Beijing and China, which is located in the centre of Beijing, to the south of the Forbidden City (see Fig. 12.1). As the site of numerous major revolutionary, historical and political events, Tiananmen Square is an important symbol of China's decline to its rise, uniting the revolutionary memory of the entire Chinese nation. In historical times,

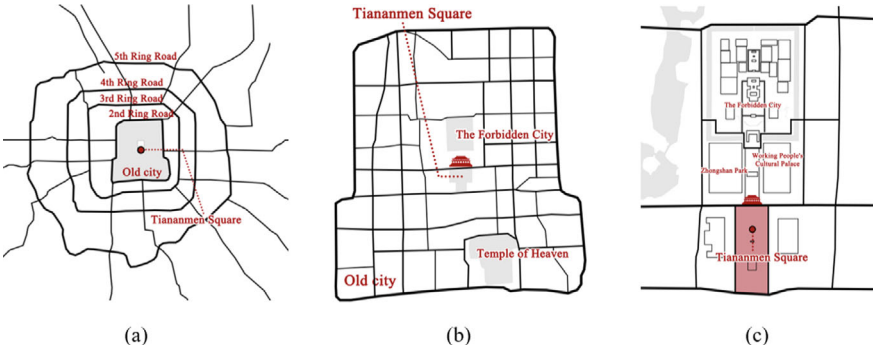


Fig. 12.1 Location of Tiananmen Square in Beijing (*Note* Author's self-drawn)

it was once a palace square belonging to the rulers of the feudal dynasty, used to highlight the status of the rulers. But nowadays, with the establishment of socialist China, Tiananmen Square has been transformed into a people's square for mass gatherings. Both the spatial structure, functional attributes and opening pattern of the square have undergone significant changes during this historical process, epitomizing the socialization process of the past into the present during the reconstruction of Beijing's old city.

The transformation of Tiananmen Square from feudalism to socialism has been studied in some detail, and has been linked to the historical process of China's revolution, construction and reform periods, with a clear division of the morphological periods (Hou and Wu 1977; Ye 2021; Hu and Liu 2021). However, these studies tend to focus on the change of physical space, lacking the continuity of different periods and the 'breakthrough' process of institutional plot, to reveal the changes in the political meanings of the built environment. This paper will focus on the relationship between major historical events and places in Tiananmen Square, and briefly explain their role and position in social changes in different periods.

In terms of the evolution of Tiananmen Square's form itself, the changes in the logic of its spatial organization can be divided into four periods, as shown in Fig. 12.2. Before 1912, the Thousand-Step Corridor on both sides of the square was the office of central government. The long and narrow shape of the building was used to emphasize the towering authority of Tiananmen and the Forbidden City. After the Revolution of 1911, the Thousand-Step Corridor on both sides of the square was demolished and the palace walls were opened with two small gates to allow traffic to flow from east to west. After the founding of the country in 1949, with the demolition of the palace wall, the square was expanded from its original irregular shape into a square, with the People's Heroes Monument in the centre, and two new large buildings, the Great Hall and the History Museum, were built on either side, which were selected as the ten most iconic buildings of the new China. After 1977, the Zhengyang Gate was added to the south side of the square, and a new Chairman Mao Memorial Hall was built to the south of the Monument so that the overall morphological pattern of the square

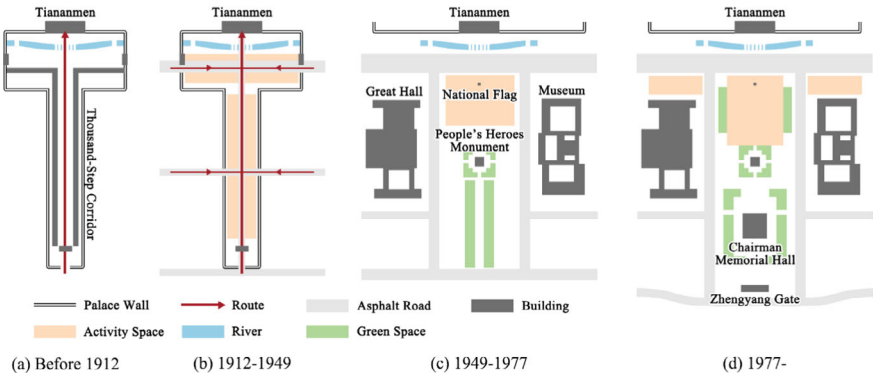


Fig. 12.2 The evolution of Tiananmen Square (*Note* Author's self-drawn)

has remained stable to this day. On the whole, the diversity of the Square's functions, building types and structures has been accompanied by a gradual expansion of the Square's area.

And the 'breakthrough' process of Tiananmen Square could be summarized in the following three points.

Breakthrough of function. The breakthrough in the function of Tiananmen Square was reflected in the changes in its activities. Before 1912, it was only a central passageway for the emperor, and apart from a few events held here to demonstrate feudal authority, it was mostly passageway that took on the primary traffic function of the emperor, to emphasize the order and hierarchy of space. After the removal of the palace walls and outbuildings in 1912, the square was transformed from the original palace square into a central place for political gatherings in Beijing, where processions, rallies and celebrations gradually took place. However, due to space constraints, the gatherings were mainly spontaneous, marching events that did not occupy the space on a regular or prolonged basis. After the founding of the state, a series of major renovation and expansion projects were carried out in the square, making it a place of admiration and remembrance, and its characteristics as a monumental space began to emerge. After 1977, with the further expansion and completion of the square, it was used for more and more major national events, including the celebrations of National Day, military parades and cultural evenings, which could accommodate over 200,000 people in a short period of time through the construction of temporary buildings such as the viewing platform, occupying the entire space of the square.

Breakthrough of town plan. In terms of the breakthrough of town plan, the change in the spatial form of the square, is closely related to the development history and social context of Beijing and the country as a whole. The double pattern of the palace walls nested within the Thousand-Step Corridor, was a product of the feudal imperial system in the service of royal power. Correspondingly, the demolition of the two types of buildings and structures mentioned above was a change to meet

social needs and modern life after the Revolution of 1911. After 1949, the enlarged area of the square, the open square space and the large buildings on either side were an expression of China's openness to the outside world at that time, and were also a symbolic expression of the socialist people's ownership. The completion of the square after the reform and opening up in 1978, and the series of major events that followed, was a manifestation of Chinese national power in the new era, which was closely linked to the grand, open town plan of the square. Moreover, the traditional layout along the central axis, which has always been orderly and symmetrical, is the inheritance and manifestation of the Chinese cultural heritage, with new innovations and reforms based on this new spirit of the times.

Breakthrough of the accessibility. Before 1912, the square was extremely closed, not only were ordinary people not allowed to enter, but the central government offices were also located on the east and west sides of the square outside the palace walls, reaching the peak of the feudalism period in China, with double palace gates guarding the east, west and south directions in addition to the palace walls. After the Revolution of 1911 and especially after the founding of New China, with the transformation from a palace square to a people's square, the original closed pattern was gradually broken, as a series of palace walls and gates were removed and the vastly enlarged square was turned into a completely open one. No longer a place reserved for the royalty or the special classes, the square is open to anyone to commemorate the history of the revolution. People can visit the square or take part in activities on any of the surrounding streets, giving it a new location and accessibility.

On the whole, as the most representative institutional plot in Beijing and even in China, its social reconfiguration has taken place with the commonality of institutional plot and urban development and renewal in China and abroad, reflected in the diversity of spatial organization, structure and function, as well as the involvement of people, also with the specificity of the institutional context of socialist China (Table 12.1). It not only carries a series of events that have been held in the square since its construction, but is also a historical microcosm of the continuous march of the Chinese nation during the same period. The influences and traces of different periods are changed by the process of accumulation, transformation and replacement of forms, and are also a process of adaption to the times and functions, resulting in the Tiananmen Square we see today.

Table 12.1 The spatial evolution of Tiananmen Square

Period	Function	Town plan	Accessibility
Before 1912	Traffic & governance	Closed, authoritative	Royal family
1912–1949	Gathering & parade	Towards social needs	Public
1949–1977	Admiration & reminiscence	Openness, symbolic	Public
Since 1977	National events	Grand, open, power	Public

12.5 Case Study: Shouhuang Palace

Shouhuang Palace, located in Beijing, China, is part of Jingshan Park, which means 'longevity' in Chinese. It is located in the northern part of the central axis of Beijing, to the north of the Forbidden City (see Fig. 12.3), and its main buildings may date back to the Ming Dynasty (Zhou 2018). In ancient times, Shouhuang Palace was mainly used to hang and worship the portraits of the emperors. It was a typical monumental space with political meaning for the royal family to make sacrifices, and it is the most highly regulated building group for royal ancestor worship in Beijing and the largest ancient building group on the central axis outside the Forbidden City. And if you look at the functional zoning within the city of Beijing during the Ming and Qing dynasties, this was also a typical institutional plot, taking on a larger imperial function.

In the context of urban development and social change, the logic of spatial organization has been changed twice completely. During the feudal period, it was a typical place of worship and the exclusive property of the royal family. After the founding of New China, under great pressure from the development of the old city, the government decided to allocate a part of Jingshan Park for Beijing Youth Activity Centre, and Shouhuang Palace became the classrooms and activity places for the youth. Until the Activity Centre moved out, after the conservation and renovation, Shouhuang Palace was opened as a cultural exhibition for local residents. The old, middle-aged and young generations of Beijingers therefore have different memories of this area.

The reasons for choosing Shouhuang Palace as a case study are as follows. First, it has experienced the whole process of social space evolution from feudal to modern society, as well as the changes in material spatial organization and urban landscape. Secondly, this process is a true reflection of Beijing's political, economic and cultural background, and a model for the renewal of traditional urban institutional plot. Thirdly, due to its special geographical location, the socialization process of this space differs from ordinary old city renovation, with great specificity in terms of functional transformation and morphological evolution. At the same time, although

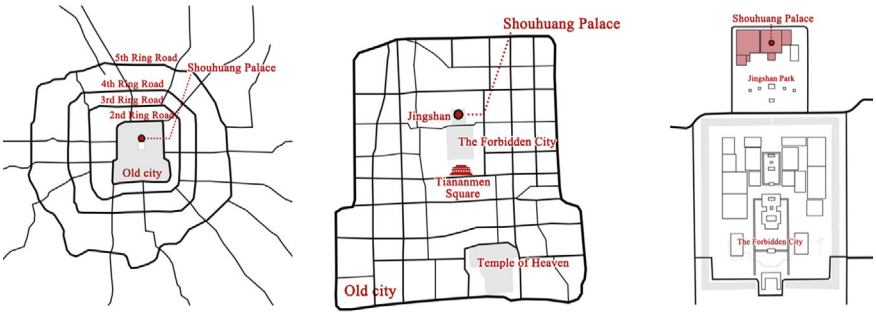


Fig. 12.3 Location of Shouhuang Palace in Beijing (*Note* Author's self-drawn)

Shouhuang Palace has always held a place in Beijing's urban spatial organization and political function, its political meanings have gradually diminished due to its publicity and secularization, and new developments have emerged.

In this context, we apply the Conzenian school's method of morphological periods. The morphological process is studied with the establishment and emigration of the Youth Activity Centre as the time nodes, divides the process into three periods, as follows: (1) Pre-Socialist Period (Before 1949); (2) Period of Youth Activity Centre (1949–2016); (3) Period of Exhibition (2016–2022).

12.5.1 Pre-socialist Period (Before 1949)

The pre-socialist period was the end of the feudal dynasty in ancient China, when centralization and the idea of 'imperial supremacy' reached unprecedented heights. The central location of Beijing was a symbol of the supremacy of imperial power during this period, and political, cultural and economic activities revolved around it. As a result, both the construction of the city and the location of the palace and temples were dominated by the emperor.

During this period, Shouhuang Palace as the core building group in Jingshan Park, it has always been an important imperial palace. It is located 500 m north of the Forbidden City, making it easy for the emperor to come and worship. Among them, Shouhuang Palace is centred in the north. The northwest is dominated by service room groups, which were occupied by a variety of staff who served the royal family. And before the Qing Dynasty, there were imperial granaries and farming land. To the northeast, there are three main building groups, Yongsi Palace, Guande Palace and Guanyue Temple, all of which can be seen as ancillary buildings to Shouhuang Palace. This group of buildings was built around Ming Dynasty, as a place for the congregation to rest and worship other deceased royalty.

In terms of spatial organization, Shouhuang Palace comprised three groups of independent spaces from south to north (see Fig. 12.4). The emperor and his attendants entered from the entrance area formed by the southernmost enclosure, crossed the functional service area from the central path, through Shouhuang Gate to the main palace for sacrificial activities.

On a larger scale, from the Forbidden City to Shouhuang Palace in Jingshan Park, the sacrificial routes also varied according to status. The emperor would march along the eastern route, with his ministers waiting at the Donghua Gate of the Forbidden City, and a series of sacrificial ceremonies would be held along the way. The empress and other women's families went directly from the front gate of Jingshan, waiting for the emperor's arrival in front of the Shouhuang Palace.

In terms of accessibility, throughout the pre-socialist period, Jingshan was only accessible to the royal family, and not to the common people. It was manned only on ceremonial days, and was guarded and maintained on weekdays by attendants, none of whom could enter without an order from the emperor.

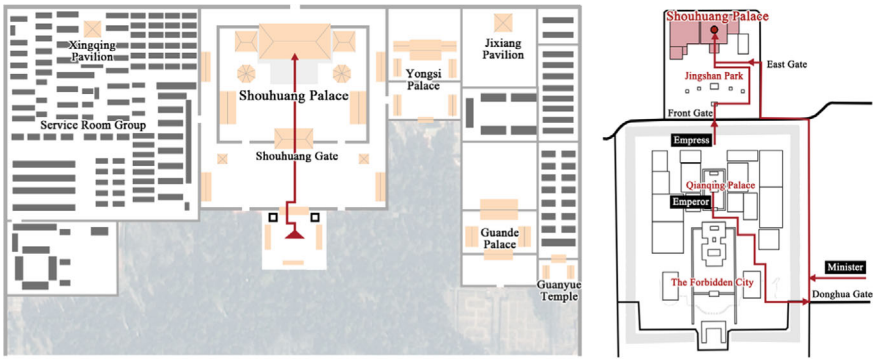


Fig. 12.4 The spatial organization in pre-socialist period (*Note* Author's self-drawn)

12.5.2 Period of Youth Activity Centre (1949–2016)

After the founding of New China, the Beijing Youth Activity Centre was established in Shouhuang Palace under the organization of the Premier and the Mayor, drawing lessons from the Soviet Model. To meet the needs of youth education and activities, the building layout and land use have been transformed, and the spatial organization form of the Palace has been greatly changed.

In terms of physical space, Shouhuang Palace was surrounded by many newly-built grey roof bungalows, mainly concentrated on the north side of the wall, the southwest side, and Yongsi Palace (dark buildings in Fig. 12.5). The original Service Room Group on the west side was completely demolished and turned into a football field and basketball field for children's sports training. In addition, in the centre of the courtyard, a fountain and a large amusement park were placed on the original central axis, which was the main site for after-school activities. Depending on the size and shape of the rooms, different buildings were used for art, instrument, model, English and other classrooms and offices. The main palace, because of its large volume was used as an auditorium and dance rehearsal room. Due to the increase in construction, Shouhuang Palace at this period no longer had a grand, stately palace environment, but gives a sense of courtyards in Hutong. The newly-built bungalows were low, with narrow aisles and dense courtyards, which had a strong sense of intimacy and life.

In the space organization, the front gate on the south side was no longer the main entrance, and was usually closed to isolate the Activity Centre from Jingshan Park on the south side. A new entrance was opened at the northwest corner, while the east–west road at the northernmost was opened as the main traffic distribution channel. It can be seen that during this period, the pre-socialist period emphasis on the middle and hierarchical structure was broken down, and was replaced by a pragmatic route of youth from north to south and from west to east.

In terms of accessibility, before 2000s, students were admitted only after an interview, which meant that only students who were deemed talented by teachers could

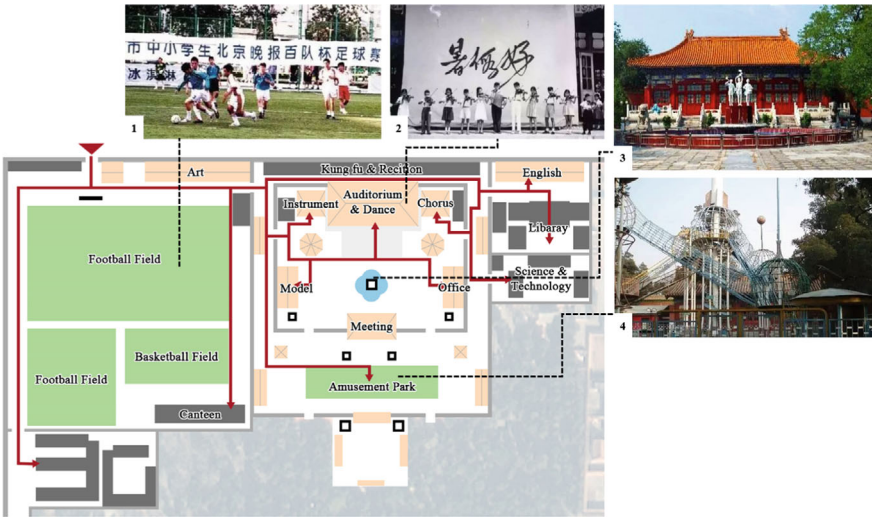


Fig. 12.5 The spatial organization in period of Youth Activity Centre (*Note* Author's self-drawn. Photos 1, 3 & 4, from Beijing Youth Activity Centre; Photo 2, 'The memory of Youth Activity Centre in Shouhuang Palace (寿皇殿的少年宫记忆)' reprinted from Beijing Daily, by Jiajia Huang, 2019, https://ie.bjd.com.cn/5b165687a010550e5ddc0e6a/contentApp/5b21da4ee4b0243950038411/AP5c8f42d7e4b099b8d0580765.html)

enter Shouhuang Palace for the programme. After 2000s, students from all over the city could come to learn through registration, while the Youth Activity Centre charges a certain amount of tuition fees. The crowd in Shouhuang Palace became more diverse.

During this period, instead of the current serious and silent scene, it is filled with the laughter of children. The large performances and gatherings that took place three or four times a year made it the centre of the old city for a short period of time, attracting the attention of many national leaders.

12.5.3 Period of Exhibition (2016–2022)

Around 2016, the Youth Activity Centre was moved out of Shouhuang Palace in batches (see Fig. 12.6). Many people who had studied and played here came to record and say goodbye, symbolizing the end of a generation of memories. The relevant departments began the work of heritage conservation and in-situ exhibition, which was opened to the public as a historical and cultural exhibition at the end of 2018.

During this period, the bungalows added during Activity Centre period were demolished, and the original building layout was restored. Shouhuang Palace, ancillary buildings and related sculptures, stone carvings and other cultural relics, have

Fig. 12.6 Scenes from the relocation of the Youth Activity Centre (*Note* Author's selfies)

also been restored to their pre-socialist appearance (see Fig. 12.7). Among them, the main palace is used as a scene recovery exhibition, the south side and the outer palaces are used for piety culture, building, sacrificial and historic show, with a cultural shop in the southeast corner. At the same time, the administration also organizes occasional cultural events with Beijing traditions, turning the site into a venue for performances, lectures and experiential activities.

On both sides of Shouhuang Palace, the original football and basketball field on the west side have been restored as the Emperor's Farm during Yuan Dynasty, which was the place where the Emperor experienced the agricultural culture at that time,

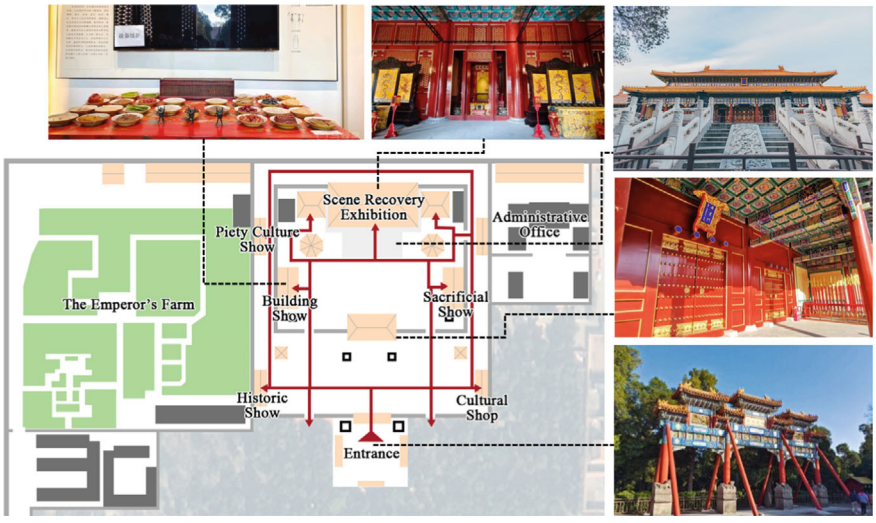


Fig. 12.7 The spatial organization in period of exhibition (*Note* Author's self-drawn & selfies)

with the intention of further construction as a garden in the future. Yongsi Palace on the east side, which has been restored to its Ming Dynasty layout, is used as the administrative office of Jingshan Park. And the entrance to Shouhuang Palace is blocked off to create a separate courtyard.

In terms of spatial organization, the south side has returned to the main entrance and the tour route unfolds along the central axis. A slight difference from the past is that the Shouhuang Gate is closed for conservation reasons, so visitors must enter the central courtyard from both sides. Visitors can either follow the route of the ancient imperial rituals, enter directly into the main hall to experience the scenes of the time, or feel free to visit the attached buildings on the east and west sides to learn about the traditional cultural landscape. On the whole, there is no fixed route to visit and visitors are free to move around.

In terms of accessibility, Shouhuang Palace is now open to all, and there is no distinction in access. The east and west sides are not open for the time being, but will open to the public after the restoration of the Emperor's Farm is completed.

12.6 Summary: The Breakthrough Process in Shouhuang Palace

On the whole, for Shouhuang Palace, the breakthrough of architectural function was the fundamental driving factor in the socialization process under the changes of political meanings (Table 12.2). On this basis, the need for a different function led to the breakthrough of the town plan of the previous period. This was reflected in the addition and demolition of bungalows, the renewal of facilities, and the change of sub-plots. The result is an increase in the secularization of the space and a change in the overall landscape and the experience of use. At the same time, the original fixation line represented by the courtyard wall has been broken, and many new entrances have been created on the east and west sides, resulting in changes in the organization of traffic and pedestrian routes. On the other hand, as the function changed, the people who used these monumental spaces and their social relationships also changed, creating a breakthrough in accessibility. In this case, Shouhuang Palace was transformed from a space reserved exclusively for the royal family to a place of leisure for the general public, with a much greater openness. And the dominant driving factor behind this process is the different political form of the city of Beijing.

Table 12.2 The spatial evolution of Shouhuang Palace

Period	Function	Organization	Building number	Accessibility
Before 1949	Worship & sacrifice	From S to N	Less	Royal family
1949–2016	Activity & education	From W to E	More	Gifted students
Since 2016	Exhibition	From S to N	Less	Public

From the logic of spatial organization, the socialization process of Shouhuang Palace, is not only a direct reflection of the political and social context in different periods, but also with the cultural and economic conditions of the time, and the understanding of space is closely related. Under the original feudal system, the emperor occupied the most prestigious space in the city, and architectural regulations and rituals were often of the highest order, so the spatial order was constructed around the emperor. After the founding of New China, economic development and national rejuvenation became the theme of the period, with the elimination of the original feudal rule and the strengthening of youth education being the main concerns. Therefore, it made sense to transform the ritual space for sacrifice into a place for activities and education. And in recent years, as society has begun to pay great attention to history, cultural heritage and the preservation of the old city, the improper use and destruction of ancient buildings has become an issue of urban governance. Thus, it is urgent to carry out the vacating of Youth Activity Centre and restore the heritage as part of the urban renewal policy dividend. This act promotes the relative integrity of Beijing old city and the important urban space, and contributes to the nomination of Beijing's Central Axis as a historical urban landscape for World Heritage.

Interestingly, although the current Shouhuang Palace has restored the pre-socialist layout of the city, the exhibition was also displayed as much as possible in its the original form. However, from the perspective of the urban landscape development, it is not a complete restoration of the heyday in Qing Dynasty, but an accumulation and overlaying of different periods in space. Among them, the Shouhuang Palace area in the middle is the spatial layout of Qianlong period of Qing Dynasty, the Emperor's Farm in the west is the legacy of Yuan Dynasty emperors, and Yongsi Palace, which is the administrative office in the east, is restored to the Ming Dynasty pattern. The reason for this is still unknown to us and needs further investigation.

12.7 Conclusion

As an ancient human behaviour, memorials or rituals originate from people's memory and inheritance of their material and spiritual life. Politics, on the other hand, has its roots in the desire to regulate order and improve the quality of life. It is against this background that institutional plots and monumental spaces with political meaning have emerged in cities. From Vitruvius' *The Ten books on Architecture* to Rossi's *The Architecture of the City*, the significance of political space is self-evident. As the source of architectural art and urban planning, it has played an important role in the emergence and development of the urban landscape, and dominates the spatial structure of the city. As Rossi said, such kinds of primary elements '*are not only preserved but continuously presented as propelling elements of development*' (Rossi 1982), and also give us the basis for studying the evolution of morphology and the social processes behind it. For this reason, the paper explores the process of transformation of the old city in socialist China in terms of the morphological study of institutional plots, focusing on the breakthrough of plot pattern, function and

accessibility under the changes of political meanings, and traces the evolution of two traditional institutional plots in Beijing old city since the end of the feudal dynasty.

Although there are great similarities between China and the West in terms of the relationship between urban elements, spatial organization and power structures, the logic of spatial use in old Chinese cities in historical periods can be revealed through the study of the main elements represented by institutional plots. However, under the guidance of the unique Chinese cultural view of the unity of man and nature, the influences behind the traditional feudal dynastic cities of the pre-socialist period and the socialist urban construction of today, as well as the evolutionary logic of the agent and agency, are all different from those in the West. In this process, traditional Chinese urban construction has been able to leave behind the shortcomings of the feudal period, and modern Western ideas of urban construction, represented by capitalism, have been gradually integrated, resulting in a new urban renewal programme for socialist China. In this process, the royal palace space, represented by Tiananmen Square and Shouhuang Palace, was transformed into a popular space, allowing the traditional Chinese city to develop in a new context, and with it, a change in spatial organization. These special institutional plots can, on the one hand, guide the viewer to understand the place by recalling the history of the country and the nation in the past, and, on the other hand, have a new special mission and role along with the needs of political, social, economic and cultural development,. Therefore, it is necessary to conduct research from the perspective of historical geography.

According to the above case study of Tiananmen Square and Shouhuang Palace in Beijing, we believe that the results can reflect the relationship between morphological transformation and urban social reform. Because of the close relationship between the material space and the context of social relations, the study of the institutional plot is also the study of the surrounding social space of the area. Therefore, in the process of socialist China's transformation, the institutional plots and monumental space under the original feudal system are being transformed accordingly. At the same time, the transformation of politics, society and citizens is also taking place at the same time, which is integrated into the social network through the use and perception of the space. Unlike in the West, the institutional plots in the Chinese traditional city central areas have often served only for the king's authority in historical times, and have always been inaccessible, and even unimaginable places for the people since time immemorial, although they share the same space and city with their living environment. Therefore, the socialization process during the transformation of the old city is a process of integration into social networks, as well as a process of compromise, adaptation and renewal with modern urban life, thus truly transforming places into memories.

As a result, it is necessary to study the process and relationship between urban morphological transformation and urban social change, to establish a mechanism of influence between the renewal of institutional plots and the political, social and cultural conditions.

References

Cannigia G, Maffei G (2001) Architectural composition and building typology: interpreting basic building. Alinea Editrice, Firenze
Conzen M (1960) Alnwick, northumberland: a study in town-plan analysis. Institute of British Geographers, London
Curdes G (1993) Spatial organization of towns at the level of the smallest urban unit: plots and building. Alhenaeum Press, Newcastle
Dai Y (2017) The organization of towns in Zhejiang Province, Qing Dynasty, from the perspective of primary element, unpublished MD thesis. Peking University, China
Hou R (1987) From Beijing to Washington—a test of urban design themes. City Issues 3:2–17
Hou R, Wu L (1977) Tribute to Tiananmen Square: the evolution and transformation from the palace square to the people's square. Chin Cult Relics 9:1–15
Hu Y, Liu X (2021) The evolution of spatial pattern of Tiananmen square. China Fam Bus Rev 12:37–40
Kantarek A, Kwiatkowski K, Korbel W, Djokić V, Djordjević A, Niković A, Samuels I (2021) Mapping post-socialist changes in urban tissues: a comparative study of Belgrade and Krakow. Urban Morphology 26(1):44–63
Lefebvre H (1972) Espace et politique. Seuil, Paris
Liu L, Xu Z (2017) Comparison and evolution of traditional memorial landscape differences between china and the west. J Anhui Agricult 45(1):158–161
Norberg-Schulz C (1980) Genius loci: towards a phenomenology of architecture. Rizzoli, New York
Rossi A (1982) The architecture of the city. MIT Press, Cambridge
Rubén C, Belén M, Lucrezia L (2016) From sacred place to monumental space: Mobility along the way to St. James. Mobilities 11(5):770–788
Vitruvius P (1999) The ten books on architecture. Cambridge University Press, Cambridge
Whitehand J (1972) Building cycles and the spatial pattern of urban growth. Trans Inst Br Geogr 56:39–55
Ye N (2021) The starting point of the Chinese Dream of gathering national strength: Reviewing the century-long history of the founding of the CPC with the reconstruction and expansion of Tiananmen Square area. Beijing Plan Rev 6:19–25
Yue H (2006) Consideration about the vicissitude of administration buildings in China and Western countries from the perspective of sociology. Chin Overseas Archit 5:78–82
Zhang L (2010) The design of the municipal office architecture morphology with the perspective of typology, unpublished MD thesis. Chang'an University, China
Zhou H (2018) Research on the architecture of pavilion of Imperial Longevity of Jingshan. Unpublished PhD thesis. Tianjin University, China

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 13
Exploring the Interaction Between Urban Landscape and Regeneration Decision-Making Factors in the Context of Urban Regeneration, Exemplified by Liverpool Docklands

Junyuan Lu and Feng Song

Abstract Urban regeneration is emerging as an important means of transforming cities for development, with built environment as the main object of operation. Modern urban regeneration process has become a mechanism in the evolution of urban landscape, where decision-making factors such as legal, institutional and administrative systems have a direct impact on the implementation of regeneration activities. In turn, the built environment will also influence the urban decision-making process. Accordingly, this article interprets the important role of decision-making factors in urban regeneration from the perspective of urban landscape, taking Liverpool docklands as a case as it bears the history of shipping and trade and is also the main area of Liverpool's urban regeneration. Based on the literature and official documents, this article reviews the urban regeneration process staging in Liverpool Docklands, identifies the decision-making factors, and constructs an explanatory framework, then the role of decision-making factors in shaping urban landscape is interpreted in stage. It is found that the role of decision-making factors is rooted in the notion of legitimacy of development power and influenced by institutional systems and administrative relationships, generally involving different agents from public, private and intermediate organisations. And the role in shaping urban landscape takes three forms: restrictive, chance and evolutionary.

Keywords Urban regeneration · Urban landscape · Agency · Agent

J. Lu · F. Song (✉)
Peking University, Beijing 100871, China
e-mail: songfeng@urban.pku.edu.cn

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_13

13.1 Introduction

The concept of urban regeneration has evolved in urban development and in the process of regional development relationships reshaped and is emerging as an important strategy to seek for new paths of development. In contemporary times, the practice of urban regeneration is still primarily concerned with the physical environment, reforming the built environment at the material level to achieve social, economic and political goals, so that it is seen as a rational means of creating new opportunities for development when cities are facing economic and social difficulties. Thus, urban regeneration has become a mechanism that cannot be ignored in the evolution of urban landscape, which implies the rationality of the practice and the initiative of human agents. In the field of geography, the concept of urban landscape is derived from cultural landscape, all of which include perspectives on regional contexts, human activities, and historical processes. Exploring the process of urban landscape evolution and achieving an interpretation of structure and logic of itself is the theoretical objective of Conzenian approach of Urban Morphology. Within this objective, the focus on the mechanisms of action between the various elements of the surface human phenomena broadens the definition of the field of urban morphology to include a focus on the human role in the surface human phenomena, which gives rise to discussions on agent and agency in the field of urban morphology.

Urban regeneration is a form of urban governance as its connotations have expanded to include physical, social and economic dimensions, involving different actors with different values and goals. Accordingly, the practice of urban regeneration becomes a process in which different actors coordinate and participate in decision-making and implementation, which also implies the influence of legal, institutional and administrative systems. The exploration of the mechanisms of urban landscape evolution and its agency in the field of urban morphology is thus concretised here in the following questions: in the context of urban regeneration, who shapes urban landscape, how it is shaped, and how we understand the process of urban landscape evolution. This article attempts to answer these questions in order to explore how the decision-making factors involved by urban regeneration have influenced the changes in urban landscape. The analysis is divided into four parts: the first part gives an account of the theoretical perspectives on which this article is based, including the relationship between the concept of urban landscape and urban morphology, the general findings of agent theory in urban morphology, and the influence of urban regeneration practice; the second part introduces the research methodology of this article; the third part is the case analysis; and the fourth part is the conclusions.

13.2 Background

13.2.1 Urban Landscape and Urban Morphology

The understanding of the spatial composition and the content of the built environment has undergone a cognitive process from descriptive to systematic, involving a variety of disciplinary perspectives. The Conzenian School of urban morphology was established along the lines of geography to provide a systematic geographic interpretation of the urban landscape. In this regard, urban landscape is an object of concern and interpretation in geography when studying urban at the morphological level (Conzen 1960).

The study of urban landscape dates to the end of the nineteenth century in Germany, from a concern with the evolution of landscapes in the discipline of geography and similar fields. Influenced by Ferdinand von Richthofen's ideas on human geography—the study of the evolution of human phenomena on the surface in terms of the relationship between people and the environment (Richthofen 1883)—his student Otto Schlüter proposed that the central aim of cultural geography (Kulturgeographie) was to study the form, function and historical development of cultural landscape (Kulturlandschaft) (Dickinson 2014). The German-speaking academia was then drawn to the problems of urban morphology, topography and development by historians, geographers and architects, and until the Second World War, morphologists in the field of German geography had not yet broken through the limitations of a simplistic morphological approach (Larkham and Conzen 2014). Thereafter, influenced by Herbert Louis, a teacher at the School of Geography at the University of Berlin, his student M.R.G. Conzen, who developed an interest in settlement geography and urban morphology, was taught to place urban morphology in the whole context of geology, geomorphology and urban history (Whitehand 1981), and finally moved to England to work in the fields of urban planning and historical geography. After the Second World War, progress in urban morphology was slower. With the publication of *Alnwick, Northumberland: A study in Town Plan Analysis*, M.R.G. Conzen constructed a basic framework for the conceptualisation and study of the evolution of townscape form, structure and the interrelationship of essential elements, and has since carried out further validation and comparative studies in other case sites. Since then, the position of the Conzenian School of urban morphology has been gradually consolidated on the basis of the succession and development of numerous scholars such as J. W. R. Whitehand.

13.2.2 Urban Landscape Analysis and Agent Theory

In parallel with M.R.G. Conzen's contribution to the basic framework of urban morphology, urban morphologists gradually developed an interest in agents and agency aiming to answer the question of how particular urban forms and spatial

composition are produced. This is in line with the connotations of cultural landscape and urban landscape, which drive researchers to discover the mechanisms between the various elements of surface human phenomena. In this context, the field of urban morphology was broadened—morphology is simultaneously the understanding of the changes in thought that are manifested by human activity on the earth surface (Larkham and Conzen 2014), i.e. understanding the motivations behind agents' behaviour and the scope and role of agency. Furthermore, from the 1970s onwards, the mainstream work in urban morphology saw no longer the built environment as a context for human habitation, and it was found that humans might actively modify and be influenced by changes in the built environment. Gordon's conceptual framework pointed to the primary role of decision-makers in the evolution of urban form (Gordon 1984). Since then, agency has been discussed beyond the human and can be non-human things (Essex and Brayshay 2007). For example, culture and values (Edwards and Carr 2004; Preston and Lo 2000) and the process of economy and globalisation can shape the actions of individuals and organisations and the landscapes they produce (Gad and Holdsworth 1987).

Other studies of agency in the field of urban morphology point to the following conclusions: (1) In terms of study objectives, urban morphology's exploration of the mechanisms of urban morphological change encompasses the academic topic of agency. (2) The discussion of agency pays attention to geographic variability and hierarchy due to the differences in the historical and geographical context of the specific case sites and their political and economic location in the region, and this has also led to the study of administrative systems, institutional systems and power relations in urban planning and urban landscape management. (3) Analyses of the scope of agency often start with processes, institutional factors and power relations directly related to the shaping of urban form and summarise the dominant agents, which are manifested in different ways for cities at stages, while institutional factors and power relations often correspond to each other, and both often define the key agents. (4) The range of agents can be categorised according to the decision-making structures, based on the possibilities for patterns of human behaviour determined by the logic of urban functioning in different development contexts. (5) When considering the role of human behaviour, agent behaviour is influenced by people's values, and in this context, it is possible to discuss the relationship between multicultural contexts and the conflicting morphology of the built environment. (6) Furthermore, when the 'rationality' of urban morphology is explained in terms of the cultural context of agency, the 'social production of the built environment' (King 1984) provides the answer that 'the environment is regarded as a reflection of the dominant pattern of economic, social and political relationships within society and as a means through which these relationships are reproduced and sustained' (Knox 1984).

Karl Kropf proposed a general model of urban morphology on agent and agency based on an analysis of Leighton Buzzard, Bedfordshire, UK, concerned with the basic human habitual behaviour of 'learning'. The formation of communities of interest, negotiation in the collective decision-making of urban morphological change and coherence of agential behaviour were emphasised (Kropf 2014). Karl Kropf focused on the role of human behaviour and classified agents into five categories:

those who propose and promote change (motive agents), those who generate the specific content of proposals (generative agents), and those who control or limit proposals (regulatory agents), those who oppose change (resistive agents), and those who use these changes (sensory agents), and any one agent may play several or all of these roles. Among that, the role of terminal users in the planning process was pointed, whose evaluations as feedback may modify forms of agency behaviour or stimulate new forms of behaviour. In addition, outcome from agents' behaviour was emphasised as arising from a situation of mutual compromise between multiple agents, suggesting the variability of the generative ideas of different agents and the possible multiplicity of outcomes, in addition to the variability over time.

13.2.3 Urban Landscape Evolution and Urban Regeneration Practice

The concept of urban regeneration originates from a summary of the salient features of such practices, which in the contemporary context include the reconstruction and transformation of the built environment, the modification or adjustment of the uses and functions of the built environment, as well as actions at the social, economic and political levels. These practices often originate from local development initiative or strategies and usually involve the built environment on a large scale. Essentially, they are carried out by humans to adapt the settlements to the needs of development, occurring at different stages of urban development–decay–renewal–redevelopment. In the context of eras and local environments, and due to the problems and institutional systems in places, there are spatial and temporal differences in the motivation, objectives, contents and modes of regeneration, policy contexts, power relations and specific measures of regeneration activities. In terms of contemporary regeneration activities, Western urban regeneration can be traced back to the slum clearance programmes of the late nineteenth century, with housing, health and welfare claims as the main motivation. The early twentieth century saw a clear trend towards suburbanisation in the UK and the USA, with inner-city problems still unresolved. Second World War influenced European cities to implement large-scale knock-down redevelopment to improve inner-city housing conditions. In the 1960s and 1970s, urban regeneration practices were characterised by public housing construction and neighbourhood revitalisation, with countries such as the UK and the USA adopting integrated community development models and placing greater emphasis on the interests of residents. In the 1980s and 1990s, with global post-industrialisation and economic recession, cities in the West with heavy industry and manufacturing as the dominant industries experienced economic declined, which, as well as suburbanisation, gave rise to numerous social problems in inner cities. Since the 1990s, urban regeneration policies have shifted to a market-led approach to property development, forming a network of public and private sector partners. In addition to the goal of improving the physical and economic conditions of cities, the rise of values and policies to

limit urban growth and protect the environment has become the stimulus for urban regeneration practices since the late twentieth century (Roberts et al. 2016).

Globally, urban regeneration has evolved in urban development and in the process of regional development relationships reshaped, from improving the built environment to focusing on multidimensional urban goals, and is emerging as an important strategy to seek for new paths of development in contemporary times. In fact, when urban regeneration has become an urban development strategy or even a policy, the practice of regeneration itself becomes a mechanism for the evolution of the urban landscape, with a degree of common characteristics that is politically, market-oriented and large-scale, and therefore its role in shaping landscape change cannot be ignored.

13.3 Methodology

'Agent' and 'Agency', which are of interest in urban morphology as one of the perspectives for exploring the mechanisms of urban landscape evolution, involve the topics of landscape shapers, shaping motives, and shaping processes. This is the theoretical starting point of this article. As urban regeneration can be seen as one of the mechanisms, this article considers urban regeneration practices as an agency and give the discussion. There are two objects, one of which is the decision-making factor in the urban regeneration practice and the other is the urban landscape. The decision-making factor refers to the factors that determine the direction of the regeneration practice at key aspects in the process, i.e., the structure and role of the human-agent.

In the mechanistic analysis of urban morphology, the relationship between case studies and general conclusions is inextricably linked. In this article, Liverpool docklands is chosen as the case site. Liverpool docklands have been closely associated with the rise and fall of the city since the seventeenth century and its transformation to seek a competitive position in the process of globalisation. In addition, Liverpool docklands is a key area in Liverpool's urban regeneration strategy, witnessing a specific history of significant political, social and economic change of the city in the post-industrial period. Liverpool's urban regeneration strategy has, on the one hand, served as a microcosm of the urban regeneration process in the UK and globally in the post-industrial transition period, and on the other hand, it has led to initiatives by various groups that have influenced local political, social and economic changes and are reflected in the changes to the urban landscape. Liverpool docklands was considered as a case study given the special characteristics it possesses.

Liverpool docklands are largely located in the waterfront area of the current Liverpool city centre, which is the study area (Fig. 13.1), but this article focuses on the larger scale and more influential regeneration practices in Liverpool docklands from the 1980s onwards. Literature and official documents are used as research material to retrace the main phases of the regeneration practices, interpreting decision-making factors and spatial outcomes in stages. In the decision-making factors analysis, decision makers and making processes of urban regeneration are summarised, then the

landscape shapers and shaping processes are identified by reference to the general model of agent and agency in built environment change from Karl Kropf. In the spatial change analysis, the concepts of urban landscape such as plot, street, building fabric and land utilisation in the Conzenian morphological approach are used to account for the landscape pattern changes in the study area. It is important to note that the landscape pattern in the article is not a terminology in the Conzenian approach, nor is it the same as the concept of plan units which refers to the identification of morphological units with hierarchical characteristics based on a combination of morphological elements such as town plan, building fabric and land utilisation. Due to the limited spatial resources available, the article uses the term 'landscape pattern' to analyse the key morphological elements and their relationship within the urban landscape of the study area.

13.4 Results and Discussions

13.4.1 Socio-Economic Background of Study Areas

A Brief History of City Development

Liverpool, located in the north-west of England, on the northern shore of the deep water of River Mersey estuary, was originally a small fishing and farming community that became a borough in the early thirteenth century and thereafter became the core city of the Merseyside region. After the Chester on the River Dee moved its trade to Liverpool in the early eighteenth century due to silting up, the Liverpool dock system was revamped, and the advent of wet docks brought a lot of trade. In the mid-nineteenth century, the Mersey Docks and Harbour Board was established as an independent body to build 13 miles of wet docks along the River Mersey, including the Albert Dock and the Pier head (Fig. 13.2). Dependent on the early industrial growth of the North West of England, and on the strong commercial networks established under the leadership of Liverpool's commercial elite, River Mersey developed as the gateway to England's trade routes to the Atlantic, and thus built up capital for the city's own development (Taylor and Davenport 2009). Liverpool has since experienced waves of immigration from other parts of the British Isles, its colonies and mainland Europe, with rapid population growth and pressure on the physical environment. To improve the overcrowding and squalor of the inner city, Liverpool embarked on a massive urban planning exercise. In the second half of the nineteenth century, with the growth of commercial activity, many shipping companies, commodity exchanges, banks, insurance companies were built around Pier Head and Castle Street which became an important element for Liverpool—Maritime Mercantile City World Heritage. At the same time, Liverpool's increasing involvement in the slave trade made it an important hub for the triangular trade between Europe, Africa and America, which earned it the 'stigma' of being 'Britain's leading slave port'. Within the city, social inequalities came to the fore and the high rate of poverty

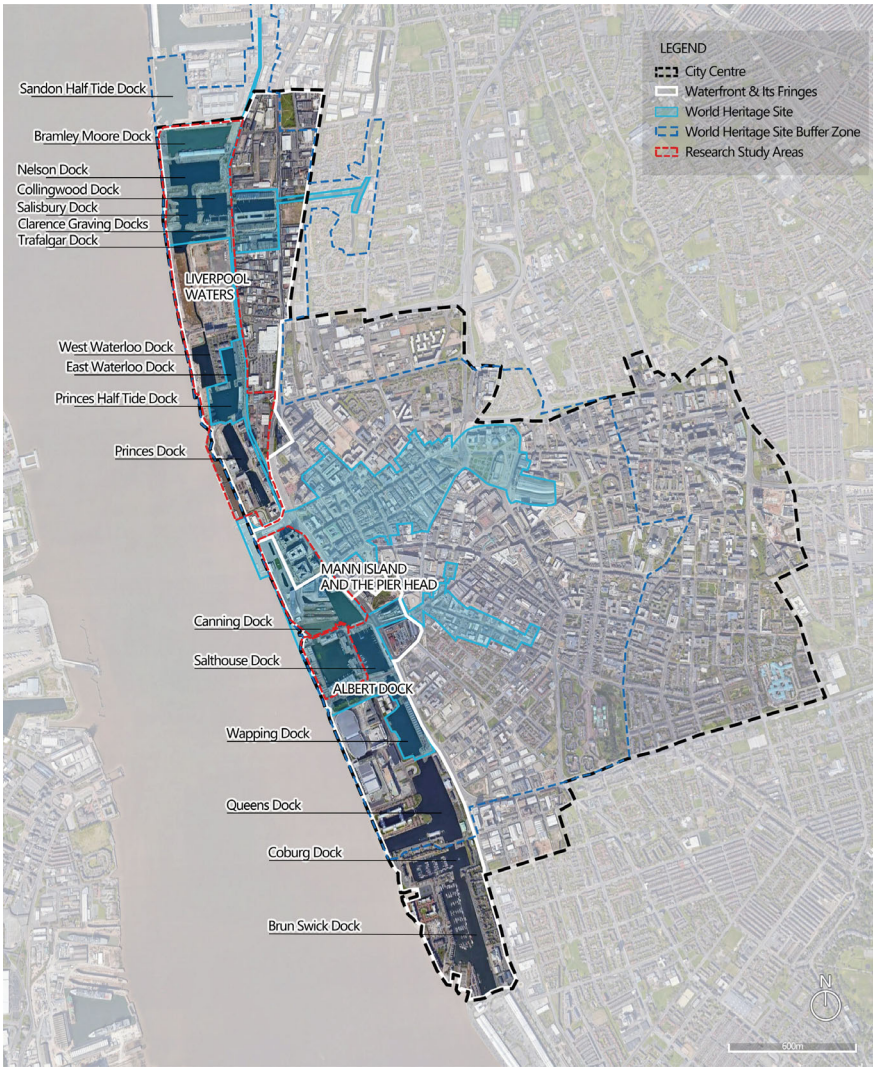


Fig. 13.1 Illustration of research study areas (*Note* Adapted from satellite image from Google Earth by the author)

and the economic culture of casual dock workers led to the problem of alcoholism, which became the largest category of crime in Liverpool in the second half of the nineteenth century (Sykes et al. 2013).

By the early twentieth century, Liverpool's population and prosperity was at its peak and as late as 1970 it was still the largest export port in the Commonwealth. Prior to the First World War, Liverpool still hosted many foreign government embassies and consulates, thus dominating world trade, finance and shipping to some extent,

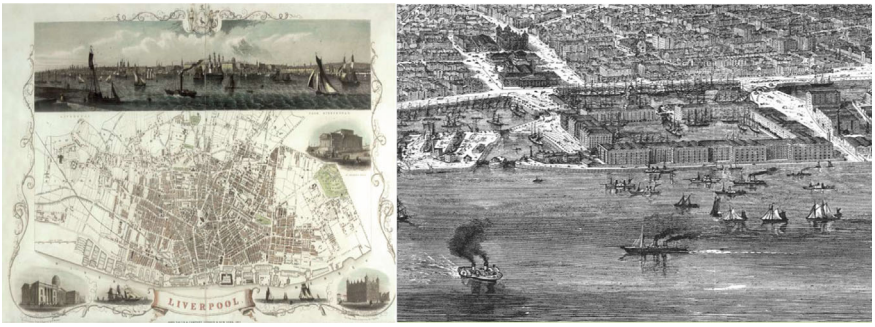


Fig. 13.2 Map of Liverpool in 1851 (Picture on the left),[1] Dockland of Liverpool in history (Picture on the right)[2]

and its city status encouraged the implementation of local schemes in health, housing and transport. Since then, due to changes in the economic environment both within and outside the city, and the physical damage caused by the war, Liverpool's position as a trading hub has diminished and it has faced competition from other regional centres for the supply of trade and services. To mitigate the internal and external crisis, Liverpool restructured its industries and invested in public infrastructure from the Second World War until the 1970s (Sykes et al. 2013). The 1970s onwards saw the collapse of the UK's manufacturing base, a shift in national economic focus to financial services, and the strategic priority of the South East of England, a recession in Liverpool and indeed Merseyside, and a rapid outflow of migrants. A shortage of labour resources coincided with rising unemployment. Social inequality remained a prominent issue (Sykes et al. 2013). After the 1980s, in order to alleviate social problems and improve economic conditions, Michael Heseltine, the Secretary of State for the Environment, took office and the Merseyside Task Force (MTF) and the Merseyside Development Corporation (MDC) were established to deal with the redevelopment of Liverpool's urban areas. It was not until the 1990s that Liverpool local government repaired its relationship with the national government and secured development funding from the national government, the European Union (EU). Through the efforts of different levels of the public sector aiming at promoting public–private partnerships and regional development, the transformation of Liverpool's industries and city centre was promoted and culture and heritage became important resource for Liverpool's urban transformation. Since the end of the twentieth century, Liverpool has continued to drive the city along the path of post-industrial transformation. While

[1] *Note* "Tallis & Co.'s map of Liverpool 1851, courtesy LRO" reprinted from Liverpool Maritime Mercantile City World Heritage Site Supplementary Planning Document (p. 29), by Liverpool City Council, 2010, https://liverpool.gov.uk/media/kd0mxbum/world-heritage-site-spd.pdf. Copyright 2010 by Liverpool City Council.

[2] *Note* "Detail from Giant Panorama of Liverpool 1865, by Jackson & Sulman" reprinted from Liverpool Maritime Mercantile City World Heritage Site Management Plan 2017–2024 (p. 5), n.d., https://www.liverpoolworldheritage.com/wp-content/uploads/2018/09/pmd-486-liverpool-whs-management-plan-final-version-as-at-27-sep-2017.pdf.

the physical environment of the city centre has been improved and the population has grown, regeneration projects further afield have faced loss and controversy (Sykes et al. 2013).

Urban Regeneration Practice in Liverpool and Its Docklands

Urban regeneration practice on a large scale in Liverpool began with post-war reconstruction efforts after the Second World War, with the primary aim of improving the plight of housing and improving the physical environment, which was a key issue on the local political agenda at the time. By the 1960s, the redevelopment of urban centres was combined with large-scale residential development, with inner-city slums relocated to the urban fringe and replaced by high-rise buildings (Sykes et al. 2013). However, the high cost of building urban infrastructure and housing demolition, combined with the recession and labour shortage Liverpool was facing, made the city increasingly dependent on central government funding for its finances.

From the late 1970s onwards, relations between the local Liverpool Labour government and the national Conservative government became very tense. It was also during this period that different models of regeneration practices were developed in the Docklands and other parts of the city. The labour-directed urban regeneration strategy, which focused on building new municipal housing and clearing 'slum' tenements, ultimately failed due to high costs. Outside of local government control, the MTF, in partnership with the MDC, undertook regeneration projects in the docklands, using significant national government funding as well as private investment, as represented by the Albert Dock. The MTF and MDC became major agents in the management of Liverpool's redevelopment at the time, both initiating or participating in much of the city's regeneration practice in the 1980s. The period saw the beginning of a rapprochement between local and national government, with local government receiving significant funding for redevelopment from national government, and the City Challenge programme, overseen by Michael Heseltine, promoted public–private urban regeneration practices. Liverpool has since continued to receive funding for regeneration practices, and organisations such as the Mersey Partnership (TMP), Liverpool City Region (LCR) and the North West Development Agency (NWDA) have been established to support regeneration practices.

In 1999, Liverpool Vision, the UK's first Urban Regeneration Company (URC), was established as an independent company responsible for the regeneration practice of Liverpool city centre. The first decade of the twenty-first century saw the development in the city centre and docklands, including projects of varying scales, driven by organisations such as Liverpool Vision and Liverpool City Council (LCC) (Biddulph 2008). In 2000, LCC published the Strategic Regeneration Framework (SRF) which proposed to further strengthen the role of built heritage as previous phase (Fageir et al. 2021), a goal and path that was validated by two key events in the first decade of the twenty-first century, namely the inscription of World Heritage list in 2004 and the award of the 'European Capital of Culture' (2008). This phase was represented by the regeneration of Mann Island and began to generate debate on heritage conservation.

In 2012, LCC published the Strategic Investment Framework (SIF) (Liverpool City Centre Strategic Investment Framework 2012), which sets out to promote urban growth over the next 15 years through non-physical investment in business, culture, creativity and the visitor economy, as well as investment in the physical environment. This phase is typified by 'Liverpool Waters' scheme in the north of Liverpool docklands, whose specificity in location, scale, form and function has once again led to a debate about the tension between urban redevelopment and heritage conservation. Liverpool Vision has now been integrated into the LCC offices and its functions will continue to be carried out in close collaboration with the City Council.

13.4.2 Discussion of Study Areas

In this section, three regeneration practices in the docklands in three phases, namely the regeneration of the Albert Dock, the Mann Island and the Liverpool North Dock, are specifically analysed in chronological order. The agents involved for the different phases are shown in Table 13.1.

Decision-Making Factors for Regeneration of Liverpool Docklands

1980–2000s: Regeneration of the Albert Dock

In the 1980s, Liverpool docklands began to be restored and redeveloped on a large scale, represented by the regeneration of Albert Dock. Amongst public organisations, the national government directly contributed to the establishment of the MTF to address social unrest in the area and appointed Michael Heseltine as leader. During the same period, MDC was established on Merseyside to redevelop the area's disused docks and had full planning powers and funding for the area to improve the local economy (Sykes et al. 2013). If the national government provided legitimacy and financial support for the redevelopment, Michael Heseltine provided strategic support, who encouraged the private organisations to invest in regeneration practices in the city centre and promised to exempt it from taxation on industrial and commercial development. MDC, as implementer of the redevelopment strategy, is responsible for providing technical support. The MDC launched the 'Initial Development Strategy' in 1981, which developed a reclamation plan and land use strategy to transform the physical environment of Liverpool's south docks with a focus on industrial and commercial, residential and leisure functions. The Albert Dock Company was subsequently established to undertake the redevelopment of the docks (Fageir et al. 2021).

After the end of the 1980s, the new LCC began to repair its external relations and actively promoted public–private partnerships and the regeneration of the docklands and the city centre. Under the auspices of the executive, the spatial scope of Liverpool's regeneration strategy was expanded, and significant funding for regeneration was secured from the national government, EU, and subsequently the Objective One structural fund (Sykes et al. 2013), European Regional Development Fund

Table 13.1 The range of agents and the general roles involved in the Albert Dock, Mann Island regeneration and Liverpool Waters scheme since the 1980s

	1980–2000s the Albert Dock regeneration		2000–2010s the Mann Island regeneration		2010s–Liverpool waters scheme	
Public organisation	National government	M	Regional government (NWDA)	M	National government	M
	Regional government (MTF)	M, G	Local government/ Local planning authority (LCC)	M	Local government/ Local planning authority (LCC)	M, Rg
	Local government/ Local planning authority (LCC)	M	Local government (UTF)	M	Non-departmental professional bodies (CABE)	Rg
	Fund supporter (EU, ERDF, ESF etc.)	M	Non-departmental professional bodies (CABE)	Rg	Combined authority(LCRCA)	M
Intermediary agency	Development Corporation (MDC)	G	Urban Regeneration Corporation (Liverpool Vision)	M, G	Partnership group(LCR, LEP)	M
	Partnership group (TMP, LCR)	M	Partnership group (LSP, LCR)	M		
Private organisation	Developer (Albert Dock Company)	G	Developer (Neptune Developments, Countryside Properties)	G	Developer (Peel Group)	G
	Operator (Merseyside Maritime Museum, TATE Liverpool, Beatles Story museum etc.)	S	Operator	S	Voluntary organisation (EH)	Rg

(continued)

Table 13.1 (continued)

	1980–2000s the Albert Dock regeneration		2000–2010s the Mann Island regeneration		2010s–Liverpool waters scheme	
	Voluntary organisation (SAVE Britain's Heritage, Royal Academy of Arts)	Re	Voluntary organisation (EH, The Liverpool Urban Design and Conservation Panel)	Rg	WHC	Rg
	Resident associations (Merseyside Civic Society)	Re	WHC	Rg	Professional bodies	G
			Professional bodies (3XN, Broadway Malyan, consultancies)	G		
			Investor (LADT)	M		
Key individual	Michael Heseltine	M				

Note M means motive agents, G means generative agents, Rg means regulatory agents, Re means resistive agents and S means sensory agents by reference to general model from Karl Kropf

(ERDF), European Social Fund (ESF), etc. This had made Liverpool more attractive to private investment and enabled regeneration practices to take place in Albert Dock and large areas of the eastern part of the city centre. At the same time, multi-funding management, multi-stakeholder collaboration and the implementation of regeneration practices had placed new demands on the city's governance, which has been crucial in rebuilding governance capacity and relationships with the outside world. In this context, the creation of organisations such as the Mersey Partnership (TMP) and Liverpool City Region (LCR) to reconcile the emerging order with existing governance models had contributed to the renewal of the city's governance framework.

A further key factor made the regeneration model chosen for Albert Dock. The dock was closed in 1972 and listed as a Grade I listed building in England in 1952 due to its outstanding architectural and historic features. In the 1960s and early 1970s, criticism from groups such as the Merseyside Civic Society, Save Britain's Heritage and the Royal Academy of Arts, and the public sentiment it generated, led to the Albert Dock to avoid options for its demolition and land redevelopment. After its closure, the lack of capacity of LCC prevented other attempts to renovate it.

In addition, the success of the Albert Dock regeneration practice was linked to a marked increase in demand for leisure activities, an outcome based on the restoration of the physical environment of the dock and driven by the reorientation of uses, the occupation of iconic public facilities and the adoption of city promotion strategies to increase awareness through international festivals. Merseyside Maritime Museum,

TATE Liverpool and the Beatles Story Museum were built and opened in Albert Dock; and by the 1990s hotels, restaurants and companies were setting up branches in the area. The high demand for leisure uses in the Liverpool docklands during this period resulted in strategic objectives changing to leisure and tourism in later years.

2000–2010s: Mann Island and the Pier Head

The regeneration practice at Albert Dock offered important lessons in terms of awareness of built heritage resources, the value of cultural industries, the priorities and constraints of heritage conservation, the effectiveness of leisure and tourism strategies and public–private partnership models, also lay the foundations for subsequent regeneration practices in terms of administrative context, urban image, physical environment and infrastructure. Administrative aspects included the availability of external funding, the emergence of new institutions and the adaptation of governance frameworks.

In 1999, LCC set up Liverpool Vision with funding from the NWRD and English Partnership (EP). As a recommendation of the Urban Task Force (UTF) report, this type of company was dedicated to promoting development in and around the city centre. The Urban Regeneration Company itself has no significant funding or planning powers, but as a coordinating organisation tasked with identifying development opportunities, preparing strategic plans, and drawing on the expertise of existing agencies to facilitate development. Liverpool Vision provided an effective interface between local authorities and developers and investors, and communicated the local development strategy to the latter and coordinates cooperation so that the strategy can be implemented in practice (Biddulph 2008). At the same time, Liverpool Vision developed a series of master plans and frameworks for some of the larger project within the city, identified areas of development potential for investors and linked them to the wider regional strategy, provided spatial strategies for land use, tourism and building design, and set out development principles and standards, generally as Supplementary Planning Documents (SPD) and reference documents for the consideration of planning applications. Liverpool Vision also supported urban regeneration at a technical level, commissioning external consultants to produce strategic frameworks and engaging external professionals in statutory planning matters with the City Council in the early decade of the twenty-first century.

In 2002, Liverpool set up the ‘Fourth Grace’ international competition for the redevelopment of the Pier Head and the winning building was abandoned due to the high cost of construction, which generated debate about design suitability and site authenticity. Indeed, the regeneration practice of Albert Dock had been criticised for not being linked to the rest of the city and becoming an independent landmark. The competition itself also faced this problem, being located just south of the three iconic buildings on the Pier Head—the Royal Liverpool Building, the Cunard Building and the Port of Liverpool Building—and in the direction of the connection between the commercial area and the water. The failure of the competition also led to a shift from landmark image design to place-making and urban design in Liverpool. Since then, Liverpool Vision, LCC and the NWDR have developed a new masterplan, and the Museum of Liverpool and Mann Island Development, located to the south of the Pier

Head, have been supported by Commission for Architecture and Built Environment (CABE) and English Heritage (EH) for their focus on continuity of public space and historical authenticity alongside architectural quality. However, World Heritage Site status makes tighter controls on the redevelopment of the Docklands heritage, and at the urging of the UNESCO World Heritage Centre (WHC) the Liverpool Maritime Mercantile City World Heritage Site Supplementary Planning Document was developed, which has become the central guiding document for the subsequent development of the waterfront.

2010s–Now: Liverpool Waters Scheme

The launch of the Strategic Investment Framework (SIF) in 2012 meant that the city would move from relying on government and EU funding for regeneration practices to job creation and attracting investment to drive the redevelopment of the docklands and the city as a whole to enhance Liverpool's competitive advantage. Liverpool Waters represents this vision (Liverpool City Centre Strategic Investment Framework 2012), which envisages a complete transformation of Liverpool's north docks. The scheme was proposed by property-led developer Peel Group, which acquired the Mersey Docks and Harbour Company in 2004 with a large amount of unbuilt land on both sides of Liverpool water, from a project called 'Ocean Gateway', which also includes Wirral Waters across the River Mersey. For Liverpool Waters, the scheme was highly controversial for the WHC because it was located entirely within the heritage site and the buffer zone. The original scheme, which featured numbers of iconic skyscrapers, was submitted in 2010 after 3 years of discussions with various bodies including EH and CABE, and planning permission was granted in 2012. However, the EH and CABE still had concerns about the revised scheme, stating that the information in the planning application does not accurately assess the impact of the development on the historic buildings. In addition, the WHC sent a reactive monitoring mission and concluded that the scheme would result in irreversible damage to the Outstanding Universal Value and the integrity and authenticity of the World Heritage Site. In 2013, the UK government confirmed that they would not call-in this scheme, leaving the decision on revenue planning permission to the local planning authorities. The city council's attitude was to support it as the regeneration of the northern part of Liverpool docks was instead a move to reconcile heritage conservation with urban development and had high economic and social benefits.

This phase is represented by the Liverpool Water as a response to the city's development strategy, but it is not only this programme that reflects the structure and role of urban regeneration decision-making factors in Liverpool. In fact, the lessons learned from previous regeneration practices were developed during this phase, such as the establishment of the Liverpool City Region Local Enterprise Partnerships (LEP) and the Combined Authority (CA), which provided financial, technical and administrative support for urban regeneration. Mechanisms have been established and the emergence of new procedures and rules marks the continued development of an urban governance framework.

Summary

Referring to the general model from Kropf (2014), it can be found that public organisation mainly acts as facilitators or controllers of regeneration practices, intermediary Organisation often act as advice providers, and private organisations are in the position of facilitating or hindering practice advice due to their different objectives. In addition, the motive agents in Kropf's model have different manifestations in actual situations, including providing legitimacy, acting procedures and competence, etc.

Analysis of the Urban Landscape

1980–2000s: Regeneration of the Albert Dock

Albert Dock was one of the first enclosed docks in the world, and prior to the implementation of regeneration practices, its landscape pattern was largely defined by the dock itself and the group of buildings that remain intact. The docks are bounded to the north by Canning Dock, between it and the then town boundary by Salthouse Dock, and to the south by Duke's Dock and Wapping Basin. The complex was the Albert Dock Warehouse, the first public general warehouse on the Liverpool Dock Estate, which opened between 1846 and 1847. At the beginning, the Albert Dock complex was separated from the town by the dock wall. After the 1960s, the removal of the quayside warehousing and transit sheds of Salthouse Dock and Duke's Dock left the Albert Warehouses complex as a whole exposed to open views and the high wall was eventually replaced by a road. The structural and functional integrity of the complex and its contrast with the surrounding modern buildings and dense street pattern enhance its uniqueness and visibility (Marketing Services, Liverpool City Council 2003).

The Albert Dock was closed in 1972, and the restoration and redevelopment works led by MTF and MDC in the 1980s began with infrastructure improvements to the dock and surrounding area, including the installation of new roads, sewers, etc., and the design of new bridges to provide connections to the city network, as well as improving water quality at the dock. Its work focused on reflecting the historic character, including the use of traditional materials and the preservation of historic buildings. The regeneration practice of the dock made full use of the dock warehouses, reusing the complex as well as the dock in the form of public services such as museums and galleries (Fig. 13.3) (Marketing Services, Liverpool City Council 2003).

2000–2010s: Mann Island and the Pier Head

This phase of regeneration is represented by the Mann Island regeneration practice closed to the Pier Head which was built in 1771 and under-used by merchant ships in the late nineteenth century due to its shallow and small water level. The site was initially owned in large part by the Mersey Docks and Harbour Commission and in small part by the Liverpool Corporation,[3] after which agreement was reached between the two companies to purchase the site and reserve part of it for the

[3] The predecessor of Liverpool City Council.

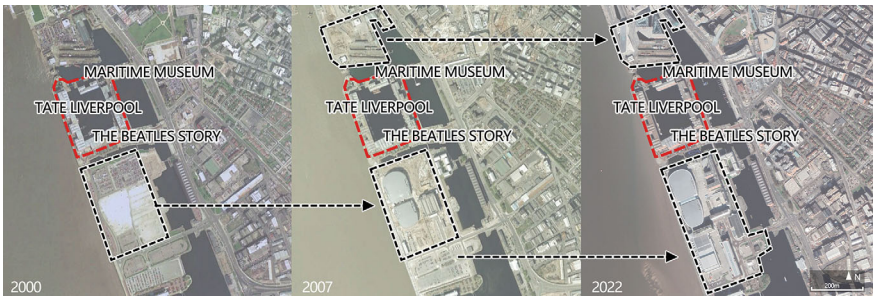


Fig. 13.3 Comparison of satellite images of Albert Dock in 2000, 2007, 2022 (*Note* Adapted from satellite image from Google Earth by the author)

Commission to build new offices. One of the three notable buildings later built on the site was the Mersey Docks and Harbour Board, the other two were built by the Royal Liver Friendly Society and the Cunard shipping line, which later acquired the freehold of the site, respectively. The three buildings, together with the surrounding docks, form the landscape pattern of the area during this period, with dock warehouses to the north and south of the three buildings and a dense commercial area to the east of them, characterised by their large scale, prominent architectural features and orientation towards the riverbank. The three buildings and the office buildings that have been rebuilt in the commercial area were physical testament to Liverpool's commercial prosperity in the early twentieth century.

Since 'Fourth Grace' design faced both high costs and neglect of the historic environment, the Museum of Liverpool and Mann Island masterplan was produced which tried to harmonise the relationship with the three historic buildings, including adaptation of the shape of the site, consideration of the skyline and views, and the appearance of materials and the internal structure of the building (Fig. 13.4).

During the same period, Liverpool One, a comprehensive programme of city centre regeneration driven by Liverpool Vision and implemented by Grosvenor Estates, was implemented to the south of the Commercial District of WHS, retaining much of the original street pattern of the site, with buildings pushed back to redevelop and public space pattern redesigned in a mix way. With the aim of retail development, the site forms an important link between the Commercial District and the Ropewalks area and Albert Dock (Biddulph 2008). In addition, the period 2001–2008 saw the transformation of major sites in the city centre and a considerable number of smaller projects, particularly in the old historic commercial centre particularly around Ropewalks and Castle Street, most of which are mixed use (Fig. 13.4).

2010s–Now: Liverpool Waters Scheme

The Liverpool Waters scheme is located on the Peel Group estate and comprises a site extending from Bramley Moore Dock, currently the most northern part of Liverpool city centre, southwards along the waterfront to Princes Dock, and is also located entirely within the Stanley Dock Conservation Area of WHS and the buffer zone.

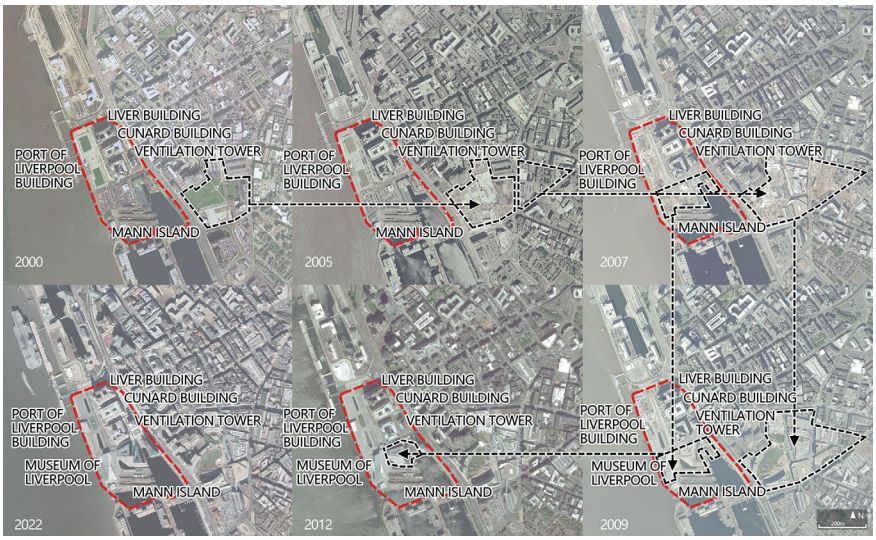


Fig. 13.4 Comparison of satellite images of Mann Island and the Pier Head in 2000, 2005, 2007, 2009, 2012, 2022 (*Note* Adapted from satellite image from Google Earth by the author)

During its time as a dockland area, the landscape pattern of the site comprised a complex of dock walls, docks (Stanley, Collingwood and Salisbury Docks), canals and locks, warehouses and clock towers of varying sizes, which were no longer in use after the closure of the docks, leaving the land, buildings and other structures in a largely derelict state. In the 1980s, Princes Dock was restored and redeveloped by the MDC, along with Albert Dock further south, to provide new infrastructure and develop the land around the docks with new offices and hotels as an extension of the Commercial District.

As a result, Princes Dock has become an important tourist destination and a source of employment for the city in the two decades since the 1980s. Indeed, due to its redevelopment and greater proximity to Liverpool's southern docklands, Princes Dock and its outer eastern site have continued to be infilled with buildings since the twenty-first century (Fig. 13.5), while the rest of the site to the north has remained largely derelict. It was only after 2018 this area were repaired or infilled in preparation for the subsequent development (Fig. 13.5).

Analysis of the Role of Decision-Making Factors

The analysis starts from the structure of the human-agent and looks at the role of the different agents in the key aspects of the decision process as a result of their interaction, and is linked in a timeline (Figs. 13.6, 13.7 and 13.8). According to the British planning system (Ministry of Housing, Communities and Local Government 2021), the complete key aspects of the decision-making process

Fig. 13.5 Comparison of satellite images of Liverpool Waters scheme in 2000, 2007, 2022 (*Note* Adapted from satellite image from Google Earth by the author)

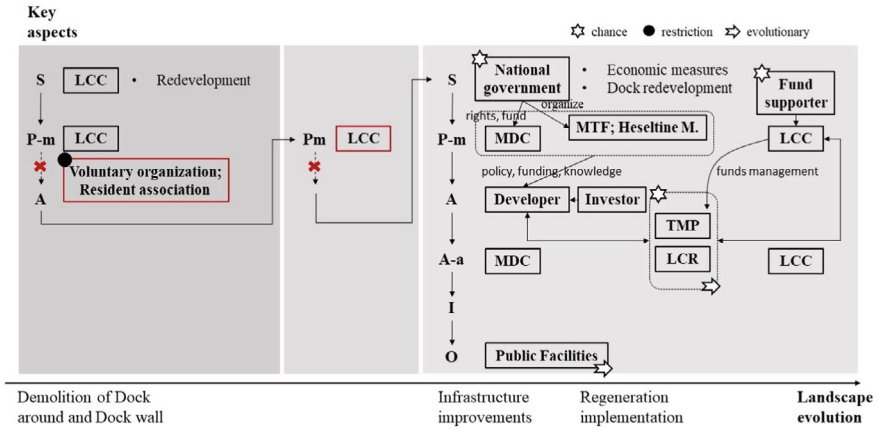


Fig. 13.6 The decision-making process of the Albert Dock regeneration (*Note* Drawn by the author)

are distinguished as 'Strategy, Plan-making, Application, Application-approval, Implementation, Operation'.[4]

1980–2000s: Regeneration of the Albert Dock

The process from the closure of the docks to the MDC-led implementation of regeneration practices can be divided into three stages of decision-making. Following the closure of the docks, the demolition of the quayside warehousing and transit sheds at Salthouse Dock and Duke's Dock and the dock wall, as well as existing international examples of waterfront redevelopment, paved the way for the redevelopment of the docks. As the docks were already a protected building, groups such as the Merseyside Civic Society, SAVE Britain's Heritage and the Royal Academy of Arts raised

[4] In the analysis diagrams, the processes are indicated by acronyms.

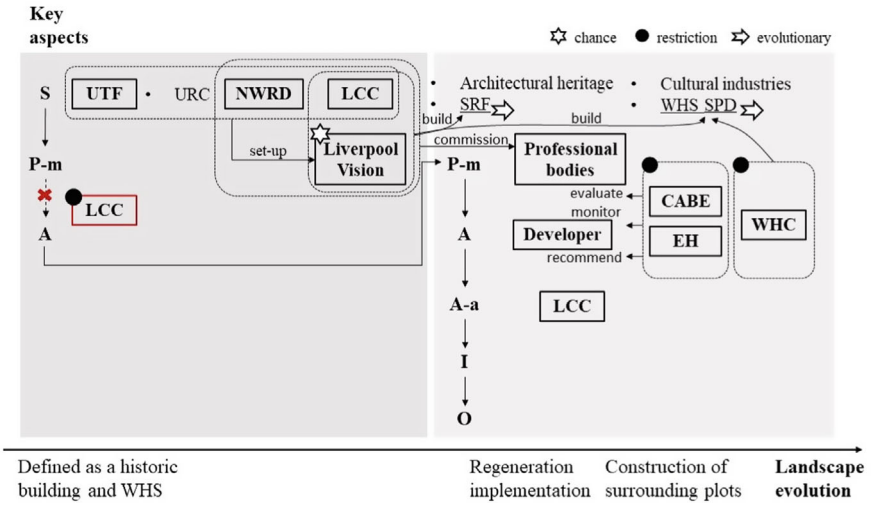


Fig. 13.7 The decision-making process of the Mann Island regeneration (*Note* Drawn by the author)

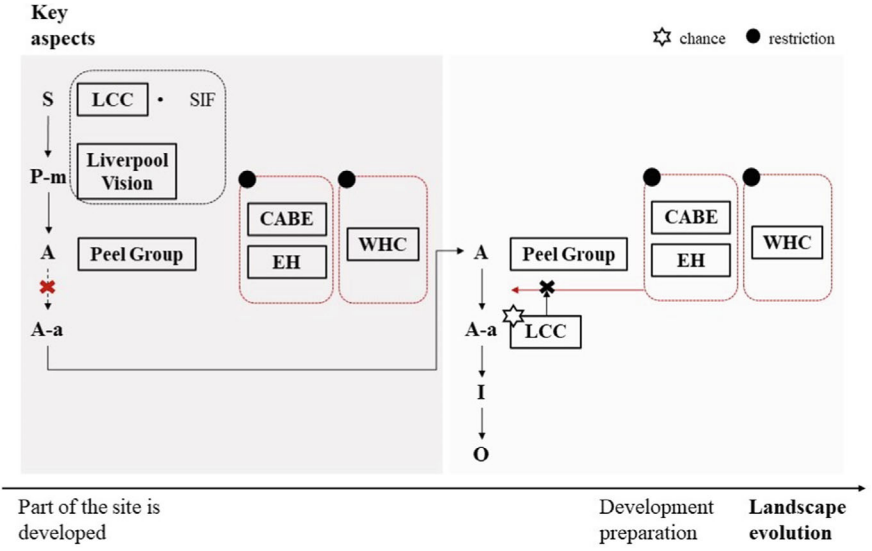


Fig. 13.8 The decision-making process of the Liverpool Waters scheme (*Note* Drawn by the author)

objections to their demolition, which allowed elements of the docks' own landscape pattern to be preserved. The second stage failed to promote change due to the capacity constraints of local planning authorities. The third stage was the key regeneration practice stage of the docks, which was driven by national government's proposed development and governance strategy. Legitimacy was provided for the subsequent

regeneration practices, which was fundamentally motivated by local socio-economic conditions and major social events in Liverpool. The national government formed the MTF and the MDC and appointed Michael Heseltine, who constituted a joint agent, giving the developer, investor, operator and other agents the power and ability to act. Those physical infrastructure improvements drove further physical environmental change. In this regard, intermediary agencies play a role to coordinate the interests of public and private institutions and manage public funds in the process of plan-making, application to permitting. They often have the same objectives as the plan makers and as transmitters of upper-level strategies, thus enhancing the influence of policies with legitimacy, in addition to improving the capacity of mainstream policy implementation. Furthermore, the emergence of the agency retains the shaping power from private interests.

The procedures, rules and mechanisms from this process were also gradually fixed and carried over into subsequent renewal practices. And the feedback from the operational phase influences the policy direction of the subsequent phases.

2000–2010s: Mann Island and the Pier Head

The regeneration practice for Mann Island was based on a more mature model through a two-stage decision-making process. The key element of this process was the URC. The formation of Liverpool Vision was jointly driven by regional and local public organisations, which represented the development and governance strategy for this period. Liverpool Vision and public organisations and LCC became a joint agent forming the producer of the urban policy framework whose formation was also influenced by the outcomes of exchanges between Liverpool Vision and private organisations. As the SPDs eventually became the standard for application approval consideration, the private organisations also influenced to some extent the specific direction of urban regeneration, while its technical expertise would be used as a learning resource and standard reference for subsequent planning and regeneration practice. The reasons for the failure of the first phase of the design competition included the lack of local implementation capacity and the opposition of groups representing the idea of heritage conservation. The process was closely linked to the cultural character of the wider regional landscape in which the site was located and directly bound the subsequent programming process. The following masterplan developed by the public bodies, Liverpool Vision and professional bodies was evaluated by the relevant voluntary organisations and reviewed by the World Heritage organisation, resulting in a supplementary planning document for the heritage site. It turns out to be crucial that the docks and landscape elements, including the Pier Head and the Commercial District to the east, and the Albert Dock to the south, are limited in their heritage status by the way and extent to which the landscape can be shaped. In the case of the Liverpool docklands, the limitation generally takes three forms: spontaneous opposition from the conservation community, a re-examination of its World Heritage status by the World Heritage organisations, and spatial legitimacy constraints by local and even regional authorities. Of these, the third sector will directly determine the decision-making process of landscape shaping, while the first two will influence the third sector's decision, manifesting as acceptance in the

decision-making process of the Mann Island regeneration and as rejection in the Liverpool Waters project.

2010s–Now: Liverpool Waters Scheme

According to LCC's 2012 SIF, the Liverpool Waters scheme is representative of Liverpool's development and governance strategy for this period. In the first phase, the project was not granted planning permission due to objections from CABE, EH and WHC. In the second phase, Peel Groups submitted a scaled down development which, although still not supported by the heritage groups and WHC, was eventually granted planning permission from the local planning authority. Development of the area is now underway, and the landscape pattern is being changed.

13.5 Conclusions

This article focuses on the academic topic of the mechanisms of urban landscape evolution in the field of urban morphology. From the perspective of agent and agency, the conception of landscape shapers, shaping motives and shaping processes in the context of urban regeneration is concentrated on. This is not an independent field with clear boundaries, but rather a certain type of phenomenon with common characteristics in the process of urban development. In terms of the logic of urban functioning, the re-instatement of the physical environment to its structure and function has become an important step in the transformation of post-industrial cities, as an objective requirement for cities to adjust their development paths, improve their facilities and meet service needs, and this phenomenon has increasingly spread around the world and taken on larger forms. Thus, urban regeneration has become a mechanism of urban landscape evolution. As the power to develop urban space is derived from and subject to the concept of legitimacy, the act of developing urban space (including the practice of urban regeneration) is subject to institutional systems and administrative relations, and the effect of this act on shaping the urban landscape is influenced by the decision-making processes determined by these systems and relations. As such, urban regeneration practices often involve multiple groups with different objectives, and the human-agent network (objectives, roles, decision-making positions, interactions) they form, based on institutional and administrative relations influences the direction of the shaping behaviour. Moreover, although human-agent is subjective in nature, the built environment does not only serve as a context for the practice process, but its physical and cultural characteristics will have a directional impact on the practice process. This article examines the role of decision-making factors in shaping urban landscape in an urban regeneration context, looking at the decision-making process and the human-agent structure.

Liverpool Docklands is in discussion. On an urban scale, the practice of urban regeneration in Liverpool has become an important agenda for urban management and governance since the end of the Second World War and has played a significant role in the transformation and redevelopment of the city. This development model

become an important strategy chosen by authorities, which brings about changes in the urban landscape and the framework of urban governance.

The conclusions from the discussion are: (1) The shaping of urban landscape by urban regeneration practices is a complex process involving different agents from public, private and intermediate organisations with differences in their objectives, roles and positions in the decision-making process. Among them, intermediate organisations may form a joint agent with public ones and provide policy, financial and technical support for the whole decision-making process, and include private ones in the consultation mechanism, with the final proposal as the result of coordination. In the UK planning system, the outcome of coordination may ultimately form the criteria for subsequent regional planning approvals. (2) The role of decision-making factors is rooted in the notion of legitimacy of development power and therefore influenced by institutional systems and administrative relationships from the local to the regional level, so that the role of decision-making factors in shaping the landscape takes three forms: restrictive, chance and evolutionary. 'Restrictive' can be expressed in terms of where, how and to what extent the landscape is shaped by existing local institutions and policies and even by the international regimes that are followed, and in terms of obstacles to the shaping of the landscape by social groups based on the public interest or the group's own values. 'Chance' is the emergence of new supportive systems and policies and new supportive institutions to improve the efficiency of decision-making processes, and the use of decision-making power by key agents. 'Evolutionary' is a consideration of temporal variables, and in the case of Liverpool docklands regeneration practice, decision-making factors have changed at different stages, including institutional systems and administrative relationships, institutional and strategic frameworks. Urban governance and strategic frameworks evolve as a result of key decisions, objective needs, learning and feedback from experience. In the decision-making process of urban regeneration, the three types of roles are not independent, but rather intertwined, influencing the landscape patterns that are ultimately expressed in the physical environment. Furthermore, the changing landscape pattern of the Liverpool Docklands also shows that in the plots identified as heritage, high degree of form persistence is maintained from plot to building, but land utilisation shows the opposite, while in the surrounding plots outside, change occurs in all morphological elements and the town plan continues to show high resistance. The above relationship is often reflected in the evolution of the landscape pattern of urban heritage areas facing urban regeneration policies, which is also closely related to the location of the urban heritage.

Indeed, the urban regeneration practices of Liverpool city and the docklands are connecting to places beyond them. Urban landscape presented here is the result of the interplay between economic globalisation and international competition, local heritage and culture, and local interests, and is the response of Liverpool city and the docklands to the socio-economic development issues, extreme urban competition, and changing patterns of urban governance they face. In addition, the landscape itself expresses the local desire to develop a renewed local image and competitiveness.

References

Biddulph M (2009) Liverpool 2008: Liverpool's vision and the decade of cranes. In: Urban design and the British urban renaissance. Routledge, London, pp 120–134

Conzen MRG (1960) Alnwick, Northumberland: a study in town–plan analysis. Trans Pap (Inst Br Geogr) 27:iii–122

Dickinson R (2014) The makers of modern geography (RLE social & cultural geography). Routledge, London

Edwards G, Carr C (2004) The morphological impact of ethnic minority ingress into an established suburban environment. University of Manchester

Essex S, Brayshay M (2007) Vision, vested interest and pragmatism: who re-made Britain's blitzed cities? Plan Perspect 22(4):417–441

Fageir M, Porter N, Borsi K (2021) Contested grounds: the regeneration of Liverpool waterfront. Plan Perspect 36(3):535–557

Gad G, Holdsworth WD (1987) Corporate capitalism and the emergence of the high–rise office building. Urban Geogr 8(3):212–231

Gordon G (1984) The shaping of urban morphology. Urban Hist 11:1–10

King AD (1984) The social production of building form: theory and research. Environ Plan D: Soc Space 2(4):429–446

Knox PL (1984) Symbolism, styles and settings: the built environment and the imperatives of urbanized capitalism. Archit Behav 2(2):107–122

Kropf K (2014) Agents and agency, learning, and emergence in the built environment: a theoretical excursion. In: Shapers of urban form. Routledge, London, pp 327–346

Larkham PJ, Conzen MP (2014) Agents, agency, and urban form: "The making of the urban landscape". In: Shapers of urban form. Routledge, London, pp 27–48

Liverpool City Council, Liverpool Vision: Liverpool City Centre Strategic Investment Framework (2012)

Marketing Services, Liverpool City Council: Nomination of Liverpool-Maritime Mercantile City for Inscription on the World Heritage List (2003)

Ministry of Housing, Communities and Local Government: National Planning Policy Framework (2021)

Preston V, Lo L (2000) Asian theme malls in suburban Toronto: land use conflict in Richmond Hill [Canadian urban landscape examples, 21]. Can Geogr 44(2):182–190

Richthofen FV (1883) Aufgaben und Methoden der heutigen Geographie. Discurso inaugural, Leipzig

Roberts P, Granger R, Sykes H (2016) Urban regeneration. Sage Publications Ltd., London

Sykes O et al (2013) A city profile of Liverpool. Cities 35:299–318

Taylor D, Davenport T (2009) Liverpool: regeneration of a city centre. Building Design Partnership Ltd., Manchester

Whitehand JW (1981) Background to the urban morphogenetic tradition. In: The urban landscape: historical development and management. Academic Press, London, pp 1–24

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 14
The Impact of Plot Configuration on the Patterns of Spatial Change: A Diachronic Approach to the Urban Redevelopment Processes in New York, Melbourne and Barcelona

Onur Tümtürk

Abstract Investigation of the patterns of urban (re)development and identification of the laws behind these processes are critically important to understand how cities evolve under different material conditions. Without denying the effect of socio-economic, cultural and historical peculiarities, it could be argued that 'urban form' itself is also an important aspect guiding future patterns of redevelopment. This research aims to examine morphological conditions created by plot structures and their impact on the patterns of urban redevelopment in three international case studies: Midtown Manhattan (New York), Central Melbourne (Melbourne) and Eixample (Barcelona). Physical changes that occurred in each selected site during identified analysis periods are mapped and measured by relying on a longitudinal geospatial database generated from various cartographic resources. The relationship between patterns of physical change and selected quantitative urban form descriptions of plots (*plot size, accessible plot density, plot frontage, accessible plot frontage and accessible plot size diversity*) is analysed in a diachronic manner. The empirical investigation indicates that character of plot configuration plays an important role in guiding long-term physical change. Critical discussion of these morphological parameters will contribute to our understanding of urban redevelopment processes and help to achieve resilient and adaptable urban spaces by providing specific design conditions.

Keywords Plot configuration · Physical change · Measuring urban form and change · Urban morphology

O. Tümtürk (✉)
Department of Urban Design and Landscape Architecture, Bilkent University, Ankara, Turkey
e-mail: onur.tumturk@bilkent.edu.tr

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_14

14.1 Introduction

Existing physical characteristics of the built environment potentially affect the future (re)development patterns by restricting certain choices and promoting some others. Urban morphology offers an expanding theoretical and methodological framework to investigate this reciprocal relationship between formal preconditions established by buildings, plots and streets and patterns of change in cities. Although plots are widely acknowledged as the most fundamental structural component of urban form (Kropf 1996; Moudon 1997), it remains as the less studied one in the current state of art in urban morphology (Scheer 2018).

In the last years, there is a growing interest in rigorous descriptions of plots and quantitative measurement of plot structures (Bobkova 2019; Berghauser Pont et al. 2019). However, most of these approaches offer 'synchronic' comparison between various spatial settings and do not address spatial dynamics and patterns of change, due to the scarcity of longitudinal datasets (see Fig. 14.1). Studies adopting 'diachronic' approach are relatively scarce within the discipline and the existing ones offer limited insight as they dominantly rely on conventional measures. This research aims to examine the impact of urban form conditions created by plot structures on the long-term patterns of physical change, by comparing three international case studies: Midtown Manhattan (New York), Central Melbourne (Melbourne) and Eixample (Barcelona). To that end, a number of prevalent hypotheses and recent quantitative measures of plots within the literature will be empirically tested and evaluated.

In order to develop a diachronic analysis for the relation between plot structures and physical change, a longitudinal geospatial database has been generated from the cartographic resources, aerial photos and historical records of each case study. The database portrays a series of comparative time frames revealing the physical transformation patterns along with the transition in the configuration of plots. The cross-case analysis of the transformation processes presents empirical findings about the association between the character of plot structures and patterns of change and development.

In the next section (Sect. 14.2), a brief review of urban form studies focusing on plot structures will be presented to identify prevalent hypotheses and common quantitative descriptions of plots. Section 14.3, methodology, presents measures of plots used in the analysis and the key methodological steps, including identification of the case studies, data sources and empirical analysis. In Sect. 14.4, empirical findings of the analysis and cross-case evaluation of the research outputs will be presented. Section 14.5 highlights data-informed insights on the role of plot structures in guiding long-term patterns of physical change and discusses future research directions.

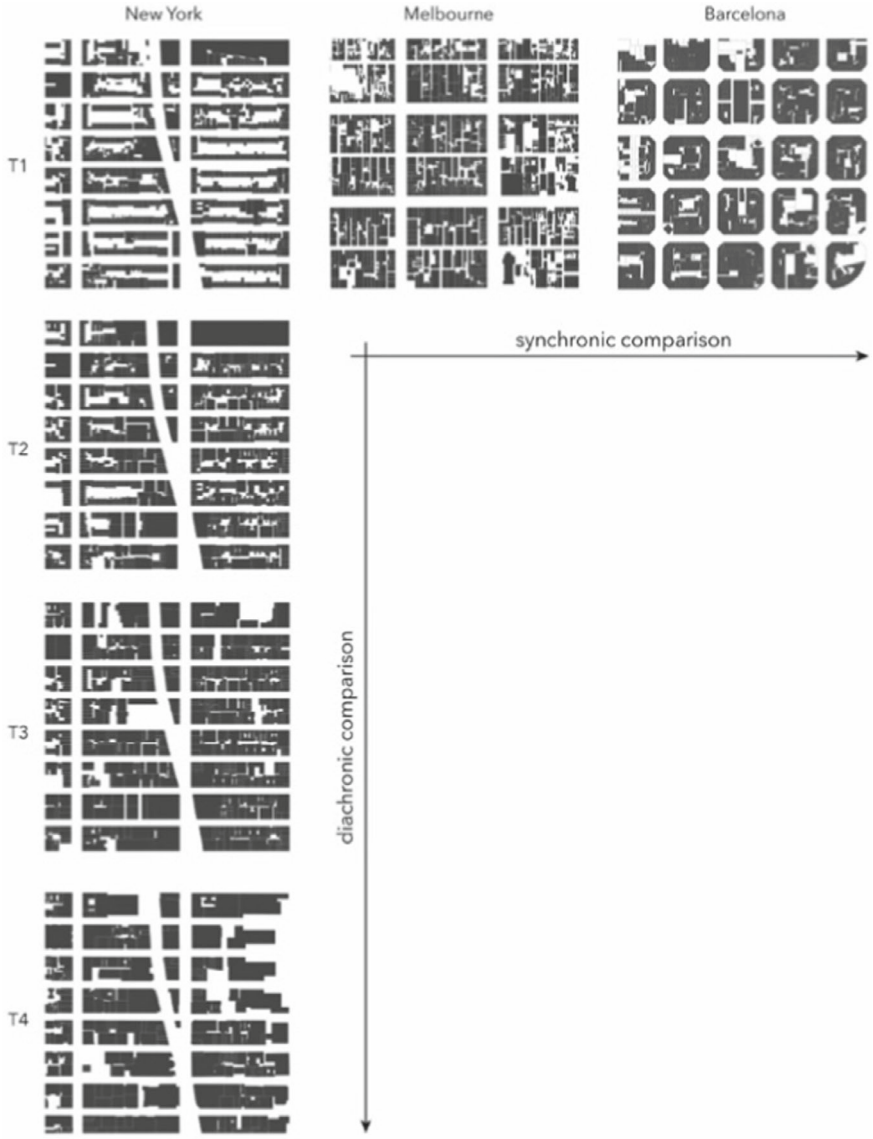


Fig. 14.1 Diachronic and synchronic comparative framework for morphological analysis (*Source* Tümtürk (2024))

14.2 Theoretical Background

Acquired by the subdivision of land into legal spatial entities, plot is the most fundamental unit of control used in the planning and design of settlements. Apart from its ties to socio-cultural institutions, such as ownership and property (Kropf 2018), plot has a physical dimension which gives it a critical role in structuring the character of urban form and affecting spatial transformation processes. In that sense, from a morphological and spatial-analytical perspective, plot serves as a measurable unit of analysis to unravel the relationship between urban form and spatial change: "*a data point consisting only of its measurements, its location, its temporality, its status and its classification*" (Scheer 2018).

There are relatively few morphological studies investigating the association between characteristics of plots and patterns of physical change and persistence. Moudon's (1986) study on Alamo Square is the most known empirical research which demonstrates that ***plot size*** has a determinant effect on physical change since the amalgamation of smaller and many plots requires more effort, time and cost. Conzen (1960) demonstrated that ***size and shape*** of 'burgage plots' and their spatial distribution were determinant on the redevelopment patterns of the medieval town of Alnwick and introduced the concept of 'burgage cycle'. Burgage cycle describes an evolutionary process in which urban densification proceeds parallel to the progressive subdivision of land into smaller plots. In addition to the relation between plot pattern and urban development, Conzen's (1960) study presents an intuitive hypothesis arguing that ***diversity in plot subdivisions*** could facilitate a more continuous adaptive process and provides a resistance to the completion of burgage cycle. Although it has not received sufficient attention like plot size and shape in the literature, the impact of plot subdivision diversity on the patterns of change and persistence deserves a further empirical inquiry. The most recent empirical studies indicate that while smaller and narrow plots accommodate functional adaptations more successfully and physically persist over time (Vaughan et al. 2015; Tümtürk et al. 2022); larger plots tend to be redeveloped more often in the long term (Whitehand and Carr 1999; Törmä et al. 2017; Hallowel and Baran 2020).

It should be noted that nearly all of these studies have exclusively been conducted in relatively low-dense and monofunctional suburban neighbourhoods. Moudon (1986) warns that some well-known parameters (such as plot size and shape) "*may not forcefully curtail change in non-residential areas because of the shorter cycles of business change*" (p. 141). Therefore, empirical testing of these prevalent hypotheses and widely used measures within different contexts is an important objective of this research.

In addition to the above-mentioned well-known plot descriptions, this study utilizes a new set of quantitative plot descriptions based on the concept of 'accessibility'. Although it is not a diachronic research, Bobkova's (2019) study portrays a new set of plot measures which could be utilized in longitudinal studies to understand temporal transformation and development patterns. Bobkova et al. (2021) demonstrated that accessibility-based plot descriptions (such as ***accessible plot density*** and

accessible plot frontage) are important variables explaining the concentration and diversification of economic activities in cities.

In the following sections, a methodological framework including conventional and novel plot descriptions will be presented as part of the analytical approach of this research. Accordingly, identified quantitative variables and their relationship with the patterns of physical change will be analysed in a diachronic manner.

14.3 Methodology

The research is based on diachronic and quantitative comparison of multiple case studies through multiple time frames, to understand the association between plot configuration and patterns of physical change. Therefore, it is important to identify both spatial and temporal boundaries of the analytical framework. Three distinctive case studies were selected from different geographies and contexts: Midtown Manhattan (New York), Central Melbourne (Melbourne) and Eixample (Barcelona). Selected study areas are large enough (approximately 2,5 km^2) to accommodate a sufficient spatial diversity and a number of different character areas within their boundaries (Davis 2013). Spatial boundaries of the analysis sites were additionally expanded by creating a 400-m buffer—which could be defined as average accessible distance by walking (Gehl 1987). Thus, the surrounding spatial context was also included in the morphological analysis. In terms of temporal boundaries, four different periods were selected to map and compare spatial conditions of each case study. The identified analysis periods correspond to the years when sufficient land surveys and map preparation were conducted before major planning regulations. Although they slightly differ between each case study, selected years successfully represent industrial (the 1880s), modernist (1920s), post-modernist (1960s) and contemporary (2000s) urban development patterns. Availability of the cartographic resources within these periods allowed to generate a comprehensive geospatial database including the elements of plots, buildings and streets across four distinctive time frames.[1]

By relying on the existing theoretical discussions on plot structures (Sect. 14.2), the following independent variables were selected to describe and measure the character of plots: ***plot size, accessible plot density (APD), plot frontage (PF), accessible plot frontage (APF)*** and ***accessible plot size diversity (APSD)*** (see Table 14.1). In addition to the descriptors of plots, patterns of urban redevelopment were conceptualized with respect to the concept of ***physical change***. Physical change describes transformation of the built form either through demolishment of existing buildings or construction of new ones between each analysis period. Identified physical changes between each time frame were projected into the plots containing them and two different populations of plots were categorized: *(a) plots accommodating physical change* and *(b) plots retaining their physical quality*. Thus, both numerical values of identified plot variables and categorical information of change or persistence were collected and stored at the scale of individual plots.

Table 14.1 Independent variables of plots and dependent variable of physical change used in the analytical framework (*Source* Tümtürk et al. (2024))

Variable	Equation	Index
Plot size	Area	
Accessible plot density (APD)	APD(o; D) = AR(o; pc; D)	o: origin, D: destination AR: attraction reach (400 m) pc: plot count
Accessible plot size diversity (APSD)	Simpson Diversity Index $= (1 - \mathrm{D}) = 1 - \frac{\sum ni(ni-1)}{N(N-1)}$	n_i: number of plots in size categories of i (XS, S, M, L, XL) N: total number of plots
Plot frontage (PF)	$PF = \frac{sfl}{ppl}$	sfl: street frontage length ppl: plot perimeter length
Accessible plot frontage (APF)	$APF(o; D) = \frac{AR(o;sfl;D)}{AR(p;ppl;D)}$	sfl: street frontage length ppl: plot perimeter length
Physical change	*Identified through demolishment of existing buildings and/or construction of new ones between each time frame. Physical changes are projected into 'plots' to store the categorical information of (a) change and (b) persistence for each individual plot*	

Amongst the variables, ***plot size*** is the most fundamental geometric description defining the spatial quality of plots and it has been widely discussed as the determinant of spatial change and persistence. The categories of plot sizes were defined by considering the original plot sizes established for each case study at the beginning of nineteenth century. Size categories were identified as extra-small (0–500 m^2), small (500–1000 m^2), medium (1000–2000 m^2), large (2000–5000 m^2) and extra-large (above 5000 m^2), respectively. ***Accessible plot density (APD)*** defines the number of plots accessible within identified catchment (which is 400-m walkable distance in our case (Gehl 1987)) for each individual plot taken as the origin. As different from the plot size which is defining the individual geometric quality of each plot, APD quantifies the intensity of potential destinations (i.e. plots) reachable via street network. Thus, it helps to evaluate the granular character of plot structures in a contextual catchment area, instead of individual size of plots. While the higher values of APD are associated with fine-grain plot compositions defined by many and small plot subdivisions, the lower values indicate coarse-grain compositions of a few and larger plots.

Accessible plot size diversity (APSD) quantifies the degree of the diversity of plot sizes accessible within 400-m walking distance for each individual plot taken as the origin (Feliciotti et al. 2016; Tümtürk 2024). Calculated by the Gini-Simpson Diversity Index, APSD defines the degree of heterogeneity for the distribution of plot sizes within accessible reach.

Plot frontage (PF) is measured by the ratio between plot's frontage length and its total perimeter; and it defines the narrowness or broadness of plot shape. While lower

plot frontage values are associated with narrow plots, higher plot frontage values represent broader plot shapes. Although it is mostly discussed with reference to the conditions of active street life and presence of potential interfaces in the literature, plot frontage could be a critical determinant affecting the patterns of change and persistence as well. ***Accessible plot frontage (APF)*** is the cumulative opportunity measure of the same variable and evaluates narrowness/broadness of plot structures within accessible catchment (Bobkova et al. 2017).

Since it is aimed to investigate how 'existing' urban form conditions of each time frame affect the patterns of physical change emerging until the next period, calculated measures are represented and mapped for each distinctive time sequence. All quantitative variables, except plot size, are represented by using equal interval discretization for 5 classes: lowest (0–20%), low (20–40%), medium (40–60%), high (60–80%) and highest (80–100%). In the next section, physical transitions between each analysis period for each case study will be presented along with the analysed measures of plot structures. Thus, the hypothetical relationship and alignment between the spatial character of plot structures and long-term patterns of physical change will be discussed critically.

14.4 Results and Discussion

Comparison of each analysis period reveals various transition patterns in plot structures in three distinctive case studies. The number of plots in New York decreases drastically through time, due to amalgamations of plots to accommodate larger building footprints (see Fig. 14.2). Since the analysis areas in Melbourne and Barcelona didn't reach their spatial extents until the end of the first analysis period, subdivision of the land continued as parallel to urban development processes and the number of plots increased until 1920s. After that period, while Melbourne gradually has lost its fine-grain plot structure like New York, the number of plots in Barcelona remain consistent over years reflecting its enduring urban form characteristics. Similarly, while the average plot size in Barcelona has been stable across years—around approximately 500 m^2—average size of plots in New York and Melbourne has substantially increased from 257 m^2 to 805 m^2 and from 455 m^2 to 914 m^2, respectively (see Fig. 14.3).

In order to investigate the relation between identified plot variables and the patterns of physical change, plots accommodating physical change and persistence are categorized and mapped for each time frame. The analysis areas in Melbourne and Barcelona were still in urban development process and did not reach their spatial extents until the second time frames. Therefore, their first analysis periods were excluded from the analysis because of the fact that it was theoretically not possible to observe patterns of physical 'change', but 'development'.

Analysis of the relationship between ***plot size*** and physical change does not present an obvious and consistent association between them, across case studies and analysis periods. For instance, in Midtown Manhattan (New York), extra-small (XS) plots

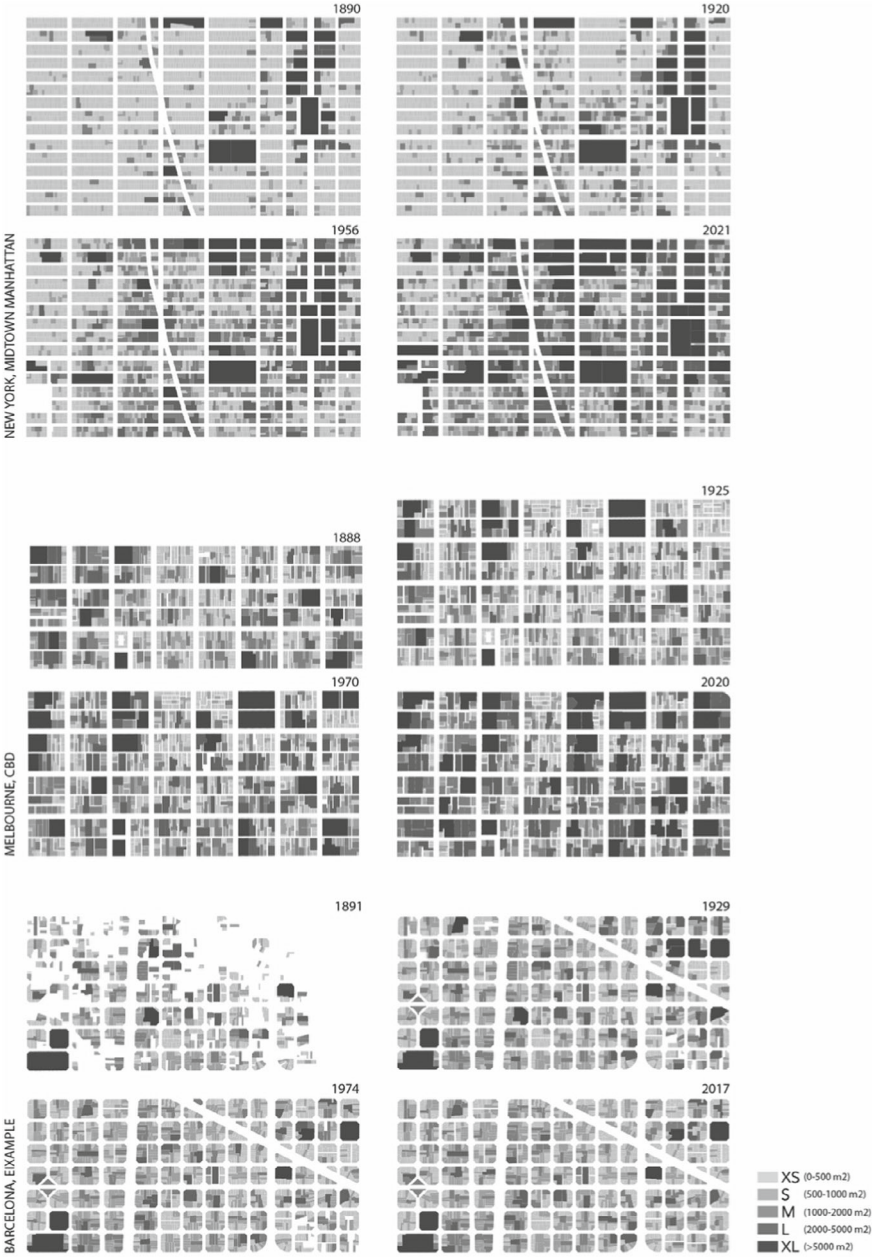


Fig. 14.2 Transformation of plot configuration and change in the distribution of plot sizes in Midtown Manhattan (New York), Central Melbourne (Melbourne) and Eixample (Barcelona) (*Source* Tümtürk (2024))

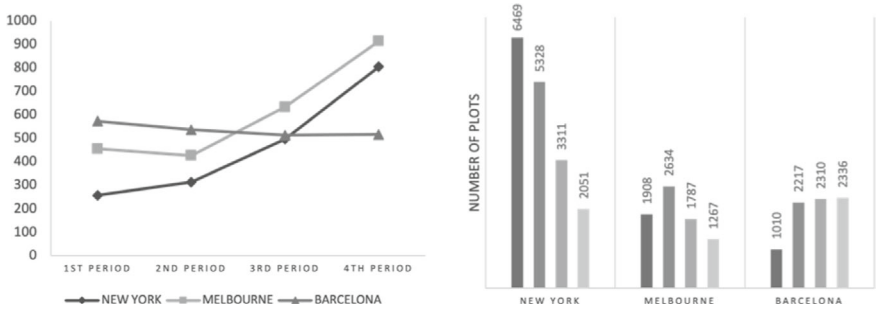


Fig. 14.3 Change in average plot size (left) and number of plots (right) in Midtown Manhattan (New York), Central Melbourne (Melbourne) and Eixample (Barcelona) (*Source* Tümtürk (2024))

changed more often than small (S) and medium (M) plots in the second and third analysis periods (see Fig. 14.4). In Eixample (Barcelona), the second analysis period presents a positive relationship between plot size and change and demonstrates that as plot size increases percentage of physical change rises too. However, this relationship could not be find in the third analysis period in a consistent manner. Amongst the case studies, only Melbourne portrays the hypothesized (by existing literature) positive relationship between plot size and physical change. Contrary to widely accepted arguments in the literature, empirical analysis results within this research do not provide support for the relation between plot size and physical change.

The empirical analysis of each case study indicates that plots having higher ***accessible plot density (APD)*** values are the ones resisting to physical change more through the years (see Fig. 14.5). On the other hand, lower APD values are associated with relatively more physical change. It demonstrates that coarser grain urban fabrics are more prone to physical transitions via frequent building demolitions and new constructions. For instance, in Midtown Manhattan (New York), while 48% of plots in the 'lowest' APD class physically changed, only 15% of plots in the 'highest' APD class experienced physical transition during the first period (see Fig. 14.5).

This relationship is consistent across the second and third periods as well and demonstrates that there is a negative relationship between APD and physical change.

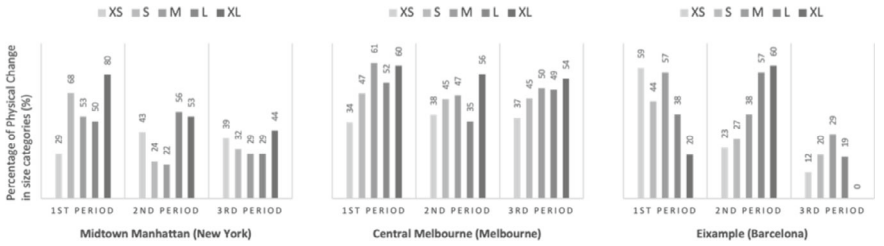


Fig. 14.4 Relationship between plot size and physical change in Midtown Manhattan (New York), Central Melbourne (Melbourne) and Eixample (Barcelona) (*Source* Tümtürk (2024))

Fig. 14.5 Relationship between accessible plot density (APD) and physical change in Midtown Manhattan (New York), Central Melbourne (Melbourne) and Eixample (Barcelona) (*Source* Tümtürk (2024))

Excluding their first analysis periods due to previously mentioned reasons, Central Melbourne and Eixample (Barcelona) portrays the similar relationship across each analysis period (see Fig. 14.5). Though it deserves a systematic and further statistical analysis, it could be argued that the percentages of plots accommodating physical change are comparatively higher in the areas having lower APD values. It shows that the mutual support of many and small plots at particular locations make them more resistant to physical change and retain their urban grain qualities through time. It could be considered that accessible plot density (APD) indirectly measures sizes of plots, as the plot sizes decrease the number of plots accessible within catchment area increases naturally. However, it is important to observe that APD is more successful in capturing patterns of physical change than individual plot size. Especially in New York and Barcelona, there is no obvious relationship between plot size and physical change, as much as that of APD and physical change. Since accessible plot density evaluates the condition of each plot within accessible context, it provides more information in explaining physical change which is arguably affected by the conditions of the surrounding context as well.

Analysis of ***accessible plot size diversity (APSD)*** illustrates the degree of heterogeneity in plot sizes within accessible reach. The comparative analysis of each time frame indicates that heterogenous plot structures manifest more and frequent physical change in each case study. On the other hand, homogenous plot structures, identified with lower APSD values, resisted to physical changes more and stayed intact through time (see Fig. 14.6). For instance, in Midtown Manhattan (New York), homogenous character areas—having 'lowest' APSD—show 14%, 19% and 12% physical change, respectively, for the consecutive analysis periods. On the other hand, heterogenous areas—having 'highest' APSD—show 50, 47 and 38% physical change across these periods. In Central Melbourne, single exceptional peak of 53% physical change in the lowest APSD category could be attributed to large-scale planning interventions to construct coarser superblocks by amalgamating many small plots in the third period. In Eixample (Barcelona), plots accommodating physical change seem to be distributed equally into the categories of APSD ranging from the lowest to the highest. Although there is no obvious relationship between physical change and accessible plot size diversity in Barcelona, the analysis does not indicate contrasting results too. Acknowledging that it presents some exceptional circumstances, accessible plot size diversity (APSD) still provides notable insights into understand physical changes across years for the cases of New York and Melbourne.

Plot frontage (PF) defines the degree of being narrow and deep or broad for a plot. According to analysis, individual plot frontage measures do not show a consistent relationship with the patterns of physical change. As shown in Fig. 14.7, the relation between PF and physical change is inconsistent not only between case studies but also within the same cities across analysis periods. The results do not provide empirical support for the widely accepted relation between individual plot shape (narrowness/broadness) and physical change.

Contrary to PF, there is a positive and consistent relationship between ***accessible plot frontage (APF)*** and physical change for each case study and analysis period (see Fig. 14.8). It could be argued that plot structures composed of deep and narrow

Fig. 14.6 Relationship between accessible plot size diversity (APSD) and physical change in Midtown Manhattan (New York), Central Melbourne (Melbourne) and Eixample (Barcelona) (*Source* Tümtürk (2024))

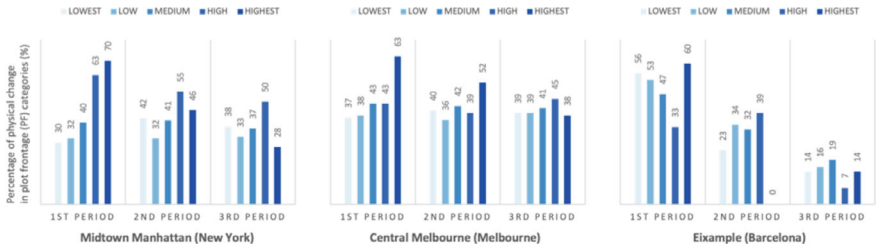


Fig. 14.7 Relationship between plot frontage (PF) and physical change in Midtown Manhattan (New York), Central Melbourne (Melbourne) and Eixample (Barcelona) (*Source* Tümtürk (2024))

plots (with lower APF) are more resistant to physical change. On the other side, areas characterized by broader plot shapes (with higher APF) have accommodated more physical change through time in each case study. For instance, in Midtown Manhattan (New York), broader plot structures—having 'highest' APF—show 53, 50 and 35% physical change for consecutive analysis periods. On the other hand, areas characterized by narrow plot structures—having 'lowest' APF—show only 21, 35 and 2% physical change across the analysis periods. Similar to the comparison of individual plot size and accessible plot density (APD), accessible plot frontage (APF) seems to be more successful in capturing patterns of physical change than individual plot frontage (PF). It reinforces the argument that accessibility-based measures work better than individual measures (size and shape) in explaining physical change since they evaluate the conditions of plot structures within an accessible context.

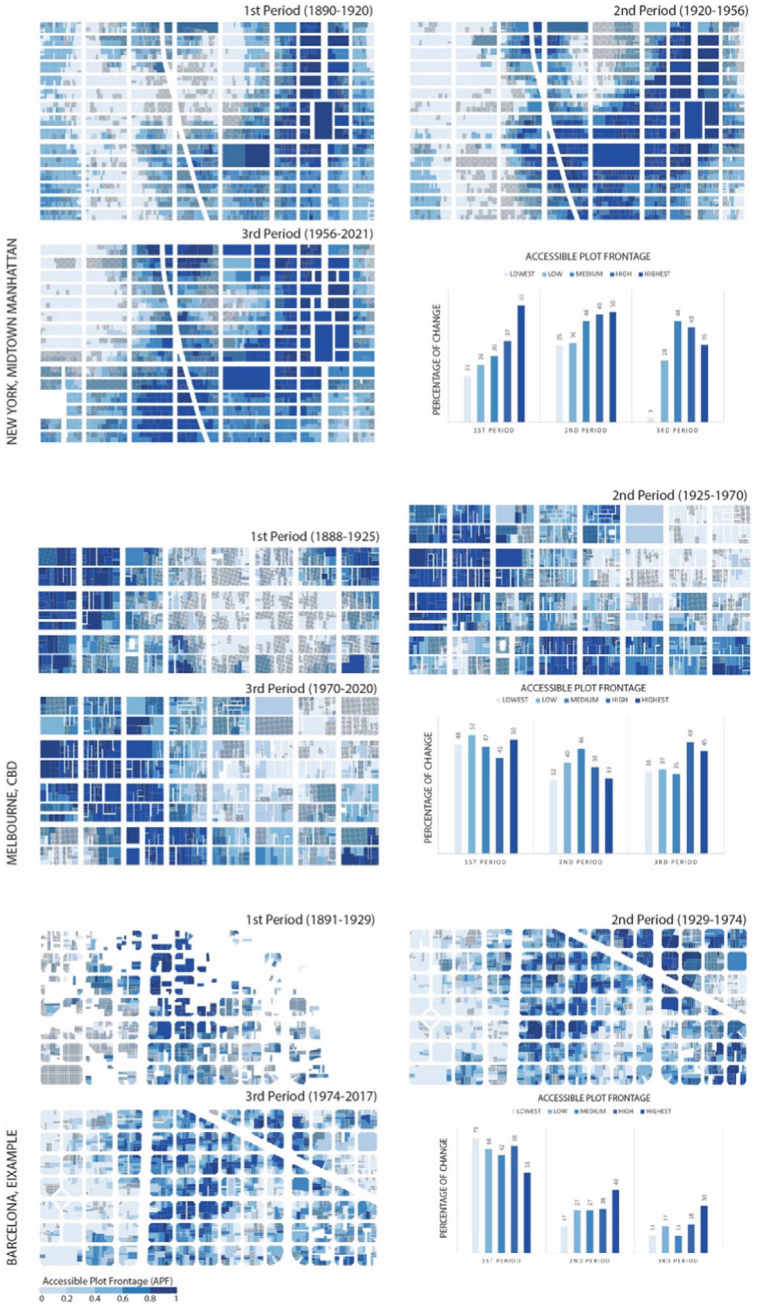


Fig. 14.8 Relationship between accessible plot frontage (APF) and physical change in Midtown Manhattan (New York), Central Melbourne (Melbourne) and Eixample (Barcelona) (*Source* Tümtürk (2024))

14.5 Conclusion

The empirical analysis indicates that plot configuration and character of plot structures play an important role in guiding long-term physical change in each of selected case studies. Acknowledging some exceptional results in specific periods, the findings illustrate that most long-term patterns of physical change and urban redevelopment could be explained by relying on the identified urban form descriptors. *Accessible plot density* (APD) has a consistent negative association with physical change in each case study and analysis period. In that regard, it is more successful in capturing patterns of physical change than *individual plot size*—which has been widely acknowledged as the most fundamental measure defining the rate of change in the built environment. Complementary to that, *accessible plot size diversity* (APSD) is another important variable having positive relationship with physical change. In that sense, fine-grain and homogenous plot structures are more resistant to the emerging pressures of urban redevelopment and change, comparing to character areas identified with coarser and heterogenous plot structures. In addition, higher values of *accessible plot frontage (APF)* are associated with higher rates of physical change, indicating a positive association. It could be argued that plot structures composed of deep and narrow plots and identified with lower APF values are more resistant to physical change. On the other hand, the research could not identify a similar relationship between individual version of the measure—*plot frontage (PF)*—and physical change.

The analysis demonstrates that accessibility based measures perform better in associating with the patterns of physical change, comparing to individual geometric measures of size and shape which are prevalent in the existing literature. It shows that evaluating the character of plot structures within a pre-defined accessible reach leads better results by taking the closer context into consideration (Tümtürk et al. 2024). The analysis should be reproduced at various catchment distances and at different contexts to optimize the findings of this study. Moreover, the analysis showed that the relationship between plot variables and physical change may show some exceptional results at certain periods. These discrepancies could be attributed to large scale and top-down planning interventions, which could be potentially included in future studies. External and non-physical aspects such as socio-economic, political and historical dynamics could be also helpful to interpret discrepancies and contextual circumstances.

The research provides empirical support for the role of plot configuration in guiding long-term patterns of change. As opposed to the prevalent hypotheses focusing on individual geometric measures of ‘size’ and ‘shape’, it demonstrated the success of accessibility based measures in capturing patterns of physical change. These preliminary findings should be questioned with the help of different morphological variables and measures, and supported with a coherent statistical analysis to draw further conclusions. Adopting cluster analysis techniques by relying on multivariables of plot structures and developing plot typologies to assess their capacity of spatial change could be the next step to extend the outcomes of the research. Critical

discussion of these morphological variables and their association with the patterns of change and persistence has a potential to contribute to our understanding of urban redevelopment processes and help to regenerate resilient and adaptable urban spaces by design.

Acknowledgements The research presented in this paper is part of a Ph.D. research completed at the University of Melbourne, Faculty of Architecture, Building and Planning and funded by the University of Melbourne—Melbourne Research Scholarship. The author would like to thank Prof. Justyna Karakiewicz and Dr. Fjalar De Haan for their generous interests and constructive comments on the earlier versions of the manuscript.

Notes

1. For New York, Sanborn Insurance Maps in the Collection of Atlases of New York City are retrieved from open-access Digital Collections of the New York Public Library [https://digitalcollections.nypl.org] and PLUTO datasets (version.21v3) are retrieved from NYC Department of City Planning's website [https://www1.nyc.gov/site/planning/data-maps/open-data/dwn-pluto-mappluto.page]. For Melbourne, Mahlstedt's Fire Insurance Plans are retrieved from State Library of Victoria [https://www.slv.vic.gov.au/search-discover/explore-collections-format/maps/maps-melbourne-city-suburbs/fire-insurance-plans] and the recent geospatial data are retrieved from City of Melbourne's Open Data Platform [https://data.melbourne.vic.gov.au]. For Barcelona, historical maps and records are retrieved from Historical City Archive of Barcelona [https://ajuntament.barcelona.cat/arxiumunicipal/arxiuhistoric/en] and the recent geospatial data are retrieved from Barcelona's City Hall Open Data Service [https://opendata-ajuntament.barcelona.cat/en/].

References

Berghauser Pont M, Stavroulaki G, Bobkova E, Gil J, Marcus L (2019) The spatial distribution and frequency of street, plot and building types across five European cities. EBP: Urban Anal City Sci 46(7):1226–1242

Bobkova E, Marcus L, Berghauser Pont M (2017) Multivariable measures of plot systems: describing the potential link between urban diversity and spatial form based on the spatial capacity concept. In: Proceedings of the 11th space syntax symposium, vol 47. Lisbon, pp 1–47

Bobkova E (2019) Towards a theory of natural occupation: developing theoretical, methodological and empirical support for the relation between plot systems and urban processes. Unpublished PhD thesis, Chalmers University of Technology, Sweden

Bobkova E, Berghauser Pont M, Marcus L (2021) Towards analytical typologies of plot systems: quantitative profile of five European cities. Environ Plan B: Urban Anal City Sci 48(4):604–620

Conzen MRG (1960) Alnwick Northumberland: a study in town-plan analysis. Institute of British Geographers Publication 27, London

Davis J (2013) Evolving cities: exploring the relations between urban form resilience and the governance of urban form. London School of Economics and Political Science

Feliciotti A, Romice O, Porta S (2016) Design for change: five proxies for resilience in the urban form. Open House Int 41:23–30

Gehl J (1987) Life between buildings. Island Press, Washington DC

Hallowel G, Baran P (2020) Neighborhood dynamics and long term change. Geogr Anal 53(2):213–236
Kropf K (1996) Urban tissue and the character of towns. Urban des Int 1:247–263
Kropf K (2018) Plots, property and behaviour. Urban Morphol 22:1–10
Moudon AV (1997) Urban morphology as an emerging interdisciplinary field. Urban Morphol 1:3–10
Moudon AV (1986) Built for change: neighborhood architecture in San Francisco. MIT Press, Cambridge, Massachusetts
Scheer B (2018) Towards a minimalist definition of the plot. Viewpoint. Urban Morphol 22:162–163
Törmä I, Griffiths S, Vaughan L (2017) High street chageability: the effect of urban form on demolition, modification and use change in two south London suburbs. Urban Morphol 21(1):5–28
Tümtürk O, Karakiewicz J, De Haan F (2022) Adaptability of urban grids: patterns of morphological change and persistence in Midtown Manhattan, 1884–2011. In: Annual conference proceedings of the XXVIII international seminar on urban form. University of Strathclyde Publishing, Glasgow, pp 201–210
Tümtürk O (2024) A data-driven investigation on urban form evolution: Methodological and empirical support for unravelling the relation between urban form and spatial dynamics. Unpublished PhD thesis, The University of Melbourne, Australia
Tümtürk O, Karakiewicz J, De Haan F (2024) The impact of urban form on physical change: a quantitative and diachronic analysis of urban form evolution in Midtown Manhattan. Environ Plan B: Urban Anal City Sci 0(0):1–21
Vaughan L, Törmä I, Dhanani A, Griffiths S (2015) An ecology of the suburban hedgerow, or: how high streets foster diversity over time. In: Proceedings of the 10th international space syntax symposium, vol 99, pp 1–19
Whitehand J, Carr CMH (1999) The changing fabrics of ordinary residential areas. Urban Stud 36(10):1661–1677

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 15
The Impact of Innovation Economy on Urban Form and Its Transformation: Taking Cases on Shenzhen

Zhenyuan Yang and Kai Xu

Abstract In recent years, many startup businesses have grown with the development of the so-called high-tech industries. Unlike conventional enterprises, these firms prefer to settle down in city centers, which gradually form innovation clusters leading to renewal processes that transform old buildings in the city. The aim of this paper is to research how the innovation economy has boosted such renewal processes and its impact on urban form. Shenzhen has been selected as the case study, which is known as the fastest-growing Chinese city highly dependent on its high-tech industry. The method is to map the distribution of 19,232 innovation companies by linking their spatial information with their innovation capacity indexes. Certain concentration areas can be identified and classified as innovation clusters according to their business models. The innovation clusters are categorized into four types. Their distribution patterns, characteristics, and formulation principles were analyzed to investigate the relation between the business composition of innovation clusters and urban morphology. By analyzing the Che-Gong-Miao area, the function of old factory buildings and their value in the renewal process was revealed. A set of morphological principles can be concluded regarding such renewal processes driven by the innovation economy.

Keywords Innovation cluster · Innovation district · Urban morphology

Z. Yang (✉) · K. Xu
College of Architecture and Urban Planning, Tongji University, 1239 Siping Road, Shanghai, China
e-mail: yangzhenyuan@tongji.edu.cn

Z. Yang
School of Architecture and Urban Planning, Shenzhen University, 3688 Nanhai Avenue, Shenzhen, China

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_15

15.1 Introduction

With the trend of globalization and technological economy, innovation clusters have gradually become a new type of highlighted urban form in cities. More importantly, innovation clusters are the crucial driving force of urban renewal that generates more jobs and benefits the economy in urban central areas, making them worthy of in-depth urban research. In the 1980s, so-called "innovation districts" were formed in Kendall Square in Boston (Katz et al. 2013). Young people working in the innovation industries have been paying more attention to the central area with better amenities and opportunities when selecting office sites (Florida 2004). They hope to have more exchanges with their peers while maintaining the quality of life, and are willing to reduce rent by sharing office space with others. Thus, innovation districts developed in this background and were distributed in the central area of the city, usually concentrated in one or several blocks (Florida 2003).

At the beginning of the twenty-first century, the Brookings Institution, a renowned American think tank, conducted relevant theoretical research on the development of innovation districts driving the renewal of urban centers. Katz et al. (2013) summarized the theory of the innovation district, which garnered extensive attention from the academic community regarding this urban phenomenon. The emergence of innovation industries and the formation of innovation clusters in the urban core area have gradually changed the population composition and economic model of the urban center, leading to the renewal of the urban center and the gradual evolution of urban form (Katz et al. 2013). This paper aims to use Shenzhen as a case study, where a strong innovation industry has developed in recent years, to research the urban morphology of innovation clusters.

In 2021, the total market value of science and technology companies in Shenzhen reached 10.64 trillion CNY, ranking first in China. The number of patent applications in Shenzhen also ranked first among large- and medium-sized cities in the country. In addition to the early-founded high-tech park area, a number of industrial clusters have formed in Shenzhen, including various innovation clusters, especially the innovation districts created in the city to incubate startups and small scientific and technological entrepreneurial teams.

After just 40 years of urban development, Shenzhen has become a globally recognized innovation city that has undergone the industrial development process from manufacturing to R&D oriented. Within such a short period of time, the development trajectory remains clear, which allows for further study of how the innovation industry has developed and correlated with urban morphology. This paper firstly studies the spatial distribution principles of innovation clusters in the city. Secondly, it analyzes the classification of innovation clusters based on industrial characteristics. Thirdly, through a case study of a typical innovation district, the correlation between the innovation industry and urban morphology is researched.

15.2 Literature Review

The researches related to the topic of innovation districts can be categorized as two types. The first is focused on the economic aspect, with the formulation of the industrial cluster concept by Porter (1998). He argued that location remains the most influential factor for industrial development and that industrial clusters benefit all firms located in the area. Florida (2003) expanded on this concept with a focus on firms in cities and analyzed the driving factors of diversity and creativities in relation to innovation. Clark et al. (2010) analyzed regional-scale data on global patenting by large and small firms to examine the resilience of innovation ecology. Patenting data was used as an essential index for measuring the performance of innovation firms. More indicators of innovation districts were reviewed, by analyzing the regeneration strategies of 22@ in Barcelona, the business configurations of innovation districts were identified (Pareja-Eastaway, Pique 2011). According to the business models, the typical forms of innovation districts based on business models, classifying them into three types: science clusters, high-tech clusters, and creative clusters (Bröcker et al. 2012). Although those researches provided definition and general indicators of innovation districts, it lacked the analysis of the urban morphologies of innovation districts, which are the basis for formulating industrial clusters.

The second category of related research gradually shifted its attention to the built environment of innovation districts. Researchers analyzed the physical forms of innovation districts on a small to medium scale using a qualitative approach with regard to sustainable development (Forsyth, 2014). Hawken et al. (2017) investigated the spatial distribution pattern of innovation firms in relation to their business connections and physical connections to urban form. Pancholi et al. (2018) explored the key design attributes related to the placemaking of knowledge and innovation spaces, which enabled subsequent research to classify innovation districts according to the related concept framework of place quality (Yigitcanlar et al. 2020). This concept framework was further expanded into an operational framework that included four dimensions (feature, function, space, and context), 16 indicators, and 48 measures (Adu-McVie et al. 2021). However, few studies have analyzed innovation districts while considering their impact on the overall urban environment from the perspective of urban morphology.

On the one hand, innovation districts demonstrate strong internal connections between firms located within them. On the other hand, innovation districts are also related to a diversity of built environments, which can be mapped and classified into various types. This phenomenon has spurred the study of how clusters of innovation firms are related to certain urban forms. This paper aims to investigate these correlations, categorize them into different types, and provide insights into their functions as parts of the city.

15.3 Background

As one of the fastest-growing cities in the world, Shenzhen celebrated its 40th birthday in 2020. In a remarkably short period, the city has grown from a small town with just 30 thousand people to a megacity with nearly 20 million people, a miraculous feat in the history of urban development. One key factor contributing to Shenzhen's rise is the beneficial policies that have arisen from China's economic reform since 1979. In 1980, the Chinese central government officially designated Shenzhen as the country's first special economic zone. Located adjacent to Hong Kong, Shenzhen became the ideal place for building factories with cheap labor and land resources. Additionally, policies allowed investment from overseas and Hong Kong to build factories, which became the foundation of Shenzhen's manufacturing industry. In 1982, Shenzhen municipality released its first master plan, which indicated that industrial areas would be evenly distributed along the linear border between Shenzhen and Hong Kong (see Fig. 15.1). During the early 1980s, Shenzhen's development was hampered by a limited budget for constructing infrastructure. The linear city layout was designed for efficiency, with one main thoroughfare (Shen-Nan Road) linking all industrial plots together and evenly distributed along the two cities' shared border, which established the industrial spatial framework of the city (Zacharias et al. 2015).

In 1983, the total industrial output value of Shenzhen was 720 million CNY, with the electrical industrial output contributing 45.4%, nearly half of all industries. The consistent growth of the electrical industry not only led to further geographical expansion of factories toward the northern suburb area but also caused the industry to transform toward an upgraded industry with a completed cycle. Besides, the successful development of the electrical manufacturing industry generated huge opportunities

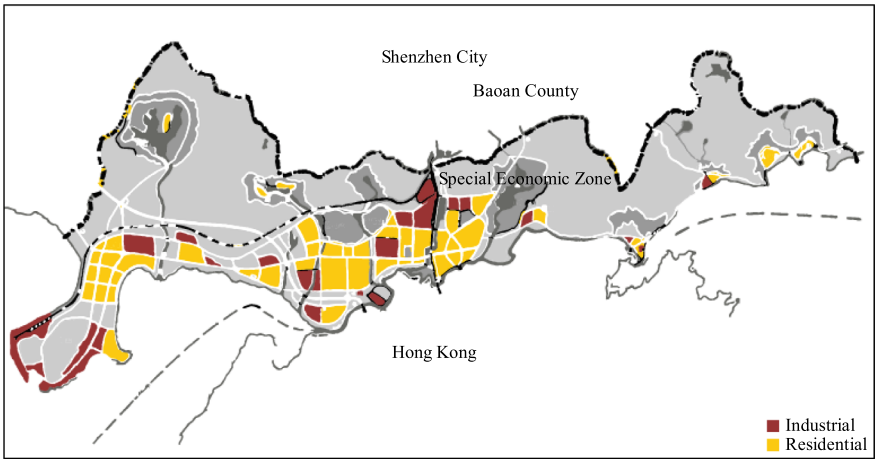


Fig. 15.1 The planning masterplan of Shenzhen in 1982

for upstream businesses, meaning the R&D sectors. Such a phenomenon released the full potential of transforming the manufacturing industry into an innovation-oriented business. During the industrial development, the manufacturing industrial areas were sequentially replaced by the innovation industry. The manufacturing industrial areas had been gradually pushed away from the city center, just like other post-industrial cities. However, the transformation of industries happened so quickly that the original industrial areas in the city center gained the opportunity to be renewed rather than abandoned, and those industrial areas became the starting point of the innovation industry in Shenzhen. In order to understand the development of innovation clusters, it is worth looking at the development of industrial areas initially.

The development of industrial land-use distribution indicates the spatial pattern of industrial areas in the city (see Fig. 15.2). From 1984 to 2003, in nearly just 20 years, the surface area of industrial areas grew from 2.5 km^2 to 208 km^2, nearly a hundred times. The whole process went through four stages of industrial growth. The first stage was the beginning of the manufacturing industry, which appeared near the demands of goods around the border. In 1984, industrial areas were mainly concentrated around the town center for better connection to Hong Kong by railway (Luohu port) and ships (Shekou port). The second stage was the formation of the industrial spatial framework, which had a strong correlation with the city's existing infrastructure. In 1994, along with the expansion of the city's territory, the distribution of industrial areas indicated an apparent spatial pattern in line with the development of highways. This pattern remained obvious from 1994 to 2000, and the industrial areas started to grow around the existing clusters in 2003. The third stage was the formation of industrial clusters, which was the process of intensification of industrial areas. The geographical growing pattern of industrial areas was driven by the manufacturing industrial chain, which further enhanced the industrial clusters. The fourth stage was the transformation of industrial clusters. More specifically, the industrial land in the outer city areas had reached 188 km^2 compared to just 20 km^2 within the inner-city area in 2003. Following the economic growth, the increasing land value of the city gradually pushed the manufacturing industry away from the city center areas. As a result, all industrial areas within the city center areas also transforming to another function in different ways. These areas were required to be integrated with their surrounding urban environments. Consequently, the spatial pattern of industrial land became the foundational framework for the distribution of the innovation industry.

15.4 Methodology

This paper is aimed to study the typology of innovation clusters in terms of the companies' constitution and their relations with urban morphology. The research also intended to investigate how innovation clusters responded to urban form. The research methods included quantitative and qualitative approaches. In general, the companies' register information was collected by the open data platform of Shenzhen (https://opendata.sz.gov.cn/). There are in total 19,232 companies with high-tech

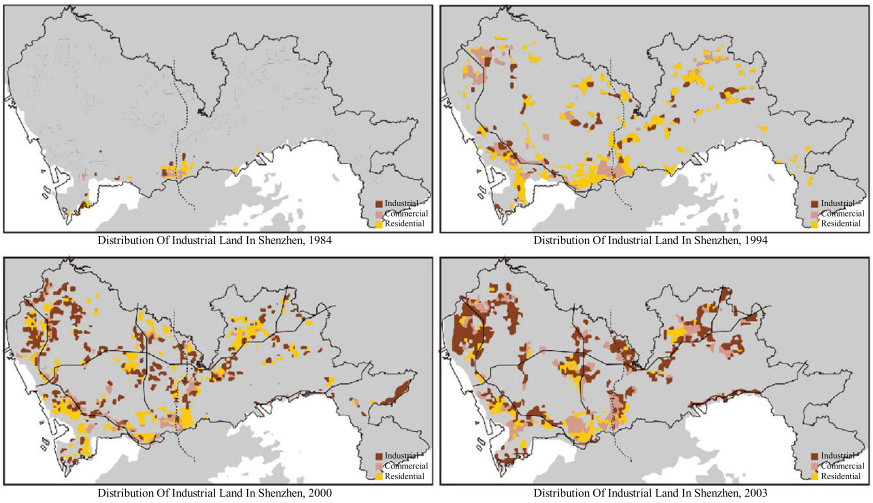


Fig. 15.2 The expansion of industry land

certifications in the city or national level. The companies' employee numbers were sourced from Shenzhen administration for market regulation (https://amr.sz.gov.cn/). The intellectual property data was sourced from China national intellectual property administration (https://www.cnipa.gov.cn/). All data was used together with the GIS model of Shenzhen to analysis the distribution of those high-tech companies, in order to map how collective firms formulated the innovation clusters. Further analysis with urban morphology approaches were used to map the spatial form of different innovation clusters, including satellite images analysis from the 2000s to the 2020s. Detailed case studies were conducted by field survey during both the working days and holidays in 2022.

The research includes three parts of analysis (see Fig. 15.3). First, the distribution of high-tech companies in the city scale was studied to locate and map the distribution patterns of innovation clusters, as well as investigate the principles of the spatial framework for innovation cluster distribution. Second, innovation clusters were researched according to their business compositions and industrial performances, in order to classify them. The morphology of specific innovation clusters was studied, and their spatial characteristics were analyzed. Third, a case study of the innovation district, the Che-Gong-Miao areas, was conducted to further research the urban morphology of innovation districts. This part of the study aimed to find out how urban morphology impacted the formulation of innovation districts' characteristics.

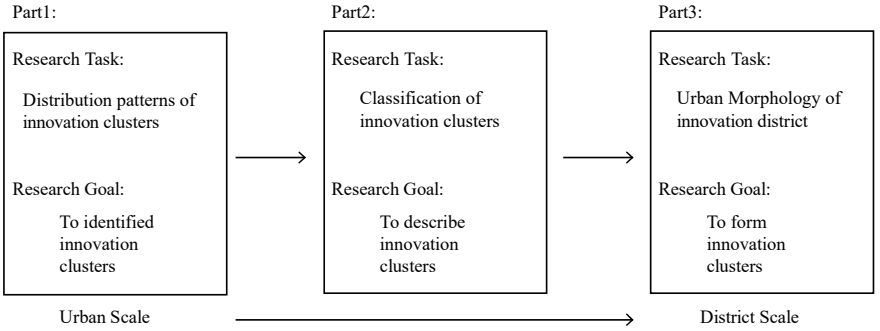


Fig. 15.3 The research framework

15.4.1 Part 1: The Distribution Patterns of Innovation Clusters

According to the list of firms' register information, business information could be projected spatially, including the number of employees, industry type, intellectual capacities, registered capitals, etc. Below study was completed by ArcGIS. Figure 15.4 demonstrated the distribution of high-tech firms, representing the innovation industry. The employees' density of innovation industry could be measured by ranking the innovation population within TAZ (Traffic Analysis Zones). It indicated that in total 50 areas were concentrated, and appeared to be the potential innovation clusters (see Fig. 15.5). In terms of the pattern of innovation population density distribution, there was a significant different between the eastern area and the western area of the overall city. The western area had 89% of all firms and 84% of all the innovation population, and this was over 5 times to the eastern area.

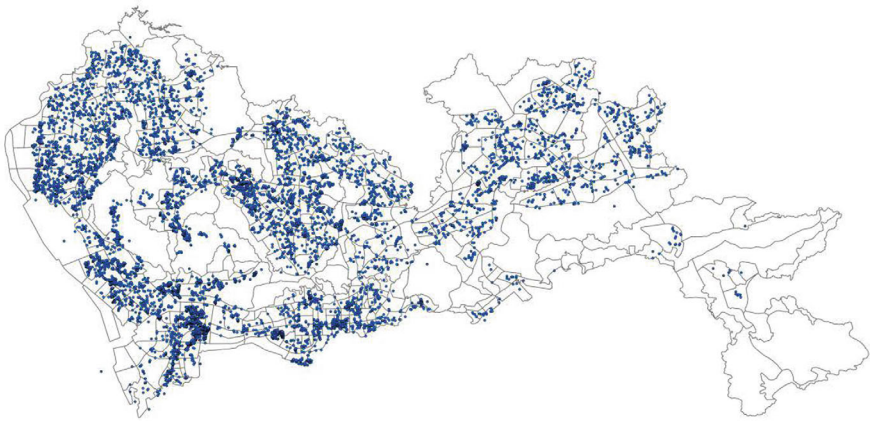


Fig. 15.4 Distribution of high-tech firms

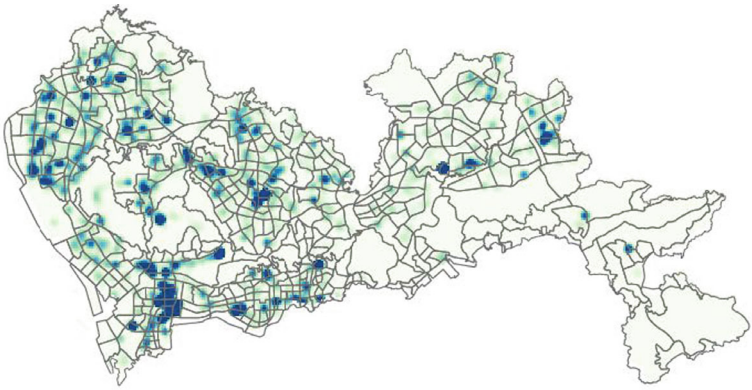


Fig. 15.5 Employees' density of innovation industry

15.4.2 Part 2: The Classification of Innovation Clusters

Further study was conducted based on the analysis of the previously identified 50 potential innovation clusters (see Table 15.1). The main streets around each sample were measured within its blocks. Due to the large scale of the Shenzhen high-tech park area, it was divided into 9 blocks for further study. Company scale was defined by the number of employees based on related national guidelines. Companies with less than 100 employees were considered small size businesses, those with more than 100 employees but less than 300 employees were considered medium size businesses, and those with more than 300 employees were considered large size businesses. The list of 50 concentrated innovation areas was studied according to their innovation capacities, which were measured by the total number of patents of all firms within the block. The dominant industry of these areas and the number of employees in that industry were also included in the analysis. An Innovation Performance Matrix (IPM) was introduced for a detailed analysis of the innovation cluster typologies. The IPM was then defined the types of innovation clusters according to evaluate their industrial characteristics (see Table 15.2). It was used to analyze the characteristics of the 50 innovation clusters, which could be classified into 6 categories, such as Innovation campus, Innovative manufacturing cluster, New built innovation district, Incubator type of Innovation district, Renewed Innovation district, and Headquarters type of innovation district.

15.4.3 Part 3: Case Study of Innovation District

Unlike other innovation districts that are typically influenced by governmental organizations or research institutions, such as universities, the Che-Gong-Miao area

Table 15.1 50 potential innovation clusters

Potential innovation clusters	Percentage of small firm employees (%)	Percentage of dominant industry (%)	Innovation capacity index (%)
Huawei Global Headquarters	1	97	44,163
High-tech Park-6	18	45	43,100.75
High-tech Park-3	18	57	24,819
Nan-Shan-Zhi-Yuan	11	25	10,424.75
High-tech Park-7	22	33	8081
High-tech Park-1	21	29	7612.25
High-tech Park-8	25	37	6316.75
Jian-Gang-Shan	27	22	5794
Central West	7	62	5229.75
Che-Gong-Miao	31	16	4280.75
Qianhai Innovation and Entrepreneur Hub	39	52	3979.75
Nan-You	31	22	3800
High-tech Park-4	37	34	3702.5
Cloud City	43	25	3465.5
High-tech Park-2	26	34	3238.25
Zhu-Keng	8	43	2990
Shi-Long	18	20	2828.25
Bao-Long Industrial Park	12	55	2348
Foxconn	9	49	2300.25
High-tech Park-5	25	35	2264.25
Bai-Mang	16	41	2015
Hua-Yuan-Cheng	26	21	1973
Exhibition Centre South	17	33	1954.75
Hua-Qiang-Bei East	18	44	1821
Shang-Li-Lang	41	20	1698.75
Yu-Tang	15	34	1653.5
Fu-Hai	31	52	1601.5
Luo-Zu	18	58	1599.75
Dong-Jiang Science and Technology Park	13	45	1542
High-tech Park-9	29	14	1511.5
Da-Lang	23	27	1494.75
Skyworth Industrial Park	25	46	1421.75
Qing-Hu	12	41	1307
Shun-Luo	11	65	1291.75
Da-Lang East	33	45	1281.5

(continued)

Table 15.1 (continued)

Potential innovation clusters	Percentage of small firm employees (%)	Percentage of dominant industry (%)	Innovation capacity index (%)
OCT Loft	15	53	1223.75
Xi-Fa Community	44	25	1223
Merlin New Generation Industry	18	23	1145.25
Fu-Qiao	20	64	891.5
Exhibition Centre North	15	58	864.25
Xin-He	10	72	860.25
International Innovation Centre	10	44	858
Sha-Yi Village	16	58	816.25
Xiang-He	4	48	616.25
Heng-Feng Industrial Park	27	34	607.5
Hua-Nan City	12	27	568
Kui-Chong Industrial Park	3	55	423.5
Tong-Fu	4	64	293.5
Dong-Men	32	58	250
Yi-Zhan Centre	19	39	196.5
Cao-Pu	0	99	142.5

Table 15.2 Evaluation matrix for categorized innovation clusters

Types of Innovation clusters	Innovation campus	Innovative manufacturing cluster	New built innovation district	Incubator innovation district	Renewed innovation district	Headquarters innovation district
Percentage of small firm employees	Low	Low	Low	High	High	Low
Mix rate of Industry	Low	Low	High	Low	High	Low
Innovation capacity	High	Low	High	High	High	High
Characters of Innovation district	Without	Without	With	With	With	Without

exhibits the characteristic of a self-grown innovation district relying on its self-growth. The Che-Gong-Miao was built in the 1990s as manufacturing factories for electric goods, it differentiated itself from other planned science park-type innovation districts. Over the years of development, there have been renewal projects mixed with new built offices within the Che-Gong-Miao area. For this reason, the Che-Gong-Miao had not only a high rate of small firms but also a diversity of building types. Besides, the Che-Gong-Miao area locates closer to the city center makes it an ideal sample for morphological study. The analysis was conducted based on three interconnected aspects: industrial characters, urban typologies, and urban integration. The comparative study provides critical observations of urban development in relation to innovation districts. The urban morphologies of both areas were studied by mapping satellite images from the 2000s to the 2020s. The industrial characters were analyzed together with the urban form by 3D massing, while urban integration studies were conducted through POI (Point of Interest) analysis.

15.5 Results and Discussions

15.5.1 Overall Distribution Pattern of Innovation Clusters

The concentration of industrial development and innovation clusters in Shenzhen is primarily located in the western area, which can be attributed to two main factors from an urban morphological perspective. Firstly, the eastern area functions as an ecological preservation area, acting as a fringe belt that segregates urban clusters and resulting in a weaker integration of the traffic road system (as shown in Fig. 15.6). Consequently, the eastern area is less attractive to investors in comparison to the western area. Secondly, the western area benefits from its advantageous location, being closer to the center of the Pearl River Delta and having shorter distances to major transport hubs such as airports, harbors, and railway stations. With less ecological preservation area and more industrial land available, the western area is able to form stronger industrial clusters that are capable of accommodating innovation industries.

Another notable characteristic of innovation employees' density distribution is the contrast between the southern and northern areas (see Fig. 15.5). The northern area, considered as the outer city, exhibited a more discrete pattern of innovation population density. This is in contrast to the southern area, the city center, which displayed a more concentrated and integrated pattern. This pattern can be attributed to Shenzhen's geographic characteristic as a linear city. The linear infrastructures such as metro and expressway served as attractors that linked innovation clusters together. This principle also applied to the district level. In Futian district, most innovation clusters were observed along metro line 1, which was the central line along Shennan Boulevard that ran through the entire city (see Fig. 15.7). Access to urban resources via metro line 1 was a key factor in the linear distribution of innovation clusters in

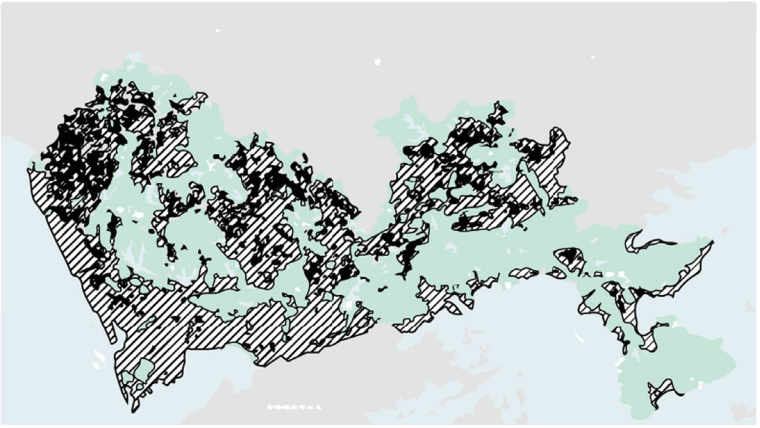


Fig. 15.6 Ecological preservation area (green) impacted on the distribution of industrial land

Fig. 15.7 The distribution pattern of innovation clusters in Futian district

this area. In contrast, in Nanshan district, the innovation clusters were more widely distributed (see Fig. 15.8). Reservation of industrial lands facilitated the consistent growth of the high-tech park. Once large firms settled in this area, their industrial chain supported downstream small firms and start-ups, leading to the accumulation of innovation companies and the formation of this highly converged distribution of innovation clusters.

15.5.2 The Diversity of Innovation Clusters

The 50 innovation clusters were arranged according to the percentage of small firm employees, innovation capacities index, and mix rate of industries, which reflects

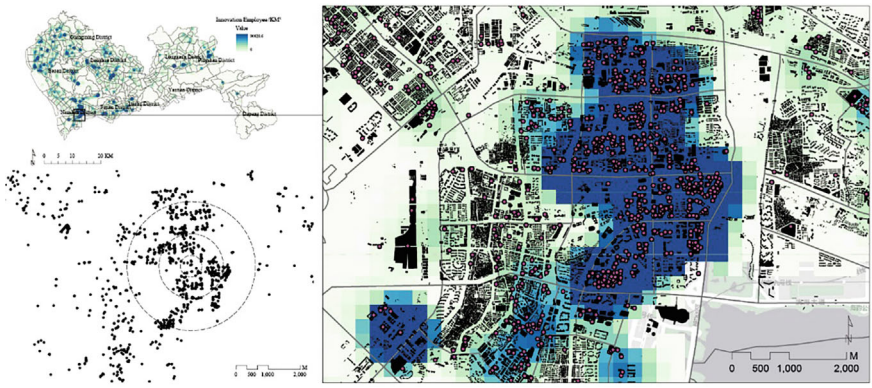


Fig. 15.8 The distribution pattern of innovation clusters in Nanshan district

the industrial characteristics of the dominant industry. According to the research data, 40% of the mix rate of industries was the threshold of appearing the dominant industry. Figure 15.9 displays the innovation clusters with a mix rate of industries below 40%, while Fig. 15.10 shows those with a mix rate above 40%. Using the IPM approach, 8 quadrants of innovation clusters with distinct characteristics were identified. However, the innovative manufacturing clusters appeared less innovation capacities index with no more than 3000. Their urban fabrics and land-use indicated that those areas without characters of innovation district. This research excluded the innovative manufacturing clusters and focused on the rest four quadrants of innovation clusters, which can be categorized into four types, including New-built innovation district, Incubator type of Innovation district, Renewed Innovation district, and Headquarters type of innovation district. This operation also excluded the Huawei Global headquarters area as the innovation campus type, which was mainly occupied by just one mega-firm. It was not appropriate to be defined as a cluster of innovation firms for the research. Besides, the incubator Innovation district type included only one incidence, the Qianhai Innovation and Entrepreneur Hub, which was promoted by local government policies to support innovative small firms and start-ups without an industrial chain coming from big firms. This allowed it to function independently without neighboring large innovation companies. However, since it was not a naturally formed innovation district, it was not suitable for further analysis.

The typical headquarters innovation district is located in the high-tech park-6 area (see Fig. 15.11, Tables 15.3, 15.4). This area houses several well-established firms' R&D centers, including DJI, Mindway, and Skyworth. It is a type of innovation district that is led by large firms and forms an industrial chain with downstream businesses in smaller sizes. In this type of innovation cluster, although the dominant industry's portion is not as high as in the Huawei area, it still accounts for over 40% of all employment, with 65% of people working for large high-tech firms and 18% working for small or start-up businesses. The headquarters innovation district is also a type of new-built innovation district, which is mainly constructed by high-rise

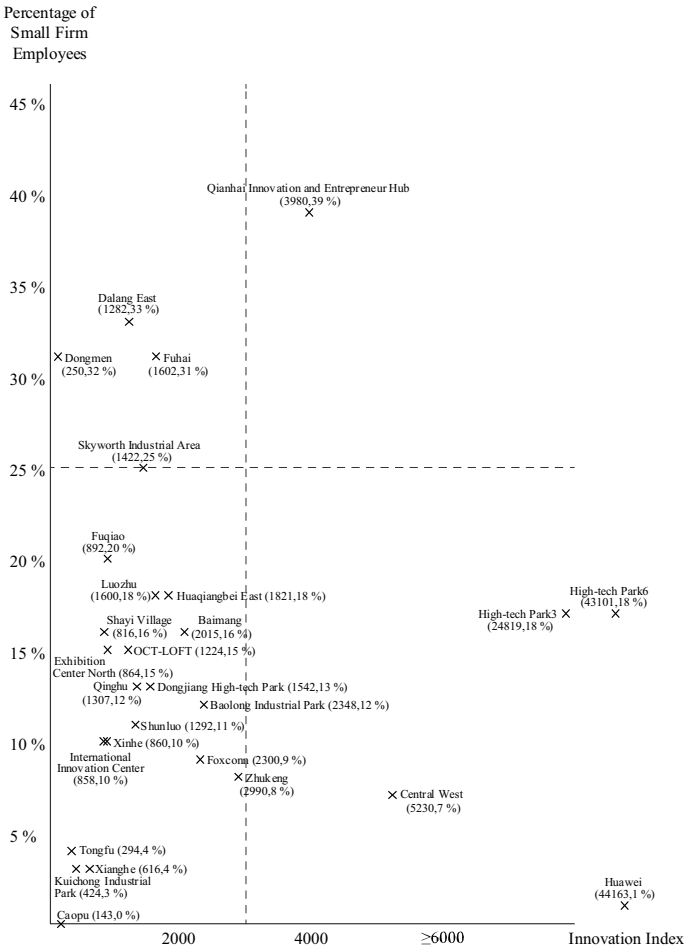


Fig. 15.9 IPM for evaluating the innovation clusters with mix rate of industries less than 40%

office towers with a high density of street networks. These two types share a similar urban morphology, although the new-built innovation district can include multiple industries and is not necessarily dominated by a single industry.

However, the focus of this research was on the renewed innovation districts, which had more than 25% of small firm employees in the area. It appears that having a diversity of companies of different sizes can increase innovation capacities in the areas. The innovation capacities indexes of these areas were always around 4000. The renewed innovation districts can be represented by the Che-Gong-Miao area (Fig. 15.12, Table 15.5, Table 15.6), which presents a different typology compared to the previous ones. In this area, large high-tech firms covered only 33% of the total employment, while small and start-up firms covered 31%. About 30% of employees were in the field of software and hardware design. Additionally, there were quite

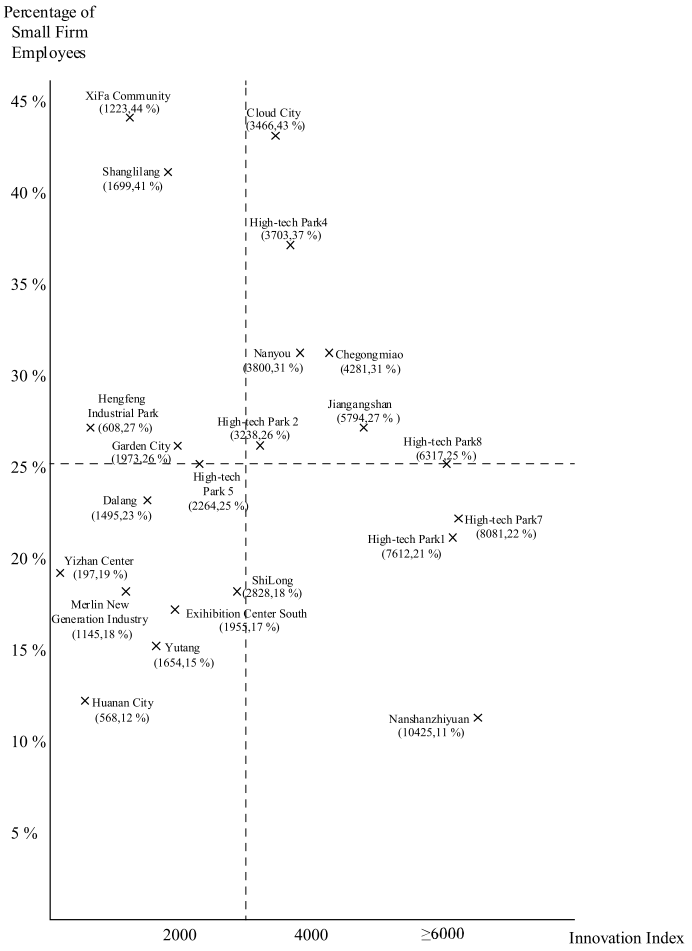


Fig. 15.10 IPM for evaluating the innovation clusters with mix rate of industries more than 40%

a few firms without a high-tech background located in this area. In contrast, in the high-tech park-6 area, employees in the field of software and hardware design were up to 61%. From these facts, it can be inferred that the Che-Gong-Miao area is an innovation district with a good mixture of innovation companies in different scales and with diverse expertise.

15.5.3 The Morphological Study of Innovation Districts

In 1988, the Chinese government launched the Torch program, which aimed to promote the high-tech industry by supporting the construction of innovation

Fig. 15.11 High-tech park-6 area as the example of innovation campus

Table 15.3 Innovation firms and their performance in High-tech park-6 area

Innovation firms of different sizes	Innovation employees' proportion (%)	Innovation employees	Innovation index
0–99	18.23	11510	5497.5
100–199	7.37	4652	1294.5
200–300	8.62	5442	1455
>300	65.78	41524	34853.73
Total	100.00	63128	43100.75

Table 15.4 Innovation industry configuration in High-tech park-6 area

Dominant industry	Industry employees proportion (%)	Industry innovation proportion (%)
Software and information technology services	44.82	76.16
Others	33.38	11.53
Manufacturing of computers, communications, and other electronic equipment	15.30	9.29
Pharmaceutical manufacturing industry	6.49	3.02
Total	100.00	100.00

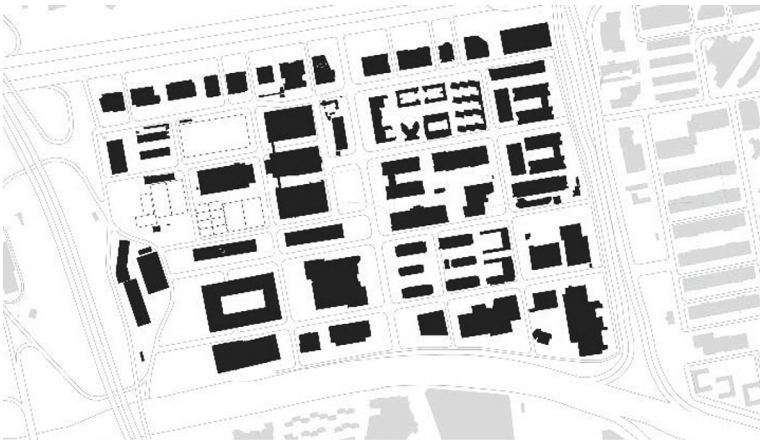


Fig. 15.12 Che-Gong-Miao area as the example of renewed innovation district

Table 15.5 Innovation firms and their performance in Che-Gong-Miao area

Innovation firm of different sizes	Innovation employees proportion (%)	Innovation employees	Innovation index
0–99	31.10	7546	2348.25
100–199	20.15	4889	1000.75
200–300	15.73	3816	289.5
> 300	33.02	8011	642.25
Total	100.00	24,262	4280.75

Table 15.6 Innovation industry configuration in Che-Gong-Miao area

Dominant industry	Industry employees proportion (%)	Industry innovation proportion (%)
Others	60.49	44.76
Software and information technology services	16.46	31.21
Manufacturing of computers, communications, and other electronic equipment	14.29	22.81
Monetary and financial services	10.76	1.22
Total	100.00	100.00

campuses. The Shenzhen high-tech park was the first innovation campus built under this program in China. During the early planning stages in the 1980s, mixed-use land use strategies were not yet popular in China. The high-tech park area was planned as a mono-functional area for innovation campuses. Such large developments initiated by policies were typically built on large empty sites, as was the case with the high-tech park area. The urban morphology of this area was studied using satellite

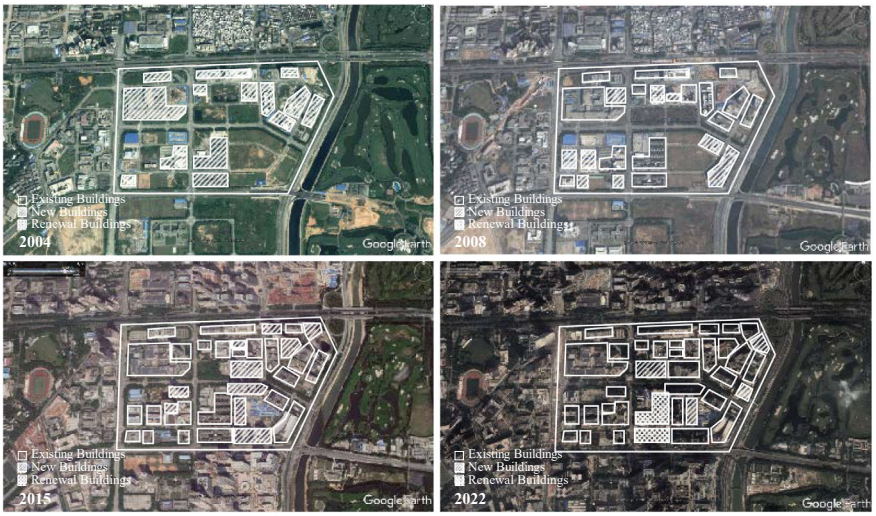


Fig. 15.13 Sequential satellite images of high-tech park-6 area. Map data ©2004–2022 Google

images. From the 2000s to the 2020s, the high-tech park-6 area were in the process of new built construction (see Fig. 15.13).

The new built innovation district had an advantage in terms of having available land suitable for large innovation companies. The small plots and dense street network planning conditions allowed for headquarters buildings to take on a compact high-rise office building form. This resulted in the high-tech park-6 area having a 20% coverage rate of office towers above 50 m and a 60% coverage rate of high-rise offices between 24 and 50 m. As a result, this area was densely populated with high-rise buildings, which coincided with the configuration of the innovation clusters. The large innovation companies dominated this area, and small businesses could potentially work downstream of the larger companies within this innovation type.

Che-Gong-Miao area in Futian district had a different story. In the early 1980s, due to its distance to the Luohu city center at that time, it was planned as an industrial area, which was mainly for manufacturing family electronics. In 2000s, Shenzhen moved its governmental center from Luohu district to Futian district. Che-Gong-Miao's location disadvantage suddenly became advantage. Following Shenzhen's rapid growing economy, Che-Gong-Miao area soon developed its strong third industry. Che-Gong-Miao's location advantage, especially its exceptional transportation infrastructure, played a crucial role in its development as an innovation district. In addition to its proximity to the border point of Hong Kong, the area's accessibility was greatly enhanced by the presence of four metro lines, which made it easier for businesses and employees to connect with other parts of the city and access urban resources. As a result, the area saw the rapid development of its third industry, with a good mixture of small and start-up firms, and a focus on software and hardware design. This diversity of companies in different sizes and expertise, as well as the availability

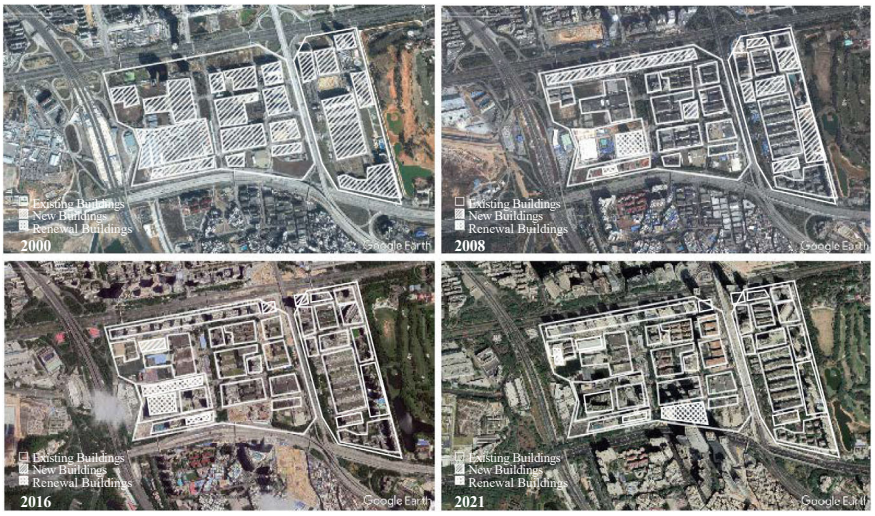


Fig. 15.14 Sequential satellite images of Che-Gong-Miao area. Map data ©2000–2021 Google

of urban resources and a supportive policy environment, helped to create a vibrant innovation ecosystem in Che-Gong-Miao.

The urban morphology of the Che-Gong-Miao area was studied based on its development strategies in past years. In comparison to the high-tech park-6 area, urban renewal has always played an important role in the Che-Gong-Miao area. Urban renewal projects within the Che-Gong-Miao area began appearing in the early 2000s. New buildings were primarily developed along city boulevards, while factories were hidden in the inner blocks. The consistency of urban development and renewal projects was crucial for maintaining the vitality of this area, resulting in a good mixture of new and old buildings (see Fig. 15.14).

As a result of this process, the Che-Gong-Miao area boasts a diverse range of building types and functions. The dominant industry in the innovation category in this area was software, information, and electric device design, which accounted for 31.8% of the industry mix, with the remaining 68.2% being a mixture of other industries. Unlike the high-tech park-6 area, which had only a 40% mixture of other industries, Che-Gong-Miao area demonstrated a diverse range of industries. This makes it a suitable example to investigate its spatial properties as an innovation district. In order to analyze the urban form of innovation clusters, the building typology where small innovation firms are located in the Che-Gong-Miao area was also mapped (see Fig. 15.15).

According to the register information of innovation companies, there was a higher concentration of innovation firms in the western and eastern blocks of the Che-Gong-Miao area, with the eastern block showing a more diverse mix of building types. The western block had undergone renovations during previous development periods, with some single-story factories being converted into high-rise offices and others were

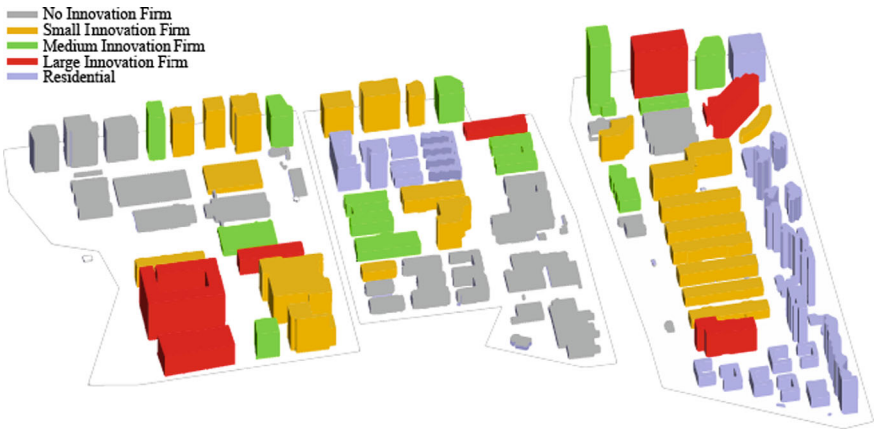


Fig. 15.15 3D massing diagram indicating the dominant type of innovation firm in Che-Gong-Miao area

renovated to amenities instead of offices. A more detailed analysis of the register information of innovation companies in the eastern block showed that a significant number of small and large firms in the dominant software and information industries were located in renovated factories, indicating that these renovated factories were still suitable as office spaces for innovation companies (see Fig. 15.16 and Table 15.7).

Another prominent feature of the Che-Gong-Miao area was its large number of amenities, including restaurants and bars. The POI information about these places showed a concentration in the middle block, which was the least dense block in the area but had the highest connectivity (see Fig. 15.17). The distribution patterns indicated a strong relationship to the streets and around the metro stations, rather than to the innovation firms located there. This suggests that the restaurants and bars not only served people working in the Che-Gong-Miao area, but were also easily accessible for people visiting by public transportation. It is apparent that the Che-Gong-Miao area had strong integration with the surrounding city.

15.6 Conclusions

In general, the innovation clusters are active and diverse in Shenzhen. They are attracted to places with excellent accessibilities and good connections for transportation. Amount all type of the innovation clusters, the most innovative area is still the one which led by the large firms and also collaborating certain number of small firms around them. The large firms should make up over 40% of the working population in the area, while small firms should not be less than 25% of the total. Industrial diversity does not seem to be as important for innovation capacity, but it is crucial for the vitality of the area, just like the diversity of building typologies. The industrial

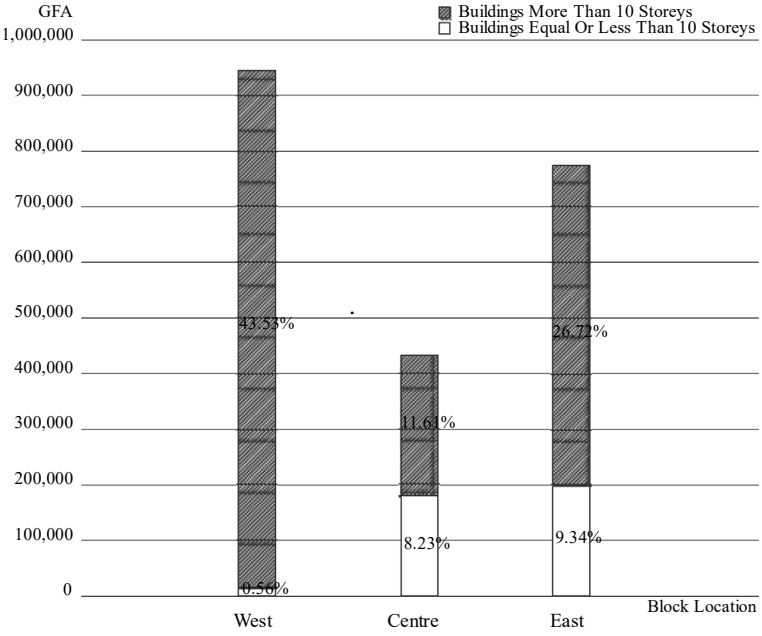


Fig. 15.16 Innovation industry and building types statistics in Che-Gong-Miao area

Table 15.7 Innovation firms in relation to building types and location

Block location	Buildings equal or less than 10 floors (renewed factories)		Buildings more than 10 floors (highrise offices)	
	Innovation employees	Innovation employees proportion (%)	Innovation employees	Innovation employees proportion (%)
East	915	15	2142	34
Center	318	5	908	14
West	122	2	1876	30
Total	1355	22	4926	78

diversity is not developed by well-planned area, rather grew up naturally rely on the flexibility of building typologies, which demonstrated strong ability to adapt to the developing economy. The development of the Che-Gong-Miao area exemplifies this phenomenon.

In the 1990s, Che-Gong-Miao was originally an industrial area. It was successfully transformed with the development of the stronger western of Shenzhen, especially following the established Futian district as the new center of Shenzhen. The increased land value of Che-Gong-Miao presented opportunities for the conversion of old factories, some of which were transformed into offices that attracted innovation firms. The

Fig. 15.17 POI for restaurants and bars in Che-Gong-Miao area

construction of the metro system accelerated the process, and soon Che-Gong-Miao became a place with a high concentration of innovative businesses and a diverse mix of industries. This urban renewal process also resulted in a mixture of building typologies. In comparison to the mono-functional new-built office towers, the renovated old factories demonstrated their advantages of being adaptable to various converted functions due to their spatial flexibility. Therefore, the old factory buildings not only functioned as renovated offices with lower rent for small innovation firms, but were also converted to commercial functions such as shops, restaurants, bars, and sports facilities for young people working in the area with strong consumption demands (see Fig. 15.18). Due to its central location and excellent accessibility, Che-Gong-Miao has become a destination for nightlife for young people. The area is home to well-known restaurants and bars that have branded the area. In other words, the old factories filled the gap of mono-functional industrial areas that lacked amenities and helped integrate the area with the surrounding city.

Although the high-tech park-6 area has a higher innovation capacity index value, the urban morphology of such an area appears homogeneous. Newly built offices, such as high-rise towers, appear to have weak adaptation to the surrounding city. At night, the high-tech park-6 area lacks vitality. The difference in urban form affects the industrial and social activities in such areas. In recent years, resilience has become a topic of urban research. The degree of functional flexibility in terms of urban morphology could be further researched in order to understand its adaptation to the developing economic environment. This research could potentially provide value for the economic resilience of the city.

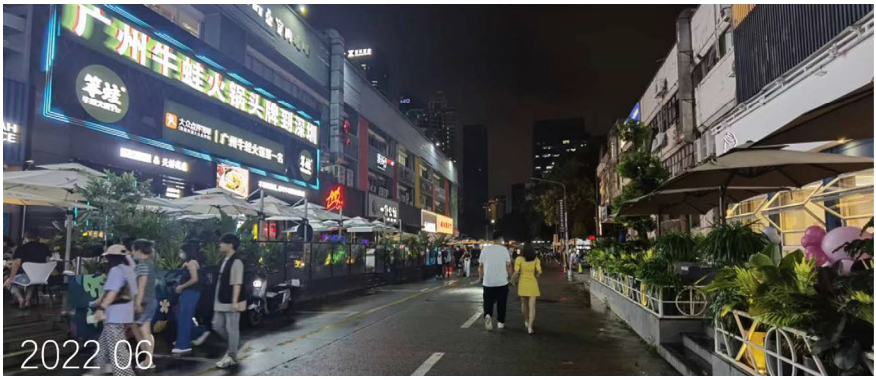


Fig. 15.18 Images showing the after renewal of factories

References

Adu-McVie R, Yigitcanlar T, Erol I, Xia B (2021) Classifying innovation districts: Delphi validation of a multidimensional framework. Land Use Policy 111:105779

Baily MN, Montalbano N (2018) Clusters and innovation districts: Lessons from the United States experience. Econ Stud BrookS Inst

Bröcker J, Dohse D, Soltwedel R (2012) Innovation clusters and interregional competition. Springer Sci & Bus Media

Clark J, Huang H-I, Walsh JP (2010) A typology of 'innovation districts': what it means for regional resilience. Camb J Reg Econ Soc 3(1):121–137

Collier D, LaPorte J, Seawright J (2012) Putting typologies to work: Concept formation, measurement, and analytic rigor. Polit Res Q 65(1):217–232

Esmaeilpoorarabi N (2019) A methodological approach for establishing place quality in Australian innovation districts. Qld Univ Technol

Esmaeilpoorarabi N, Yigitcanlar T, Guaralda M (2018a) Place quality in innovation clusters: An empirical analysis of global best practices from Singapore, Helsinki, New York, and Sydney. Cities 74:156–168

Esmaeilpoorarabi N, Yigitcanlar T, Guaralda M, Kamruzzaman M (2018b) Evaluating place quality in innovation districts: A Delphic hierarchy process approach. Land Use Policy 76:471–486

Esmaeilpoorarabi N, Yigitcanlar T, Guaralda M, Kamruzzaman M (2018c) Does place quality matter for innovation districts? Determining the essential place characteristics from Brisbane's knowledge precincts. Land Use Policy 79:734–747

Esmaeilpoorarabi N, Yigitcanlar T, Kamruzzaman M, Guaralda M (2020) Conceptual frameworks of innovation district place quality: An opinion paper. Land Use Policy 90:104166

Florida R (2003) Cities and the Creative Class. City Community 2(1):3–19

Florida R (2004) The rise of the creative class and how it's transforming work, leisure, community and everyday life (Paperback Ed.). GEN, New York: Basic Books

Forsyth A (2014) Alternative forms of the high-technology district: corridors, clumps, cores, campuses, subdivisions, and sites. Eviron Plann C Gov Policy 32(5):809–823

Hamidi S, Zandiatashbar A (2019) Does urban form matter for innovation productivity? A national multi-level study of the association between neighbourhood innovation capacity and urban sprawl. Urban Studies 56(8):1576–1594

Hawken S, Hoon Han J (2017) Innovation districts and urban heterogeneity: 3D mapping of industry mix in downtown Sydney. J Urban Des 22(5): 568–590

Katz B, Bradley J (2013) The metropolitan revolution: How cities and metros are fixing our broken politics and fragile economy. BrookS Inst Press
Katz B, Wagner J (2014) The rise of urban innovation districts. Harv Bus Rev
Kireeva AA (2014) Theoretical and methodological framework establishing the conditions for the development of innovation clusters. Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz= Economic and Social Changes: Facts, Trends, Forecast (1): 182–189
Pancholi S, Yigitcanlar T, Guaralda M (2018) Attributes of successful place-making in knowledge and innovation spaces: evidence from Brisbane's Diamantina knowledge precinct. J Urban des 23(5):693–711
Pancholi S, Yigitcanlar T, Guaralda M (2019) Place making for innovation and knowledge-intensive activities: The Australian experience. Technol Forecast Soc Chang 146:616–625
Pareja-Eastaway M, Pique JM (2011) Urban regeneration and the creative knowledge economy: The case of 22@ in Barcelona. J Urban Regen & Renew 4(4):319–327
Wagner J, Katz B, Osha T (2019) The evolution of innovation districts: The new geography of global innovation. The Global Institute on Innovation Districts: New York, NY, USA
Yigitcanlar T, Adu-McVie R, Erol I (2020) How can contemporary innovation districts be classified? A systematic review of the literature. Land Use Policy 95:104595
Yigitcanlar T, Edvardsson IR, Johannesson H, Kamruzzaman M, Ioppolo G, Pancholi S (2017) Knowledge-based development dynamics in less favoured regions: insights from Australian and Icelandic university towns. Eur Plan Stud 25(12):2272–2292
Zacharias J, Ma B (2015) Industrial zone development policy related to real estate and transport outcomes in Shenzhen, China. Land Use Policy 47:382–393

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Part III
Social and Cultural Determinants of Spatial Redevelopment and Regeneration

Chapter 16
Urban Regions Under Stress: The Case of Madrid After the Lockdown

J. Barros-Guerton and J. M. Ezquiaga-Domínguez

Abstract Urban density, mobility, and revenue disparity are relevant factors in terms of urban analysis and project. The COVID-19 pandemic declared in March 2020 has meant a stress test for urban regions, as the alteration of mobility patterns led to changes in social dynamics. This paper investigates the correlations between the evolution of the disease and these three factors. The analysis focuses on the Madrid Urban Region, in Spain, and uses open data available from cadastral, census, and health-related official websites. This use of public information also provides a test on how such inputs could fit in a regional digital twin and can help replication. The analysis shows that overall, the basic structure of regional urban centralities, those with more people at day than at night, keeps stable in the central city and relevant economic areas. There are signs of temporary relocations to low-density areas, to holiday homes, which decreased in 2021. And there is no mathematical correlation between density and disease at the end of the period; figures show, however, of significative correlation during the initial stages, so density, at the household level (housing overcrowding) more than at the neighborhood level (dwellings per hectare), appears as an initial driver for disease expansion whose influence has been dampened progressively over time.

Keywords Resilience · Urban regions · Madrid · COVID-19 · Urban density · Open data

16.1 Introduction

Cities, and urban regions as well, are organizations that over time have evolved to cope with changes in their context. Changes have been a constant in history, and over the recent few years, there has been an increase in their speed due to the geopolitical context and the pressure that climate change is placing on the resources that urban

J. Barros-Guerton (✉) · J. M. Ezquiaga-Domínguez
Departamento de Urbanismo y Ordenación del Territorio (DUYOT), Escuela Técnica Superior de Arquitectura de Madrid, Universidad Politécnica de Madrid, Madrid, Spain
e-mail: javierbarrosguerton@live.com

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_16

dwellers use. The concept of resilience as the ability of a system to recover from difficulties has become relevant to cities and territories, and the COVID-19 pandemic provides a testing ground of interest. The recently published articles of Wang et al. (2022), Zidong and Liu (2022), Esteban y Peña et al. (2021), Carozzi et al. (2020) and Instituto Nacional de Estadística (2022c) show examples of attempts to get knowledge from the pandemic, as well as the complexity of the task. The work of Batty (2017) provides a wider view on the need to integrate approaches to define a new science of cities integrating all that knowledge, and the surge in open data availability provides an opportunity for study.

16.2 Background

Urban density has been one of the main indicators in urban planning since its modern formulation. Since the COVID-19 pandemic began, voices in the press like Rosenthal (2020) or Gracia (2020) have argued that cities, as dense concentrations of population, are natural hotspots for the illness. The knowledge acquired over the last 3 years provides a longer perspective to evaluate the links between density, mobility, and health. The case of Madrid is well suited for such an analysis due to its five million population and rich public open data landscape.

The COVID-19 pandemic has been a major stress factor for most cities globally. In Spain, the first case of the disease was confirmed on January 31, 2020, and on March 14 of that year, a lockdown was enacted by the national government. The government lifted gradually this lockdown starting in May, allowing short strolls around homes, until June 21, 2020, removing mobility and travel restrictions, while indoor capacity restrictions for retail and hospitality businesses along with mask use have remained longer.

During 2020 and 2021, the regional governments have defined territorial mobility restrictions in areas where the incidence rate has been higher. In Madrid, restrictions used the basic health zones, a territorial subdivision which establishes the public basic health center that corresponds to each citizen. Residents in zones with high incidence rates were allowed to go to work and essential chores, resulting in more mobility freedom than during lockdown, but were not allowed to move for less stringent uses. As the dense city is subdivided into many adjacent basic health zones without physical barriers, and the basic health zones subject to restriction were updated frequently, there has been a real difficulty in communicating those perimeters to citizens in a comprehensible way and to enforce effectively those measures in a city with a high percentage of pedestrian mobility, so this has not been considered in this article.

The impact of the pandemic on the Spanish economy in general, and in the Madrid Region, has been quite high, as tourism, one of the main revenue sources, has been sharply reduced for almost 2 years. Although there has been a rise in telecommuting for those jobs able to use those technologies, unemployment increased and specific brief time working strategies were widely used to cushion the impact of the crisis on the society.

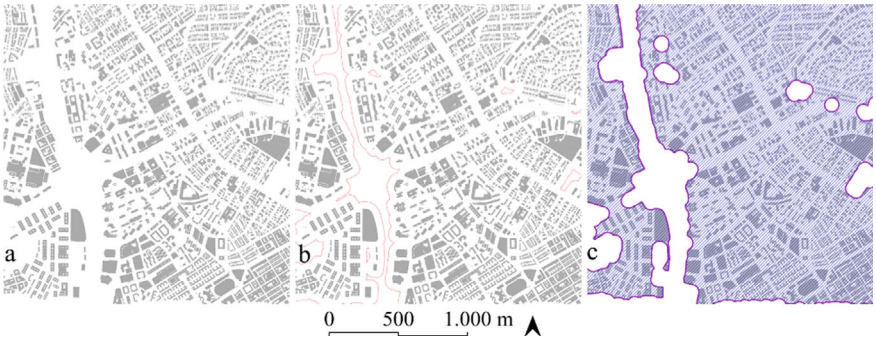


Fig. 16.1 Homogeneous area measure geometric definition, from building footprints (**a**) through a first outward 50 m buffer (**b**) and a further inward 50 m buffer (**c**) of the resulting polygons (*Source* authors, 2022)

16.3 Methodology

16.3.1 Case Study Selection

The urban region of Madrid, which for the purposes of this study we consider as a working simplification as equivalent to the political region of the Comunidad de Madrid, covers an area of 8.030 km^2 and has a population of over 6,7 million. Along with the city of Madrid, which acts as the core of the region, there are also high mountain ranges and rural areas which are sparsely populated. Due to its size, the region presents a diversity of physical, social, and economic contexts which facilitate a comprehensive analysis. Madrid is also a relevant study case as there is a wide set of open data sources which allow an interesting look at the interaction between different parameters. These include cadastral data with graphic and alphanumerical information, COVID-19 incidence data, mobility data from cell phones, and revenue data.

16.3.2 Research Design

This article is quantitative research that considers the geographical configuration of the Madrid region and the subjective input from the authors, who have worked and lived in the region for most of their life and have experienced there the COVID-19 crisis. The use of open data with high spatial and temporal resolution allows the obtention of detailed results and the replicability by other authors. Since the data spatial and chronological granularity is heterogeneous, the analysis considers these differences to reach conclusions. The research has followed the following sequence, with the aim to answer the following questions:

(A) Data preparation
(B) Analysis at the scale of the 246 census districts

   a. Basic morphological and demographic analysis
      i. Are population and housing stock moving the same way?
      ii. To which extent these changes are related to urban density?
      iii. Which are the morphological conditions of the areas that have witnessed more robust growth?
      iv. To which extent has there been a change in these dynamics before and after lockdown?
   b. Specific age group analysis
      i. Has population location evolved over time for different age groups?
      ii. Has there been a change in the distribution of age groups according to housing typology?

(C) Analysis at the 4.147 census tracts and their groups

   a. Is there any indication of links between urban density and disease dynamics?
   b. Is there any link with mobility indicators?
   c. Are there any density indicators that show a higher correlation with disease progression?
   d. Are there lessons from the evolution of the disease dynamics over time in relation to density?

(D) Conclusions

Further research will refine this approach to the problem as more detailed data is available, so its conclusions are provisional. Although there are data about the behavior of these indicators during the lockdown, its singular conditions have made the authors think that the recovery process was more interesting.

16.3.3 Data Preparation

We organized the research according to the following set of criteria:

1. Geographical study areas preparation (Fig. 16.1): All the building footprints defined in the state cadaster are subject to a double buffer process, to provide a homogeneous area measure for the floor-area ratio calculation:

   a. First, they are subject to a 50 m outward buffer. This 50 m dimension allows to differentiate urban tissues separated by large avenues and motorways, rail corridors, or linear parks, which can we assume to be urban interaction limits by breaking the domestic scale. We then dissolved the resulting polygons, as to provide a continuous buffer of the built footprint, regardless of the use of the building. Although in some cases, a minute analysis of the data shows uses classification issues due to the difference in criteria between the tax

orientation of the source and the urban analysis use, overall, we consider it an accurate description of the current situation on the field.

b. Then, that overall buffer is subject to an inward buffer, also measuring 50 m. This provides a footprint that allows a density measurement which is consistent between zones, as more usual divisions as census tracts or health zones do not differentiate built-up areas from more open spaces. This way to measure density is intended to consider the potential interaction intensity between residents.

The resulting shape is then subject to two geometric operations:

i. Census district scale:

1. Results are intersected with the "distritos censales", as provided in Instituto Nacional de Estadística (2022d), providing a set of 246 polygons which, considering the geometric process, can have "islands" and "holes".
2. Morphological indicators regarding density and geometric configuration are related, according to the personal knowledge of the area by the authors, to the urban dynamics in the region. Table 16.1 shows the indicators used to generate each map. In demographic terms, children under 5 have been selected as the search for a better environment to raise them could be a driver to move to a different home after lockdown; the 65–69 age group corresponds to those just retired, who could also choose to move to a less dense place; and the over 69 group seemed interesting as they would seem to tend to stay in their homes.
3. On each map a table compares the results of the indicators for the affected set of census districts and compares those with the ones corresponding to the whole region. The two indicators to the right correspond to a geometric shape coefficient (geom), which is the result of dividing the area of the homogeneous area intersected with the census district by the square of its perimeter, to ensure a non-dimensional coefficient. For instance, a 2×2 square would have a coefficient of $4/8^2$, while a 4×1 rectangle, with the same area, would have a $4/10^2$ coefficient, hence the more compact the shape, the higher the coefficient. The second one is a floor-area ratio considering the sum of the built areas of any use according to the cadaster.

ii. Census tract scale:

1. Results are intersected with the "secciones censales" (census tracts) defined by the National Statistics Institute (INE). This step in this order is relevant, as even though these tracts are the building blocks for other zones as those related to health and mobility, the publicly disseminated shapefiles for the latter have been subject to a geometric generalization that would produce artifacts if geometrically overlapped as they are. The results are 4.417 polygons, one for each census tract, albeit with a morphologically defined boundary based on building footprints.

Table 16.1 Preparatory maps at the census district scale (*Source* authors, 2022)

	Rises between 2018 and 2022	Rises every year 2018–2022	Decreases 2018–2022	Decreases every year 2018–2022	Rises 2018–2020, decreases 2020–2022	Does not rise 2018–2020, rises 2020–2022
Nr single-family housing units	A1	B1	C1	D1	E1	F1
Nr multifamily housing units	A2	B2	C2	D2	E2	F2
Average surface of single-family housing units	A3	B3	C3	D3	E3	F3
Average surface of multifamily housing units	A4	B4	C4	D4	E4	F4
Average cadastral value of single-family housing units	A5	B5	C5	D5	E5	F5
Average cadastral value of multifamily housing units	A6	B6	C6	D6	E6	F6
Total population in the Padrón	A7	B7	C7	D7	E7	F7
Total population aged under five	A8	B8	C8	D8	E8	F8
Total population aged 65–69	A9	B9	C9	D9	E9	F9
Total population aged over 69	A10	B10	C10	D10	E10	F10

2. Then, each of the resulting polygons is assigned to the corresponding basic health zone and mobility analysis zone in independent text fields.
3. An additional field for each resulting polygon displays the area in m^2, as to provide density indicators.

2. Statistical data preparation:

a. Data from the various sources is included in the database in different tables, in each case defining the corresponding original geographic coverage area.
b. A set of joins allows to take account of that data in each analysis dimension (urban density, mobility, disease incidence rate…).

16.3.4 Open Data Used

Cadastral data. There are several methodologies to measure urban density, as in Berghauser Pont and Haupt (2009), which address the issue through specific measures. For this work, we chose to use official open built areas data. The Spanish Ministry for Budget produces and publishes open cadastral data for a set of 46 provinces, which includes Madrid, using different formats. There is an aggregate set of statistics that covers municipalities and "distritos censales" (census districts), summarizing for a set of land uses the number of properties and their basic features. The Madrid region has 179 municipalities, and 16 of them are subdivided into census districts, to a grand regional total of 246. Albeit this source has a low spatial granularity, it provides a temporal sequence that can be more informative than the detailed sources mentioned ahead, and it provides, at the graphical scale of this paper, a less detailed but clearer view of the whole region.

At a higher resolution, that of the individual parcel, there are two main sources. The national specification has a richer content but results in bulkier files, so we used the Inspire specification for buildings. The Ministry publishes Inspire-formatted data twice a year, and in this paper, we used the 2022 first dataset. This includes the building footprints that allow the previously explained homogeneous area delimitation. It also assigns a single land use to the complete set of buildings included in a lot, corresponding to the one which occupies the largest built area, and a figure for the number of dwellings in the lot and the built area. This number of dwellings is an approximation, as it really represents the number of invoices sent by the municipal tax office to individual real estate properties that have a residential use assigned. This means that when a single landowner rents several flats at a single address and is taxed for the whole, this appears as a single dwelling. As the proportion of rented dwellings in Spain and in Madrid is exceptionally low, and most of them are single dwelling properties, the differences between that dwelling number and other measurements, as that of the population of housing census, are generally small, so they are not taken into account. Besides, the currently available data census is from 2011, and as of March 2023, the National Statistics Institute has published the 2021 census data just

for residents but not for buildings, so even if this last decade has seen scarce building activity, authors have chosen to use the cadastral data.

Population data. The Spanish National Statistics Institute produces two basic sets of population data. The first is the 10-year census, whose last published results are from 2011, and whose 2021 results are not yet available. The second one is the "Padrón Municipal de Habitantes", which is an administrative record of the residents in each municipality. When a resident in Spain is born or changes residence, concerned municipalities update the corresponding address along with basic data, avoiding double counts. As the inscription at a given address can provide access to public schools or services in specific locations, in large metropolitan areas there are cases of people living in an area but inscribed as residing in the municipality in which they work. For the purposes of this research, we considered that this is not significant.

The National Statistics Institute publishes this population data in its most detailed spatial resolution by "secciones censales" (census tracts), which correspond to around 1.000 residents on average, with 4.417 tracts for the whole region, which are subdivisions of the previously mentioned census districts. In densely populated areas, this covers an urban block, but in rural areas, they can cover the whole municipality. The published data informs about the total size of the population, its gender and age composition, place of birth, and education level. The Spanish National Statistics Institute publishes data at this resolution once a year, and municipalities as that of Madrid have started publishing monthly data; as this would only cover about a half of the population, we used homogeneous yearly data for the whole region.

The dataset that we analyzed (corresponding to the population on January 1, 2021) Instituto Nacional de Estadística (2022a) corresponds to 6.751.250 residents, a decrease of 28.640 (0,42%) from the January 1, 2020, figures (6.779.890). The Spanish National Institute for Statistics publishes specific data on residential variations that show how people move between addresses over a year. We have not evaluated this information as it is not available with enough granularity, and there has been also no data source to obtain detailed information about deaths resulting from COVID-19.

COVID-19 incidence data. The Health Department of the Madrid Regional Government has published data of the COVID-19 incidence rate, as measured per 100.000 residents, using the basic health zones' geographic boundaries (aggregates of census tracts) as the most detailed. The publications provide daily data for the lockdown period (March–June 2020), and since June 2020 twice a week. There are two open data formats: a 14-day mobile average, which better portrays local surges and the regional government used for local lockdowns, and an absolute incidence rate, which is a number that can only grow and not oscillate as the 14-day mobile average. The absolute incidence rate provides an approach to potential long-term impact, as unfortunately there is no data on the severity of the cases or the mortality at that scale.

The Madrid Regional Government publishes this data for the geometries of 286 Basic Health Zones.

Mobility data. In 2019, the Spanish National Statistics Institute started an experimental mobility study based on cell phone data, Instituto Nacional de Estadistica (2022b). As COVID-19 appeared, the National Statistics Instituto adapted that operation to provide data about the impact of the pandemic on mobility patterns. As in Spain there are over 55 million mobile lines for 47 million residents, this source seems representative. During the lockdown period, data showed that the overall mobility on a working day diminished to weekend levels. Following that period, and in a similar fashion to the COVID-19 incidence data, the publication frequency for this data was reduced by the National Statistics Institute. The information provided does not include the mobility mode, or speed, but focuses instead on the number of people that are during daytime and nighttime in each area, as well as the links between the areas in which people spend nights and days. For this study, we chose to pay attention to the quotient between the total population detected during daytime in an area and its resident population, which is the one staying at night.

The geometry of the areas of the Madrid Region on which this data is published is 295 polygons, which aggregate census tracts.

16.3.5 Data Processing and Visualization

The mentioned data has been processed through Microsoft 365 and the open-source QGIS for Windows software, using SQL expressions to filter and aggregate the original data to obtain the used indicators at each geographic scale. To get a global vision of the built density versus population density issues, a matrix of maps already described in the data preparation section has been created at the census district geographic detail, which given the final publishing format provides a clearer view. The maps in that matrix that have provided interesting results are figures in this article, along with those that, at other scales, provide further relevant results.

As there are two sets of maps, one at the census district detail scale and the other at the census tract detail scale, density figures are different, as the larger zones considered for census districts provide lower average densities; this is considered in the conclusions.

16.4 Results and Discussions

16.4.1 Census District Scale

This scale allows to consider overall dynamics for the building construction dynamics. As the analyzed period is quite short compared to the planning and permits pipeline, we chose to analyze building dynamics for multifamily and single-family housing units using the cadastral statistics between 2018 and 2022, covering the total

figure as of December 31, of each year. The reason to obtain different figures for both typologies is related to the potential attraction that single-family homes could have after a lockdown in an overwhelmingly multifamily housing stock. As the total stock of housing units in the region during those 5 years rose by less than 1% overall, the test focused on whether the numbers rose or went down.

Overall, between 2018 and 2022, the number of housing units has grown in 219 of the 246 census districts; this growth, rendered in Fig. 16.2, has been limited in proportion and has favored multifamily housing units in absolute terms, with over 10.000 new units which are an 0,4% increase when compared to 2018, and single-family units in relative terms, as the over 4.000 additional units mean a 1,19%increase. This means that overall, the trend is to continue the relative increase in the presence of lower density urban tissues. A closer analysis shows that the largest increase in single-family units has been in areas where both typologies grow. Areas in group (a) in Fig. 16.2 are in peripheral locations which are less connected to the main roads, which could explain why only single-family units have grown; they are the less populated but have experienced the highest percentual population growth. In group (b), in which multifamily units have grown but not single-family ones, we find the densest urban tissues in the region; these have the most compact urban shape as the geom coefficient shows, and the highest floor-area ratio. In group (c), which is the scene for a growth in both typologies, are peripheral areas better connected to the main roads. This (c) group has a looser geom coefficient, but higher floor-area ratio than group (a), so are becoming more complex and gaining population faster than the denser tissues of group (b).

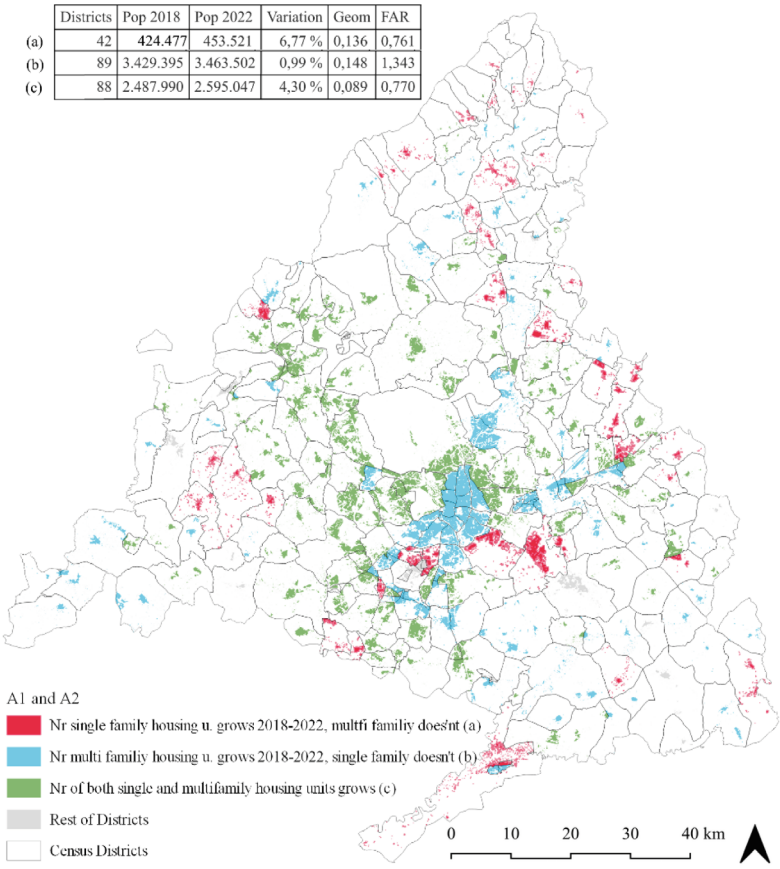
When analyzing population growth considering the 2020 (lockdown) threshold, most districts, and clearly those in more central locations in the metropolitan system, have gained population in the 2018–2020 period to later loose residents until 2022 (Fig. 16.3). The eight districts that had no growth prior to the lockdown are in extremely peripheral areas, and their total population is minute. The geom coefficient of these eight districts is quite like that of the opposite group, but with lesser FAR, as these are small rural settlements with compact urban shapes but limited building height.

The specific 0–4 years old group shows a growth in peripheral areas, as it also happens in the case of the decrease (Fig. 16.4). The numbers show that the changes after 2020 have had a limited impact on the pre-lockdown dynamics. Areas losing toddlers after the lockdown that had previous growth in their number are slightly more compact but have smaller FAR than the opposite group.

Figure 16.5 shows that the districts that following the lockdown have gained retired residents are scattered around the region, but especially concentrated around the urban core, even though many of those are quite dense areas. Anyway, population gains have been quite reduced.

When it comes to the oldest groups of age, population losses are in the central city (Fig. 16.6). Further data would help to differentiate losses resulting from COVID-related deaths from other sources.

Overall, the analysis by age groups shows limited insight on any influence of the pandemic on the residential location. The fact that Spain and the Madrid region have



	Single family housing units		Multifamily housing units		Overall 2018-2022 growth	
	2018	2022	2018	2022	Single family	Multifamily
(a)	39.152	39.834	136.737	136.394	682	-343
(b)	89.648	88.788	1.440.360	1.446.170	-860	5.810
(c)	210.323	214.893	803.340	808.711	4.570	5.371
Rest of districts	19.892	19.779	81.943	80.969	-113	-974
Grand total	**359.015**	**363.294**	**2.462.380**	**2.472.244**	**4.279**	**9.864**

Fig. 16.2 Composite map of A1 and A2 census district maps. Variation in the number of multifamily and single-family housing units by census district between 2018 and 2022 and summary table (*Source* authors, 2022)

a high rate of home ownership, which is more rigid in its changes than home renting, is relevant here. What this data does show is the fact that the low-density urban forms keep gaining residents at a faster pace than denser areas.

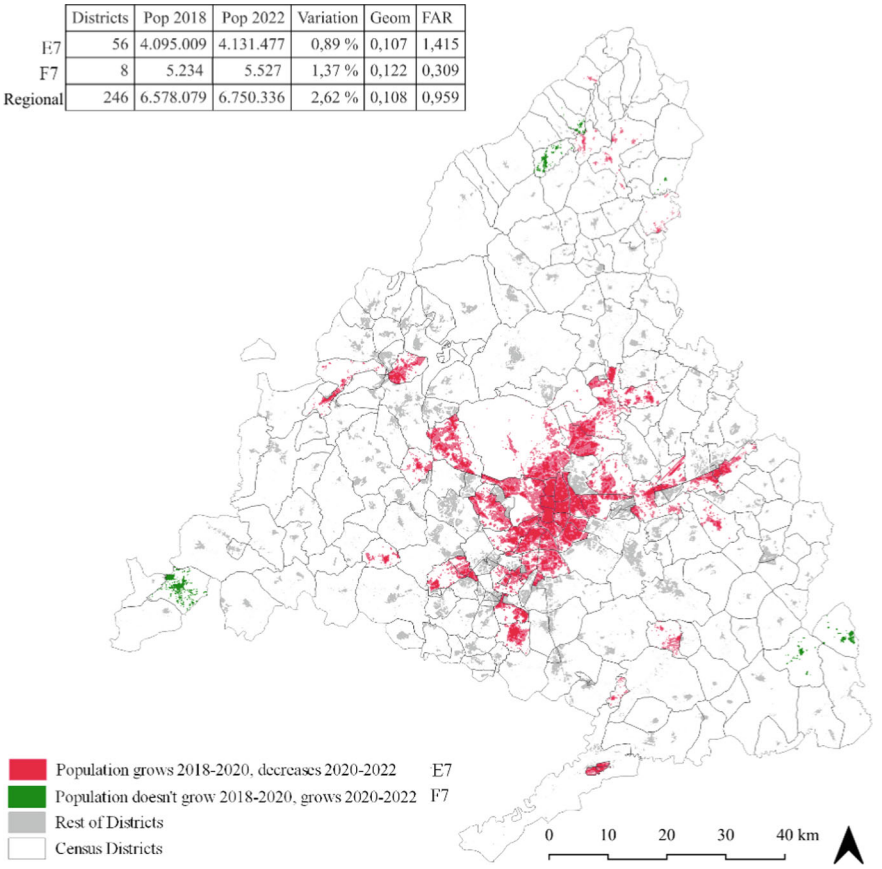


Fig. 16.3 Composite map of E7 and F7 census district maps. Variation in population by census district, considering the 2020 (lockdown) threshold (*Source* authors, 2022)

16.4.2 Census Tract Scale

16.4.2.1 Built Density

In terms of built density, displayed as a floor-area ratio that considers the homogeneous area definition prior described, the central city of Madrid, along with a set of suburbs in the nearest areas, have the highest values in the region. Most of central Madrid is over three m^2/m^2 as measured on homogeneous areas at the census tract level. Sixty-nine percent of the built-up area is on lots in which homes are the main use, 10% is on those on which industrial use is the main one, and 4% goes to retail and to offices.

The average dwelling density is of 45 dwellings per hectare, and there is a step gradient in which the densest areas are in the central city. Only 0,92% of the dwellings

	Districts	Pop 2018	Pop 2022	Variation	Geom	FAR
E8	43	47.713	45.368	-4,91 %	0,098	0,832
F8	27	10.540	10.706	1,57 %	0,105	0,460
Regional	246	320.026	275.142	-14,03 %	0,108	0,959

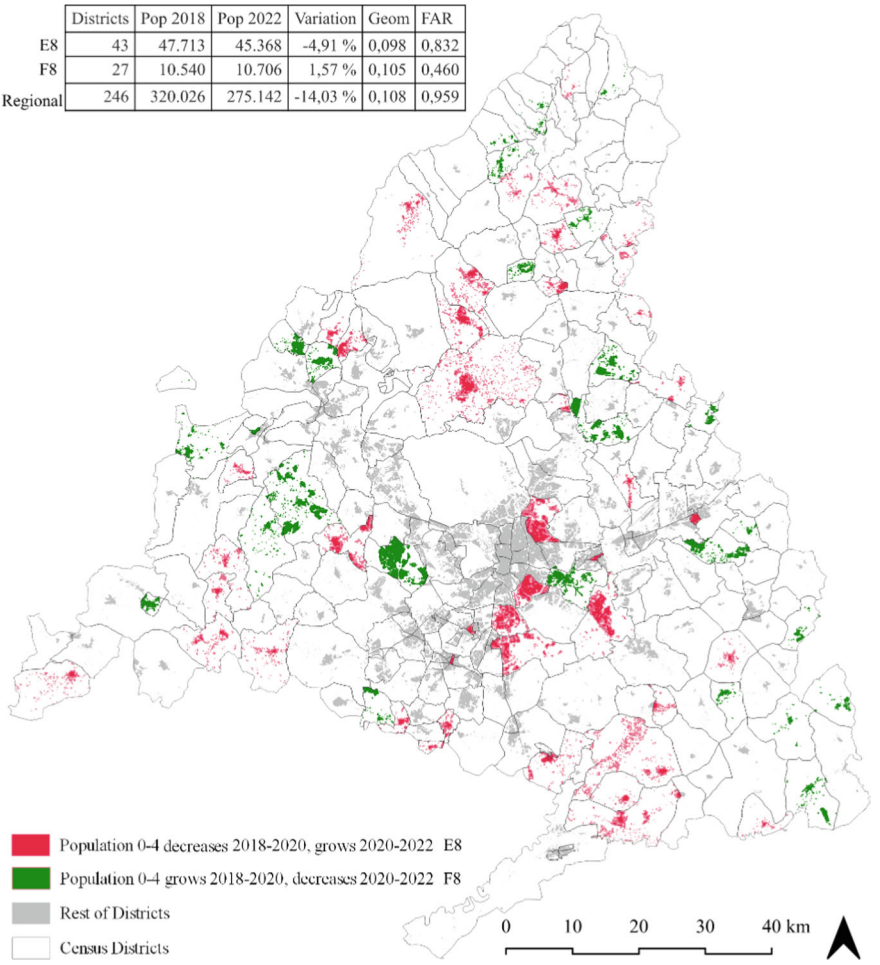


Fig. 16.4 Composite map of E8 and F8 census district maps. Variation in population aged 0–4 by census district, considering the 2020 (lockdown) threshold. Total regional numbers for population considered here just for the age group (*Source* authors, 2022)

recorded in 2022 were built after 2019, and the proportion of both overall built-up area and residential built-up area built after 2019 was close to 1,4%, which means there was an acceleration of growth, as only 3,57% of the recorded housing units in 2022 were built after that year.

The average built-up area per dwelling was 148 m^2, with a strong correlation at the regional scale between that parameter and household disposable income. The areas with the highest average built-up area per dwelling are usually in the richer districts of the inner city and in peripheral areas.

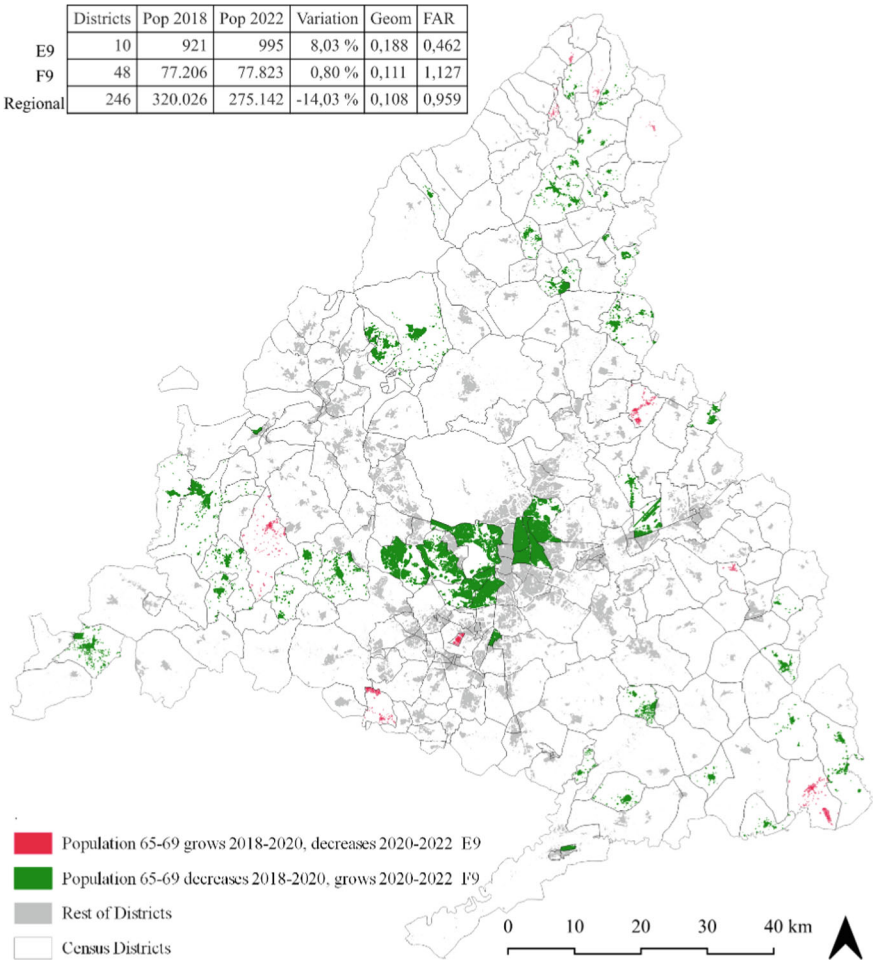


Fig. 16.5 Composite map of E9 and F9 census district maps. Variation in population aged 65–69 by census district, considering the 2020 (lockdown) threshold. Total regional numbers for population are for the age group (*Source* authors, 2022)

16.4.2.2 Population Density

The average population density of the defined areas as of January 1, 2022, was 105 persons/hectare, and there is a step gradient in which the densest areas are in the central city (Fig. 16.7). This is closely correlated to the average dwelling density.

	Districts	Pop 2018	Pop 2022	Variation	Geom	FAR
E10	34	342.364	338.897	-1,01 %	0,136	1,682
F10	10	1.642	1.643	0,06 %	0,211	0,416
Regional	246	320.026	275.142	-14,03 %	0,108	0,959

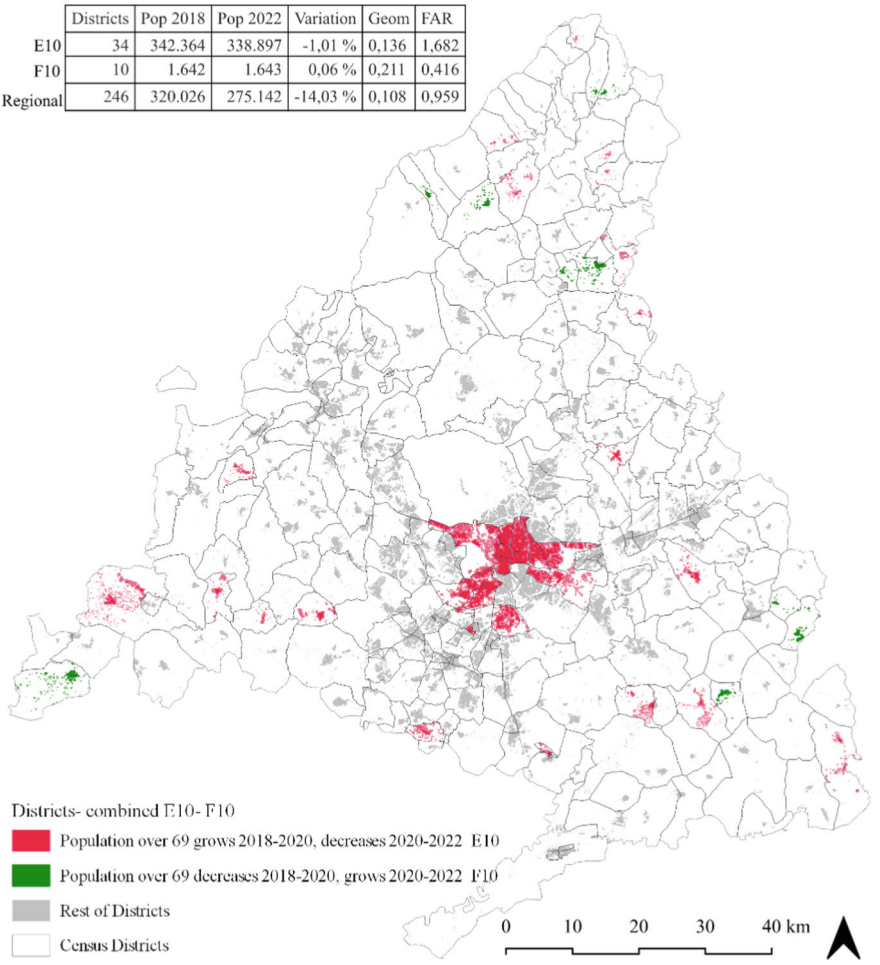


Fig. 16.6 Composite map of the E10–F10 census district maps. Variation in population aged over 69 by census district, considering the 2020 (lockdown) threshold. Total regional numbers for population are for the age group (*Source* authors, 2022)

16.4.2.3 COVID-19 Incidence

The COVID-19 incidence has evolved over time by a set of "waves" in which 14-day averages rose sharply to later decrease, getting at the end of the period to as high a 19.317 per 100.000 (Fig. 16.8). From March 2020 to August 2022, the estimated death toll for the Madrid Region has been of 19.112, with 1,91 million recognized cases. Over 5,7 million residents in the region received the double shot, and over 3,5 received a third dose.

In a first visual analysis, the higher overall ratios as of November 30, 2021, are in the densest central locations of the region (Fig. 16.8), but a quantitative analysis

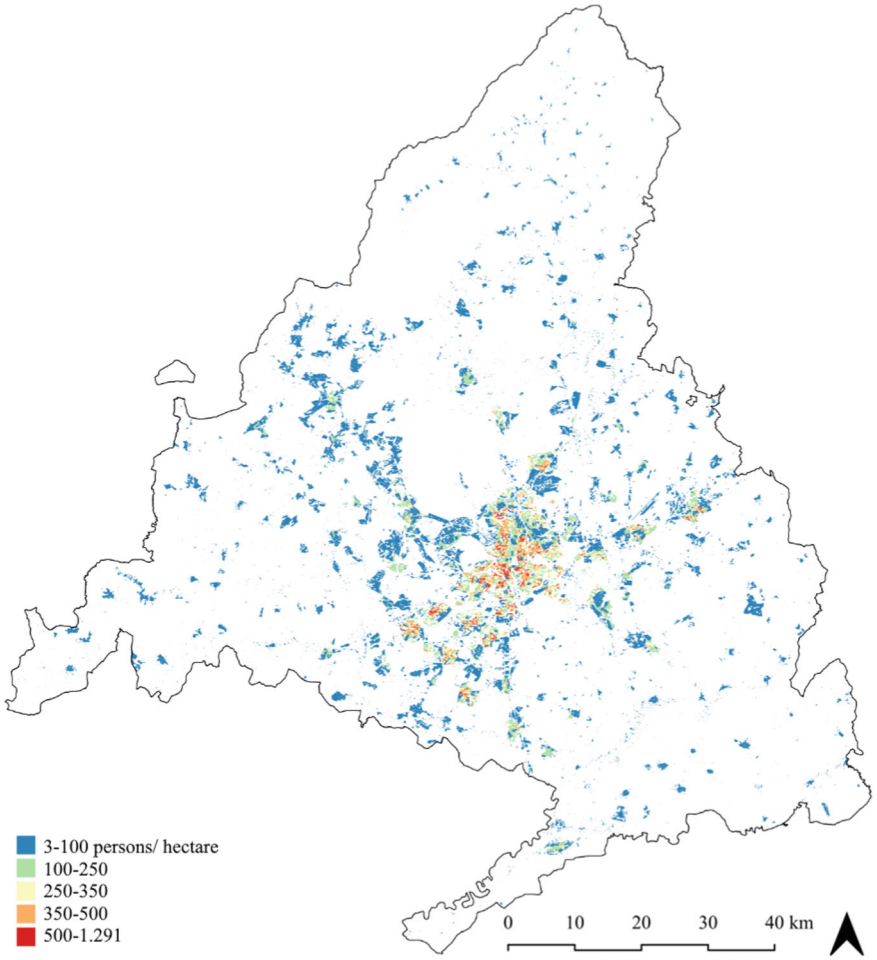


Fig. 16.7 Population density as of January 1, 2022, in persons per hectare (*Source* authors, 2022)

shows differences. When considering the built densities of each census tract and the cumulative incidence of the corresponding basic health zone, the correlation is weak, as R2 is just 0,0366. A more detailed data on incidence, by census tract, could provide more insight, as would data about the severity of infections at that spatial resolution. When we evaluate the correlation against built-up surfaces (Fig. 16.9) the R2 value decreases. Parallel research published in Barros-Guerton and Ezquiaga-Dominguez (2023) shows a coincidence of these results with those for the central city of Madrid, although in certain moments of the second wave there seemed to be a strong correlation between home size and disease (Fig. 16.10).

Figure 16.11 shows the Pearson correlations between different indicators; in each case CIR is the highest published data for each area, built-up areas and numbers of

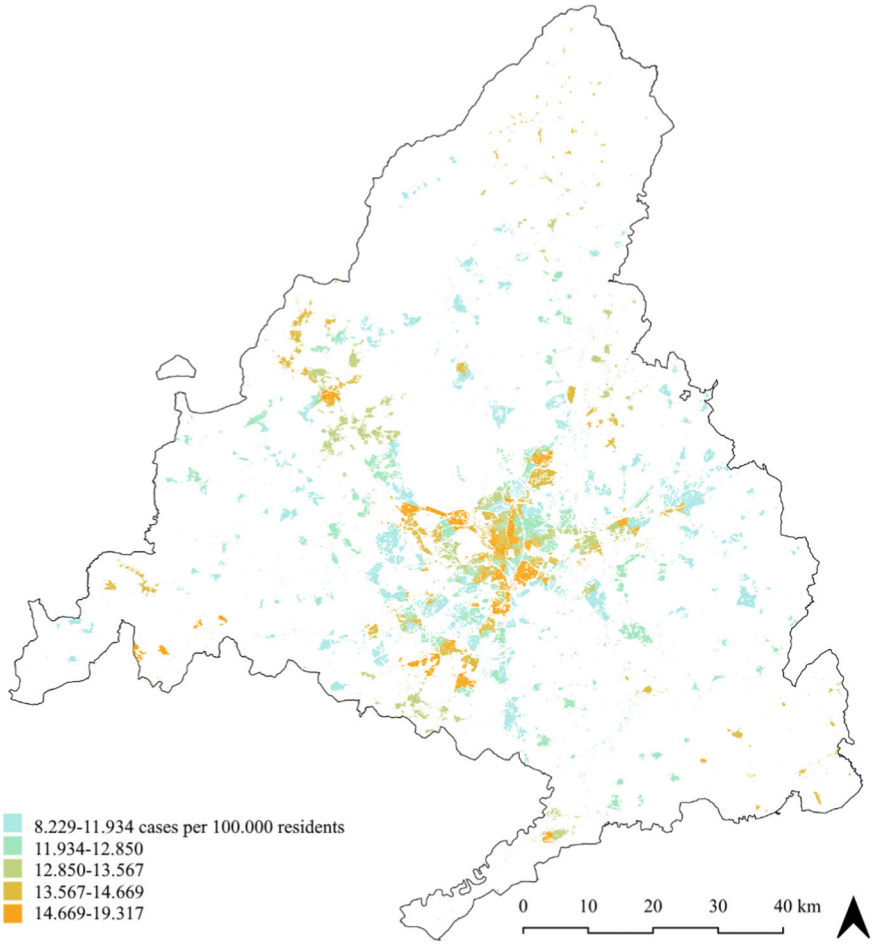


Fig. 16.8 Overall cumulative incidence rate for COVID-19 by basic health zone, as of November 30, 2021, according to the Regional Government data, in cases per 100.000 residents (*Source* authors, 2022)

dwellings are the 2022 data; the change in built areas between 2020 and 2022 has been quite minute, as it has become evident in previous sections, so the figures are considered constant, and there are specific indicators for change. Adopting a more dynamic analysis from June 2020 to March 2022, it becomes clear that the stronger Pearson correlations on a regional scale have happened after the 2020 summer, with a +0,542 for persons/hectare versus CIR, meaning that the more crowded the home, the higher the chance of getting infected, and a −0,610 for m^2/dwelling versus CIR, meaning that the higher the home surface, the lesser the chance of infection. The third highest correlation, also around that time, is for the dwellings per hectare correlation, at 0,482. It is strange that the correlation between persons per dwelling and CIR is

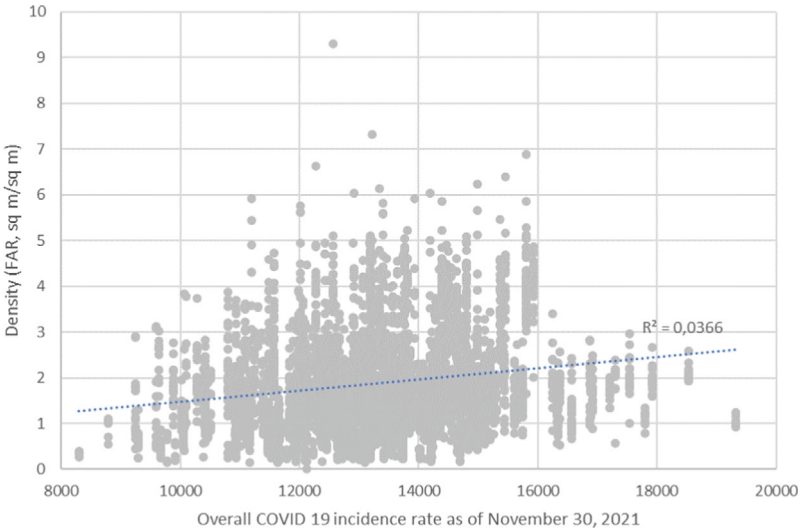


Fig. 16.9 Overall Cumulative Incidence Rate for COVID-19 by basic health zone, as of November 30, 2021, according to the Regional Government data, in cases per 100.000 residents, in correlation with built-up density (FAR in m^2/m^2) (*Source* authors, 2022)

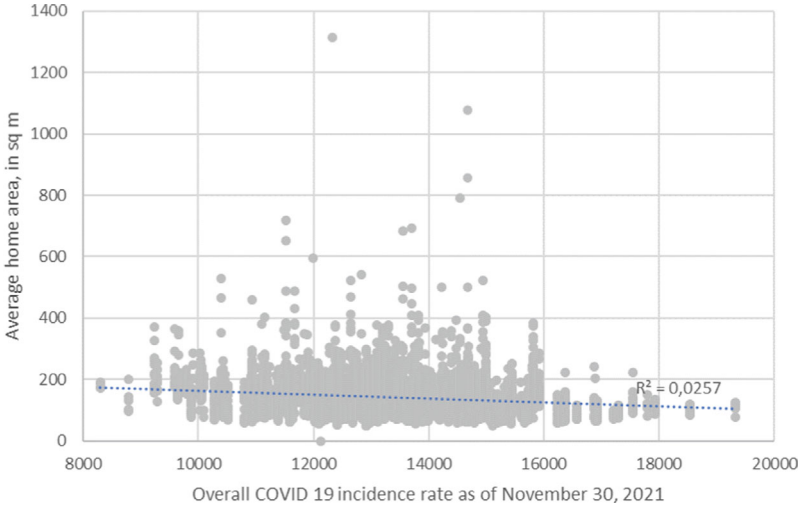


Fig. 16.10 Overall Cumulative Incidence Rate for COVID-19 by basic health zone, as of November 30, 2021, according to the Regional Government data, in cases per 100.000 residents, in correlation with average home built-up area in m^2 (*Source* authors, 2022)

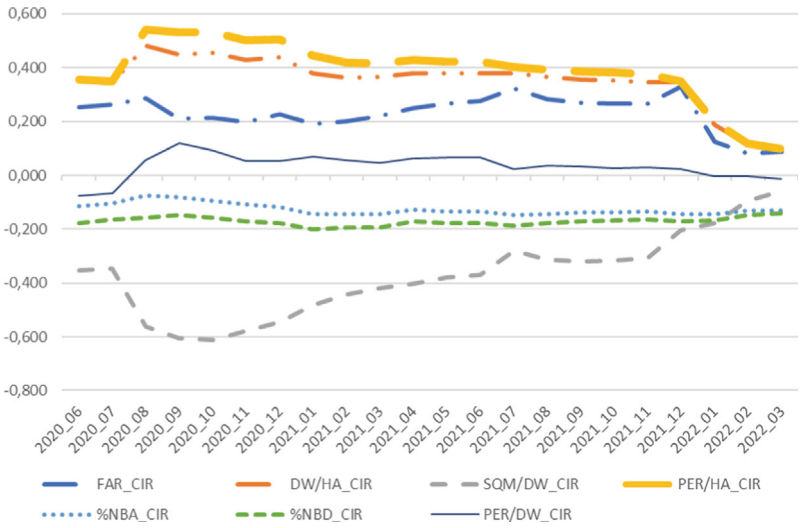


Fig. 16.11 Evolution of the Pearson correlation coefficient between the highest COVID-19 Cumulative Incidence Rate (CIR) for each month between June 2020 and March 2022 in the Madrid Region. FAR: floor-area ratio, DW/HA: dwellings per hectares, SQM/DW: square meters per dwelling, PER/HA: persons per hectare, %NBA: % of built-up surface erected after 2019, %NBD: % of dwellings erected after 2019, PER/DW: persons per dwelling (*Source* authors, 2022)

quite low, but this can be since in some areas there are substantial number of vacant dwellings. A gradual flattening of those curves is subject to a clear change from January 2022, coinciding with a methodology change for case accounting.

16.4.2.4 Mobility Data

We approached mobility by counting, among the 150 days with published cell phone data between June 2020 and November 2021, those in which the number of daytime persons exceeded that of nighttime residents (Fig. 16.12). In 3.559 areas (80,5% of the total areas, with 81,91% of the population) no single day complied with that rule, which means they overall sent more people to work, study or receive services in other areas than they received. On the remaining 858 areas the highest numbers of days correspond overwhelmingly to the central city and, to a lesser degree, to economically relevant locations (Barajas airport), in high-income low-density residential areas (La Moraleja). This also applied to sparsely populated municipalities in the northern tip of the region which may have been a temporary shelter for people which the Padron Municipal de Habitantes recorded as living in other areas, and its relevance has increased by the low recorded density prior to the COVID-19.

To get an idea on how this has evolved over time we applied a simple test. As the June 2020 to November 2021 period covers 18 months, have the areas experienced more days complying with the defined condition during the first 9 months or during

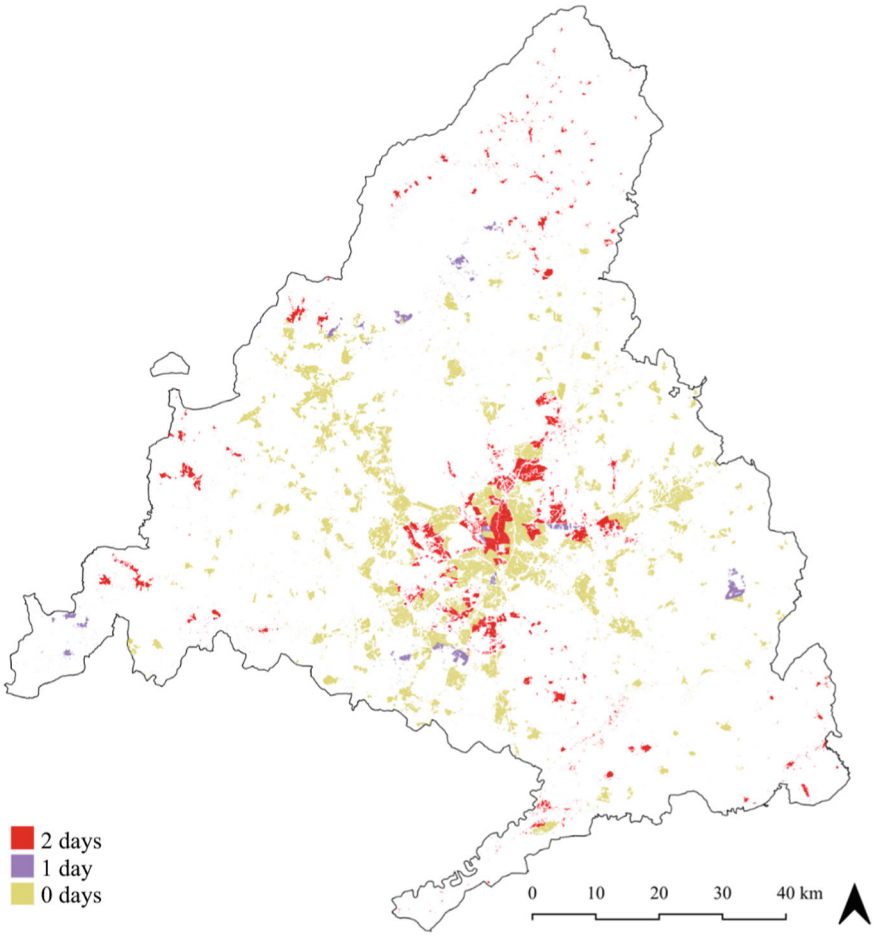


Fig. 16.12 Number of days with data in the June 2020–November 2021 period in which the number of persons present during daytime in the area was larger than that of residents at nighttime. 0 = no recorded days with such condition. 1: more than one recorded day, and most of the days were in the first 9 months of the interval. 2: more than one recorded day, and most of the days were in the second half of the interval (*Source* authors, 2022)

the later? Among the sixty-three mobility areas which overall complied with the condition, only in fifty-three there were more days of compliance during the second half of the period. These fifty-three areas follow a similar pattern of use and density to the one described above. Meanwhile, the areas in which the number of days with more visitors than residents fell correspond to low-density areas in which secondary dwellings (i.e., holiday houses or flats) were used after lockdown, to later return to permanent housing units in denser areas.

So, in terms of mobility, the lockdown, and the perception of low quality of life in smaller multifamily multistorey units compared to that in low-density areas

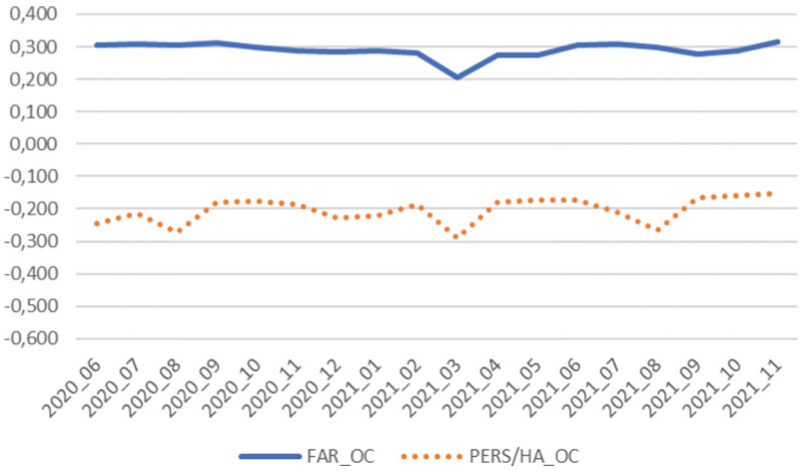


Fig. 16.13 Evolution of the Pearson correlation coefficient between the highest monthly ratio for the daytime population versus nighttime population and Floor-Area Ratio (FAR) and density in persons per hectare (PERS/HA), for Wednesdays (*Source* authors, 2022)

created a certain displacement of residents, which later tended to return to their usual dwellings, which have better access to services.

A further refinement along the 150 days of that period is to differentiate between Wednesdays and Sundays, the two days of the week for which there are data. When just taking into account to which extent the floor-area ratio, as a measure of density, is related to daytime arrival of visitors, the direct correlation for Wednesdays (Fig. 16.13) is direct but low (0,3) and lesser for Sundays (Fig. 16.14); when considering human density in persons per hectare the Wednesday correlation is negative but weak, but on Sundays it is higher, around 0,45, and negative, so the higher the human density of residents, the lower the chance to have people coming from other areas on Sunday. More detailed data from non-pandemic moments could confirm whether this was a result of the psychological pressure of lockdown, or it is a social constant in Spain, but it seems consistent with the perception of the authors that the lockdown experience played a relevant role.

16.5 Conclusions

The complexity of the COVID-19 pandemic and its long duration has made it difficult to identify single factors of correlation with the disease, as it has had consequences on urban tissues that were already under complex situations in Spain due to an economic crisis that has lasted for more than a decade. Overall, the results show that urban density alone is not necessarily a driver of the spread of the disease, as initially claimed by the mass media as in Rosenthal (2020) and Gracia (2020).

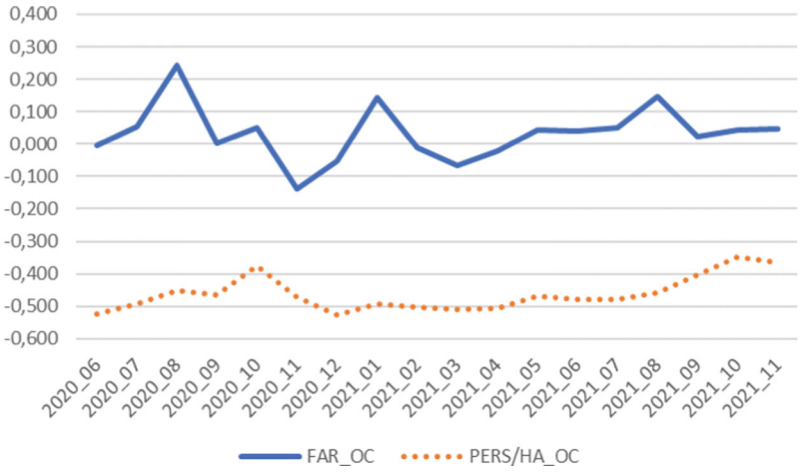


Fig. 16.14 Evolution of the Pearson correlation coefficient between the highest monthly ratio for the daytime population versus nighttime population and Floor-Area Ratio (FAR) and density in persons per hectare (PERS/HA), for Sundays (*Source* authors, 2022)

Data shows some signs that the main effects of COVID in terms of urban dynamics, besides the obvious decrease in street-level economic activity that has crippled many businesses, have been some increases in daytime population in low-density peripheral areas which can be related to a temporary use as a main residence of what usually was a secondary home, and this has decreased over time. According to mobility data, the areas that have a greater population during daytime than at night are still the central areas of the core city and some peripheral locations that are related to high economic activity; a substantial difference in the correlation between human density and the degree of attraction on Sundays, in the negative sense, seems coherent with a stringently felt lockdown. On the other hand, the changes in the overall population over the 2020 year contrast sharply with those corresponding to the 0–4 years age group; further work could establish whether a trend to move to lower density areas when having children is intensifying, or this was a response to the trauma caused by lockdown in small apartments which often lack good access to sun and open views in the densest area of Madrid, or other factors are at stake.

The complexity of the analyzed data and the absence of disease data at the census tract scale can mask interesting results; there is a strong correlation between population density and home size versus cumulative incidence rate in the first wave after the lockdown. This would be consistent with other historical pandemics, in which home overcrowding played a role in disease transmission, so it seems reasonable to think about the housing standards in planning documents and the adequate provision of decent housing as a positive measure against future epidemics. Even if that correlation has decreased, the fact that it was high during a second wave in which personal movement was unimpeded, could point to the fact that less densely occupied housing units would have resulted in lower incidence.

The existing data is detailed, but it shows its limits when subject to scrutiny, as the use of sources with different aims can mask some outcomes. For instance, the cadastral data used does not provide information on whether a building is in use. A Regional Digital Twin would need further refinements of those tools, taking into acount the complexity of interactions and coertions as stated in Guerton and Dominguez(2022).

As referred in Barros-Guerton and Ezquiaga-Dominguez (2023), mobility patterns in the inner city are changing, and there is a chance that telecommuting, enabled by the internet, could be a substantial part of that change.

References

Barros-Guerton J, Ezquiaga-Domínguez JM (2023) Caer y levantarse: como la ciudad de Madrid ha afrontado el COVID19 de acuerdo con los datos de libre reutilización. Ciudad Y Territorio Estudios Territoriales **55**(218), 1033–1054. https://doi.org/10.37230/CyTET.2023.218.3

Batty M (2017) The new science of cities. MIT Press. https://mitpress.mit.edu/9780262534567/the-new-science-of-cities/

Berghauser Pont M, Haupt P (2009) Space, density and urban form. https://repository.tudelft.nl/islandora/object/uuid%3A0e8cdd4d-80d0-4c4c-97dc-dbb9e5eee7c2

Carozzi F, Provenzano S, Roth S (2020) Urban density and COVID-19. IZA Institute of Labor Economics, IZA DP No.13440. https://www.iza.org/publications/dp/13440/urban-density-and-covid-19

Comunidad de Madrid (Regional Government of Madrid) (2022) COVID 19—TIA Zonas básicas de salud (indicence rate by basic health zones). https://datos.comunidad.madrid/catalogo/dataset/covid19_tia_zonas_basicas_salud

Esteban y Peña MM, Guil Bermejo JL, Fernández Velasco E, Fernández Velasco R, Jiménez García R (2021) COVID-19 en la ciudad de Madrid y vulnerabilidad. Análisis de las dos primeras olas. Revista Española de Salud Pública. 2021; 95: 25 de octubre e202110119. https://www.sanidad.gob.es/biblioPublic/publicaciones/recursos_propios/resp/revista_cdrom/VOL95/ORIGINALES/RS95C_202110119.pdf

Gracia AI (2020) Ayuso: "El problema es la densidad de población, todos los vascos caben en el metro de Madrid". In elespanol.com, 11 May 2020

Guerton JB, Domínguez JME (2022) Urban digital twins, morphology, and open data: an initial analysis in Madrid. In: Annual conference proceedings of the XXVII international seminar on urban form. University of Strathclyde Publishing, Glasgow, pp 847–854. ISBN 9781914241161. https://doi.org/10.17868/strath.00080467

Instituto Nacional de Estadística (Spanish National Statistics Institute) (2022a) Padrón municipal de habitantes (municipal population records). https://www.ine.es/dyngs/INEbase/es/categoria.htm?c=Estadistica_P&cid=1254734710990

Instituto Nacional de Estadística (Spanish National Statistics Institute) (2022b) Estudios de movilidad a partir de telefonía móvil (mobility studies from cell phone data). https://www.ine.es/experimental/movilidad/experimental_em4.htm

Instituto Nacional de Estadística (Spanish National Statistics Institute) (2022c) Información estadística para el análisis del impacto de la crisis COVID-19 (statistic data for the análisis of the impact of COVID-19). https://www.ine.es/covid/covid_inicio.htm

Instituto Nacional de Estadística (Spanish National Statistics Institute) (2022d) Census cartography. https://www.ine.es/ss/Satellite?L=es_ES&c=Page&cid=1259952026632&p=1259952026632&pagename=ProductosYServicios%2FPYSLayout

Ministerio de Hacienda y Administraciones Públicas—Dirección General del Catastro (2002) Inspire open cadastral data. https://www.catastro.minhap.es/webinspire/index.html

Rosenthal BM (2022) Density is New York City's big 'Enemy' in the coronavirus fight. In www.nytimes.com, 23 Mar 2020

Wang J, Zeng F, Tang H, Wang J, Xing L (Oct 2022) Correlations between the urban built environmental factors and the spatial distribution at the community level in the reported COVID-19 samples: a case study of Wuhan. Cities 129:103932. https://doi.org/10.1016/j.cities.2022.103932

Zidong Y, Liu X (2022) Spatial variations of the third and fourth COVID-19 waves in Hong Kong: a comparative study using built environment and socio-demographic characteristics. Environ Plan B: Urban Anal City Sci. https://doi.org/10.1177/23998083221107019

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 17
Residential Community Renewal Performance Assessment Based on Social Network Analysis—Taking Jialingqiao Xicun Community, Chongqing Municipality, for Example

Simai Pang and Bo Yan

Abstract Restricted by the times and economic conditions, public spaces of old residential communities have problems, such as low utilization and uneven resource distribution. Because of these problems, resident activities and communication are limited and residents lack the sense of belonging. This necessitates the establishment of activity spaces suitable for communication through the renewal of old residential communities. Activity spaces of this kind can help re-establish residents' social connections. This paper aims at assessing the performance of residential community renewal. Social network analysis is used to build the community public space network and the resident daily behavior and activity network, respectively. Meanwhile, the aforesaid two networks are comparatively analyzed from the perspective of the network structure and influence of node, and considering four parameters (density, small world density, node betweenness centrality, and structural hole) as well as its derivative indexes. Taking existing residential community for a case analysis, this paper quantitatively assesses and compares the public spaces of the residential community, finding that the inconsistency between the public space network and the resident activity network is attributable to elements, such as quality of space, space accessibility, and node combination. On that basis, strategies for optimization of spatial design are proposed.

Keywords Social network · Community renewal · Public space

S. Pang (✉) · B. Yan
Chongqing University, Chongqing 400044, China
e-mail: pangsimai@163.com

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_17

17.1 Introduction

In 1998, monetization of housing distribution was gradually carried out in China, which led to the transformation of the housing system from a planned economic system to the market-oriented economic system (Lan 2021). Following the transformation, residential planning shifted its emphasis from satisfying rigid needs to pursuing the coziness and livability of the residential area. Driven by the deepening of urbanization, old residential communities built before the twenty-first century have been faced with increasingly prominent problems, such as lack of forward-looking design planning, improper maintenance and management, inadequate green areas, low spatial utilization rate, and crowdedness (Chang and Hu 2018). This paper refers to old urban residential communities, which are relatively closed and independent residential groups or residential areas in cities built before 2000, with common characteristics, the sense of belonging, and a certain degree of social interaction among residents, but with poor public facilities and decaying spatial environments (Guo 2018). Public spaces within residential communities of this type are usually poorly designed, in which public facilities cannot effectively satisfy needs of the modern community life. The sharp contrast between these residential communities and the downtown areas where these communicates are located has aggravated residents' dissatisfaction with the quality of life, which can also hold residents from fostering the sense of belonging and identification, and finally result in the loss of the community order, thus leading to further worsening of the community environment (Hu, Wu and Song 2022).

Public spaces of residential communities constitute the major outdoor environment, which holds social significance and reflects collective psychology (Gu 2010). Residents socialize with each other or relax in public spaces, and in the process, the organizational and emotional communication networks are formed. Well-organized and pleasant public spaces can increase residents' satisfaction about communities, strengthen their willingness to participate in community affairs, enhance the cohesion among community residents, and promote communication between residents with different social resources and from different social classes as well as the maximization of community resources (Yan and Zheng 2021). As a transition from urban public space to personal space, the public space system of the residential area has striking hierarchical and structural characteristics. The accessibility and centrality of the space are controlled by the spatial hierarchy to further control the impairment of public attributes of the space and the gradual shrinking of major users. Public spaces which are oriented toward the whole residential community usually have high accessibility. These public spaces are activity spots where residents can gather together. So the degree of matching between the community spatial network and the resident activity network can mirror whether the creation of community space is valid.

Though transformation and coordinated governance of old residential communities have gained growing attention from citizens and urban administrators, the superficial transformation of the material environment has ignored the necessary

protection for the original social network. Consequently, communication with residents and residents' participation is inadequate; subjective experience cannot ensure a correct positioning of design based on practical situations; community spatial layout and residents' activity needs are inconsistent, all of which have triggered a serious waste of social resources (Yang and Wang 2021). In practice, not only should scientific research methods be adopted to facilitate optimization of spatial layout but also attention should be paid to the exploration of the community cultural background for a better knowledge of residents' activity and communication habits. This can effectively avoid unnecessary conflicts between residents' use habits and community spatial transformation. Thereby, the social network research method is employed by this research to assess the validity of the effort to optimize the community public space design based on quantitative data. By doing so, this research attempts to provide positive theoretical support for the further renewal of communities.

This research proceeds as below. To start with, relevant research fields, research methods, and research background are briefly introduced. Second, the research framework, model building means, and parametric indexes are described. Following that, the results of the case analysis are elaborated. On that basis, causes of inconsistency between the spatial network and the resident communication network are discussed via comparative analysis of the social network. Moreover, strategies for design optimization are proposed. The final section concludes and points out research limitations.

17.2 Background

Originated from the graph theory, social network analysis or SNA emerged in the 1960s, later finding extensive applications in studying social relations (Reilly et al. 2021), economic relations (Palacios-Marques et al. 2021), and spread of pandemic diseases (Kolak et al. 2021). A typical social network is composed of lines and nodes, and can reflect the relations within the network via quantitative analysis (Huang 2018). It is concerned about the dynamic interaction between the structural characteristics of the system and the network vertex. To study the topographical structure of the space from the perspective of social network analysis can not only display integral characteristics of the network structure but also show the position of individuals in the whole through the node connection (Liu 2009).

So far, many scholars have attempted to study architecture and urban space using SNA. For example, Shi and Huang (2018) used SNA to compare the social relation network of residents within different forms of blocks for the purpose of examining the impact of the network structure on social relations of neighborhood residents. Sergio Porta (2006) abstracted the street road network as the network and applied SNA to a comparative analysis of the urban street network topological structure. The analysis results were adopted as a standard to judge the cohesion and integrity within the network and to comparatively study the characteristics of different urban street network structures. Yang and Wang (2021) abstracted resident activities as the

network and combined the resident activity routes with the residential area public spaces. Meanwhile, they obtained residents' general transport distance by analyzing the goodness of fit and adopted residents' general transport distance to assess the accessibility of public spaces. Other researchers have compared the differences and similarities between the public facilities network and the resident activity route network within a city, revealing the mechanism of action of spatial position and scale of facilities on residents' communication (He et al. 2014; Yang and Xin 2020). The above research results suffice to show the strong potential of social network in shedding light on how public spaces can influence community residents' socializing activities. Meanwhile, to abstract residents' socializing activities into the social network and comparatively analyze the social network with the spatial structural network can not only reveal residents' tendency toward socializing and activities in the community but also reflect the use efficiency of public spaces and expound on the correlation between the quality of spaces and resident activities. On that basis, suggestions can be made for further transformation of the community.

Though the previous researchers have fully recognized the influence of residential community public spaces on residents' activity selection, they have generally focused on the centrality degree or accessibility of residential community space nodes in the network, while ignoring the influence of the correlation among public space nodes on residents' activity selection. In this paper, social network analysis (SNA) is used to assess the validity degree of residential community public space renewal from the perspective of node connection. The assessment content is integrated into the node central network analysis, and the causes behind the formation of the residential community network structural characteristics are explained from the perspective of node connection. This helps deepen the understanding of the correlation between the formation of the weak connection within the residential community and the space nodes.

17.3 Methodology

17.3.1 Network Abstraction

In SNA, the network is connected by the correlation among different nodes. In this research, the node of the residential community public spatial structure network is used to represent the public space within a residential community. In the resident activity route network, the node stands for the place where residents stop for some activities. Whether the spatial renewal is successful is decided by whether the centrality of residential community public space is consistent in the structural network and the resident activity network. In the residential community communication scenarios, human activity forms and demands are varied in different layers of public spaces. This research divides network nodes into the "residential public spaces," "group public spaces," and "unit public spaces" according to the major

activity group and public degree in the space. The publicity of the aforesaid three types of spatial publicity is ranked by a descending order. The scope of major service groups narrows down as well. But the boundary of the three types of space calls for further clarification. In this paper, major factors, including spatial scale, function, and major service group, are comprehensively considered, and the space nodes within the residential community are summarized.

After node establishment, the connection between nodes is identified by the contact modes specified by the residential community public space structural network and the resident activity route network. The residential community public space structural network emphasizes on the connection of public spaces, so the connection between different nodes means that the actual residential community public spaces are connected directly by certain paths. On the contrary, the resident activity route network studies residents' actual activity paths. The connection between nodes can indicate the connection between the nodes where residents stop for daily activities. Information like the activity track and the public spaces where they stop can be acquired through the randomly distributed questionnaire. Additionally, the nodes are connected in the network and statistically overlapped. At last, the resident activity route network matrix is formed.

17.3.2 Coefficients Computation

In order to study the influential effect between the public space network structure and the resident activity route network within a residential community, this research uses UCINET to establish an assessment framework for comparative analysis from the perspective of the network integral structure and network node, and based on indexes, including network density, clustering coefficient, average path length, small world index, betweenness centrality, and structural hole. The parameter expressions are shown in Table 17.1 below:

Whole Network Characteristic Parameters

Density: Density refers to the degree of compactness of the connection between various nodes within the network. The higher the network density is, the more comprehensive the network is, and the more likely it is that network nodes will interact with each other. In an undirected relation network, the integral network density is indicated by the ratio of the total connections actually existing to the total maximal connections potentially existing.

Clustering coefficient, average path length, and small world index: The clustering coefficient, average path length, and small world index can jointly reflect the connecting efficiency and accessibility of nodes within the network. Among them, clustering coefficient can reflect the transferability and agglomeration degree of nodes in the network. In other words, it is the ratio of the enclosed triple formed by mutual connections among three network nodes to the triple units formed by any three nodes of the whole network.

Table 17.1 Analytical metrics. (by Author)

Attributes	Parameters		Equations	Notes
Whole Network Characteristic Analysis	Density		$\frac{2l}{n(n-1)}$	l denotes the total number of connections, while n denotes the number of nodes
	Small world	Clustering coefficient	$\frac{1}{N}\sum_{i\in G}\frac{2E_i}{k_i(k_i-1)}$	In the network G with the total scale being N, the node i is connected with the other k nodes
		Average path length	$\frac{2}{N(N-1)}\sum_{i,j\in G, i\neq j} d_{ij}$	In the network with the total scale being N, the distance between the node i and j is d_{ij}
		Small world index	$\frac{C_a L_r}{L_a C_r}$	$C_a L_a$ denote the clustering coefficient and the average path length of the actual network, respectively
Network Node Characteristic Analysis	Betweenness centrality		$\frac{\sum_{j,k} n_{jk}^i}{P_{jk}}$	n_{jk}^i denotes the number of the shortest paths from the node j to the node k via i; P_{jk} denotes the total number of the shortest path from the node j to the node k
	Structural hole	Effective scale	$\sum_j \left(1 - \sum_q p_{iq} m_{jq}\right)$	j denotes all nodes connected with the ego-node, i; q refers to each third party besides i and j; p_{iq} denotes the percentage of the input correlation, q, of the actor i; m_{jq} denotes the maximal ratio of the correlation between j and q and the correlation between j and other nodes
		Efficiency	$\frac{1}{N}\sum_j \left(1 - \sum_q p_{iq} m_{jq}\right)$	N denotes the actual scale of the ego network of the node i

(continued)

Table 17.1 (continued)

Attributes	Parameters		Equations	Notes
		Restriction	$\left(p_{ij} + \sum_q p_{iq} p_{qj}\right)^2$	p_{iq} denotes the percentage of the correlation between i and q in the total input correlation, i
		Hierarchy	$\frac{\sum_j \left(\frac{C_{ij}}{C/V}\right) \ln\left(\frac{C_{ij}}{C/N}\right)}{N \ln(N)}$	C_{ij} denotes the restriction between the node i and node j

The average path length represents the mean distance between any two nodes, which is an indicator of the network accessibility. The shorter the average path is, the fewer the nodes should be crossed between two nodes, and the more convenient the activities will be.

The network with small-world characteristics has a highly clustering and accessible network. In the Watts–Strogatz model, it is believed that, if the ratio of the actual network clustering coefficient to the average path length is larger than the ratio of the clustering coefficient of a random network of the same scale to the average path length, then this network is identified to have small-world characteristics.

Network Node Characteristic Parameters

Betweenness centrality: The mediating role of certain node in the betweenness centrality research network on the shortest path between other nodes can reflect the control capacity of the node in the whole network. The higher the betweenness centrality of the node is, the higher the influence of the internal network flow will be, and the more likely residents will pass by or stop by the public space.

Structural hole analysis. Structural hole indicates the link lacking the connection in the open triple with two undirected edges connecting three nodes. The existence of structural hole means that the three nodes have formed a special weakly connected structure. In this structure, the central node is known as the broker, which can establish the linkage between different groups to improve the network connection efficiency. Though the network redundancy, structural symmetry, cohesion, and network robustness might be impaired accordingly, a low-redundancy spatial network can effectively connect different community clusters under the prerequisite of ensuring the node accessibility. Therefore, the space nodes as "brokers" call for critical attention.

The structural hole indexes mentioned by Burt include four dimensions, efficient scale, efficiency, restriction, and hierarchy. Among them, efficient scale refers to the scale of non-redundant factors in the ego network of the node; efficiency indicates the ratio of the ego network efficient scale of the node to its actual scale. In the ego network, the larger the efficient scale is, the more efficient it will be, the smaller the network multiplicity is, the more likely the existence of structural hole will be, and the stronger the influence of this node on the information flow of other nodes will be.

The restriction proceeds from the intimacy of its connection with other nodes to reflect the extent to which nodes are controlled by other nodes. The higher the index of the restriction is, the stronger the network closing performance will be, and the fewer the structural holes will be generated by this node. Hierarchy is used to suggest to what extent the restriction of a node concentrates on one node. In a community public space, the weaker the restriction of certain public space node is, the lower the hierarchy will be, the higher the accessibility of the node is, and the closer the position of the public space node network is to the core.

17.3.3 Case Introduction

Founded in the 1980s and the 1990s, Jialingqiao Xicun Community covers an area of 5.78 hectares, of which 64 are residential buildings with a population of around 7,134 in 2,250 households. Apart from transport convenience and competitive geographical conditions, Xicun Community possesses advantages of both natural and cultural landscape. Inside the community, it has two historic relics (one is Yiyuan, known as the Former Residence of Song Ziwen, on the southwest side and the other is the Former Residence of Xian Ying) left by the War against Japanese Aggression, in addition to the neighborhood committee, kindergarten, market, canteen, public toilet, and other public facilities. Residents of Jialingqiao Xicun Community are closely linked. This creates a strong life atmosphere. Nevertheless, as a typical old community arranged by the organization, Jialingqiao Xicun Community is not free from problems, such as building aging, damage of public supporting facilities, worsening of the green environment, aggravation of population aging within the community, etc.

In the 2011 comprehensive improvement of old residential communities in Yuzhong District, Chongqing, community residents initialized the establishment of the residents' autonomous property management committee under the guidance of the government and designers. The committee periodically organized community cultural activities to promote residents' participation in community management. In terms of spatial forms, designers summarize the community road network and select major space nodes to finally form three kinds of spatial layers. First of all, the designer used the main road, with its two ends as the main entrance to the community, to connect the two historic relics related to the anti-Japanese regression and the sightseeing platform. The main road was pinpointed as a major channel for external display to foster residents' sense of pride for their community as well as the cohesion among them. Second, the designer had four ring roads to extend from the main road and to connect the courtyard within each cluster. At last, benches for relaxation were set up at the entrance of each unit to enrich residents' communication and create a relaxation space for senior residents.

Affected by the renewal project of the No. 25–No. 30 Building of the Jialingqiao Xicun Community, this paper excludes No. 25–30 Building and the balcony areas from the research scope. The final research scope includes 24 nodes distributed in

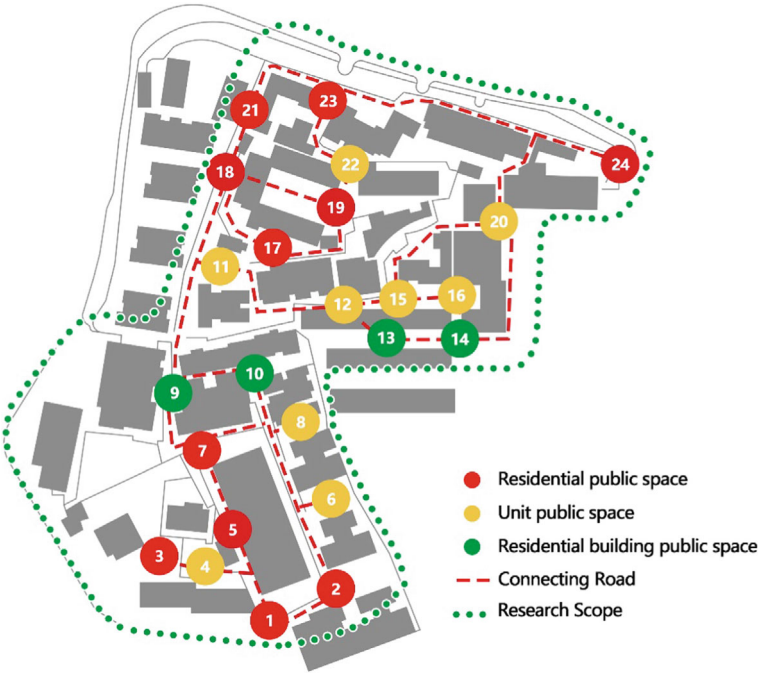


Fig. 17.1 Node distribution of public spaces in Jialingqiao Xicun Community. (by Author)

three types of spaces, namely "residential public space," "cluster public space," and "unit public space." (See Fig. 17.1 below.) After classifying and numbering public spaces, a questionnaire on community activities is conducted on community residents. Residents are asked to mark their daily activity routes and public spaces where they stop for activities on the site plan. On that basis, the use of the community space nodes is statistically analyzed. In total, 100 copies of questionnaire are delivered, of which 94 valid copies are collected.

17.4 Results and Discussions

17.4.1 Results

After drawing and computing the residential community public space structural network and the resident activity route network, we obtain the overall structural characteristic parameters of the two networks, which are shown in Table 17.2.

The spatial network is drawn based on the information given by the field survey and questionnaire analysis. The betweenness centrality of different nodes in the residential community public space structural network and the resident activity route

Table 17.2 Comparison of structural characteristic parameters between spatial network and social network. (by Author.)

Network types	Network density	Clustering coefficient	Average path	Small world index
Public space structural network	0.123	0.378	3.739	1.952
Activity route network	0.355	0.956	1.119	6.193

network is displayed in Fig. 17.2. The larger the node is, the higher the betweenness centrality is. The connection in the resident activity route network is weighted by residents' frequency to pass by. The higher the frequency the residents pass by, the thicker the connection will be. Data analysis and comparison of centrality are shown in Table 17.3. The parameters higher than the average are highlighted. Combining Fig. 17.2 and Table 17.3, one can observe that Node 7, Node 11, Node 12, Node 18, and Node 21, excluding the entrance Node 2, all play a strong mediating role in the public space structural network and the resident activity route network. Node 9 and Node 10, though located at a place with a high mobility, are not important nodes in the resident activity route network.

Figures 17.3, 17.4, 17.5, 17.6 show the visualization of graph drawing of node parameters, including effective scale, efficiency, restriction, and hierarchy. Table 17.4 compares four parameters of the structural hole. Among them, parameters of effective scale and efficiency which are higher than the average, and parameters of restrict and hierarchy which are lower than the average are marked.

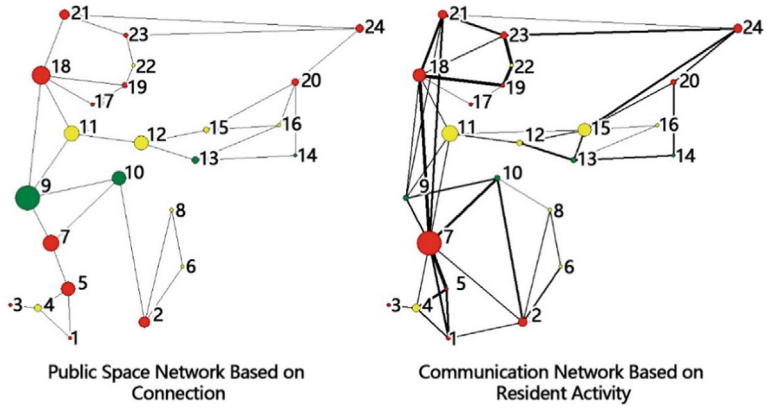


Fig. 17.2 Comparison between two networks. (by Author)

Table 17.3 Comparison of betweenness centrality of 24 public spaces. (by Author)

Node Number	Betweenness Centrality of Public space network	Betweenness Centrality of Communication Network
1	0.000	0.000
2	42.000 *	2.500
3	0.000	0.000
4	22.000	17.000 *
5	60.000 *	0.000
6	0.000	0.000
7	76.000*	73.500 *
8	0.000	1.000
9	126.000 *	0.000
10	60.000 *	0.000
11	70.333 *	42.000 *
12	60.333 *	16.000 *
13	20.750	9.500
14	2.167	0.500
15	15.417	21.000 *
16	2.667	0.000
17	0.000	0.000
18	89.083 *	24.500 *
19	14.833	10.000 *
20	21.167	1.000
21	36.250 *	11.500 *
22	3.083	2.000
23	8.250	3.000
24	25.667	0.000

17.5 Discussions

17.5.1 Analysis of Whole Network Parameters

As one observes in Table 17.2, the small world index of the public space structural network is larger than 1. It means that the public space within the residential community has formed a compact network. However, according to the network density, the 24-node residential community public spatial network might have 276 maximum connections in theory. Nevertheless, there are 32 paths which have been actualized, so the network is not complete enough. The average distance suggests that, if a resident goes from one node to the other node, the resident will cross at least three to four spaces to arrive at the destination. All the above coefficients reveal a weak

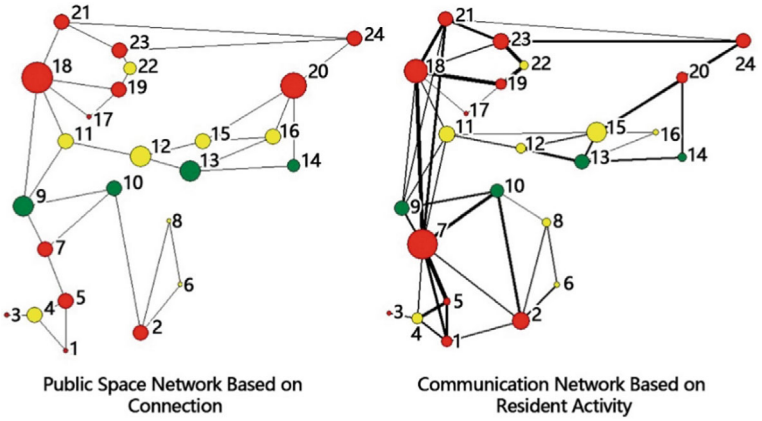


Fig. 17.3 Comparison of effective scale between two networks of public spaces and residents' behaviors. (by Author)

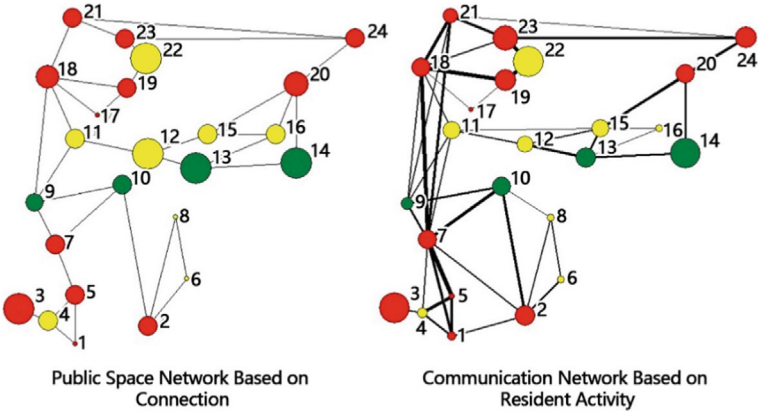


Fig. 17.4 Comparison of efficiency between two networks of public spaces and residents' behaviors. (by Author)

concentration and connectivity among residential community public places and a scattered internal organization. Located at the mountainous area, Xicun Community has a high attitude difference internally and a loose organization, which can increase the distance for residential community residents to go to different places. Under the background of community aging, the current road organization is not beneficial to residents to transport between different places.

The small world index of the activity route network is 6.193, meaning that the network is highly complete and that the residential community residents are closely connected and communicate with each other harmoniously. The clustering coefficient is relatively high, which suggests that residents are prone to moving within the fixed

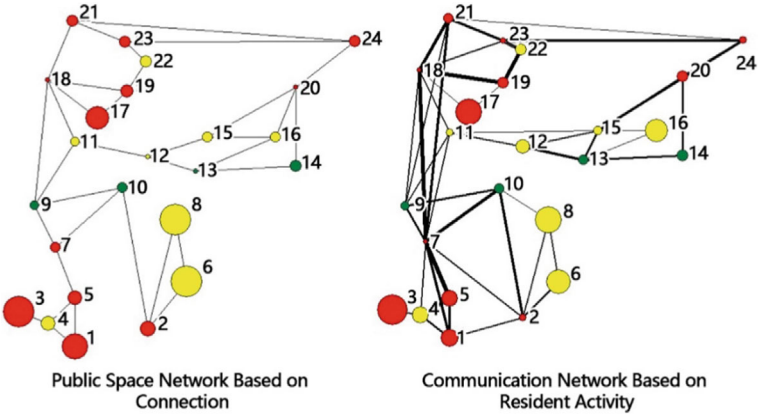


Fig. 17.5 Comparison of restriction between two networks of public spaces and residents' behaviors. (by Author)

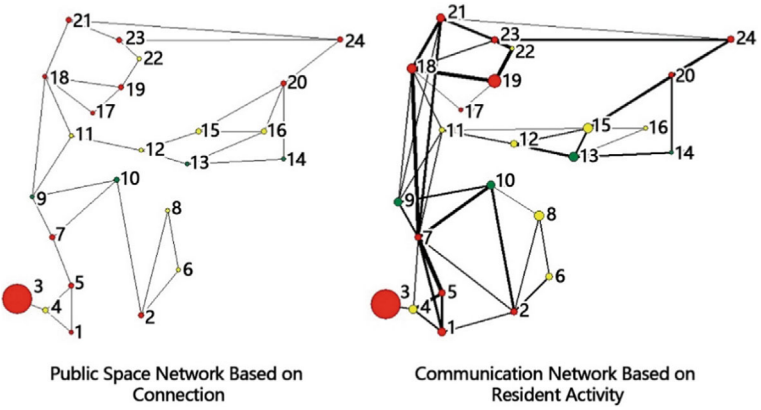


Fig. 17.6 Comparison of hierarchy between two networks of public spaces and residents' behaviors. (by Author)

scope. The average path length is 1.119, which is far lower than the space structure network. On the one hand, this shows that residents have a clear purpose for their activities. Seldom do they stop at public spaces excluding destinations. On the other hand, part of nodes are not attractive enough for residents to stop at.

17.5.2 Analysis of Network Node Parameters

Combining Fig. 17.2 and Table 17.3, one can observe that nodes with a high betweenness centrality in the spatial network, including Nodes 5, 7, 9, 18, and 21, connect the

Table 17.4 Comparison of structural hole indexes of 24 public spaces. (by Author)

Node number	Public space network				Communication network			
	EffSize	Efficie	Constra	Hierarc	EffSize	Efficie	Constra	Hierarc
1	1.000	0.500	0.889	0.000*	2.485	0.621	0.670	0.155
2	2.333*	0.778*	0.611	0.052*	4.124*	0.825*	0.387*	0.086*
3	1.000	1.000*	1.000	1.000	1.000	1.000*	1.000	1.000
4	2.333*	0.778*	0.559*	0.045*	2.588	0.647	0.623	0.140*
5	2.333*	0.778*	0.559*	0.045*	1.757	0.586	0.631	0.082*
6	1.000	0.500	1.007	0.010*	1.214	0.607	0.845	0.090*
7	2.333*	0.778*	0.482*	0.025*	7.153*	0.795*	0.313*	0.102*
8	1.000	0.500	1.007	0.010*	1.776	0.592	0.880	0.187
9	3.000*	0.75*	0.423*	0.003*	3.495*	0.699	0.421*	0.132*
10	2.333*	0.778*	0.482*	0.025*	3.18*	0.795*	0.439*	0.160
11	2.333*	0.778*	0.445*	0.016*	3.906*	0.781*	0.378*	0.055*
12	3.000*	1.000*	0.333*	0.000*	2.273	0.758	0.538*	0.089*
13	3.000*	1.000*	0.333*	0.000*	3.314*	0.829*	0.434*	0.191
14	2.000	1.000*	0.500*	0.000*	2.000	1.000*	0.500*	0.000*
15	2.333*	0.778*	0.482*	0.025*	4.679*	0.780*	0.412*	0.185
16	2.333*	0.778*	0.482*	0.025*	1.200	0.600	0.804	0.001*
17	1.000	0.500	0.804	0.008*	1.111	0.556	0.899	0.019*
18	4.200*	0.840*	0.335*	0.019*	5.543*	0.792*	0.326*	0.180
19	2.333*	0.778*	0.521*	0.049*	2.549	0.85*	0.478*	0.327
20	3.500*	0.875*	0.347*	0.029*	2.433	0.811*	0.480*	0.036*
21	2.333*	0.778*	0.506*	0.029*	3.613*	0.723	0.435*	0.129*
22	2.000	1.000*	0.500*	0.000*	2.000	1.000*	0.500*	0.000*
23	2.333*	0.778*	0.506*	0.029*	3.629*	0.907*	0.343*	0.100*
24	2.333*	0.778*	0.506*	0.029*	3.381*	0.845*	0.394*	0.105*

principal axes of residential community roads and connect the other three ring roads, which are the most important activity routes for residential community residents. Affected by this, Nodes 7, 11, 12, 18, and 21 have a high betweenness centrality in the activity route network. These nodes are places which are frequently chosen by residents for a rest. This means that the position and centrality of residential community public spaces in the whole network can influence whether residents will stop at these spaces for activities. However, Node 9 is the point where two ring roads are divided and converged. Though the spatial network has a high centrality, the betweenness centrality of Node 9 is far below the average in the activity route network. Residents seldom choose the activity route network with a small throughput. The inconsistency between the accessibility of public spaces of the kind and public activities also exists in Node 10. A main cause of the phenomenon is that the unit

public spaces, Node 9 and Node 10, though connected with the principal axis of the residential community, are narrow. Only benches for rest are set up, and the spaces have a high privacy. Major users of Node 9 and 10 are residents from surrounding buildings. Nodes 15 and 19 are opposite to Nodes 9 and 10. As public spaces above the cluster, Nodes 15 and 19 are relatively spacious, have a high greening rate, and more comprehensive public service facilities. So they can better attract the cluster and residents of the surrounding clusters to stop here for activities. The difference among the aforesaid nodes suggest that resident activities are affected not only by the centrality of public spaces but also by the opening degree of spaces and creation of relevant facilities.

Comparison of the public space structural network hierarchy (Fig. 17.6) and efficiency (Fig. 17.3) suggests that, excluding some nodes, the overall spatial network demonstrates a high accessibility while a low network redundancy. Besides, the value of space nodes is evenly distributed, which means that the residential community spatial network can maximally save resources, and ensure basic equality between spatial correlation and resource distribution. Nevertheless, Node 3 has a small effective scale but a high efficiency, restriction, and hierarchy, which means that Node 3, though its low redundancy can help save spatial resources, can also have the problem of low accessibility. Meanwhile, a resident must pass Node 4 first before reaching Node 3, which means that Node 3 is highly reliant on Node 4. As a historic relic with a low accessibility, Node 3 can be well protected, but tourist activities might disturb resident activities. Moreover, Nodes 6, 8, and 17 have a small effective scale, efficiency, and low hierarchy, but a high restriction. As to the reason behind this, Nodes 6, 8, and 2 form an enclosed triple cluster, while Nodes 6, 8, and 17 are not directly connected with nodes outside the triple cluster, so their correlation with other nodes is weak, which has resulted in their redundancy in the whole network. This characteristic is also reflected in the activity route network. Specifically, the triple cluster formed by Nodes 2, 6, and 8 are found with frequent communication among residents, but its connection with other clusters is weak. The same situation is found with Nodes 4, 5, and 16 in the activity route network. So no further discussions are made here. The inconsistency between Node 16 and public space node characteristics can reflect the problem with the spatial design itself. Combining the field survey, Node 16 is not connected with the entrance of the residential building, so it has a poor lighting and negative spatial atmosphere. There are almost no users of the space. Consequently, the connection between Node 16 and other nodes is thus weakened.

Moreover, during the field survey on the rules of resident activities and their communication, it was also found that the spaces most chosen by residents to stay for their daily activities were Nodes 2, 5, 7, 18, 21, and 23. Among them, Nodes 2, 5, 7, 18, and 21 are also the nodes with a high degree of betweenness centrality in the spatial network. This is consistent with the previous analysis that the position and centrality of residential community public spaces in the whole network can influence whether residents will stop at these spaces for activities. However, Node 23, despite the low degree of betweenness centrality, attracts more residents for social activities due to the inclusion of open space facilities and kiosks. Similarly, Node 19, which is the node with a low degree of betweenness centrality, also has more residents

choosing to stay due to its comprehensive public service facilities. Furthermore, when classifying the daily activity routes of the interviewees according to the unit they live in, it can be found that the unit with the lowest average number of spaces chosen by residents for activities are units 1–4-5 and 2–6-8. And a high proportion of residents who chose to stay in Node 5 belonged to unit 1–4-5. This supports the idea discussed earlier that the enclosed triple cluster within the spatial network will make the residents of the unit have weak connections with other unit.

The problems with nodes and their possible causes are summarized in Table 17.5.

17.6 Conclusions

This research mainly aims at promoting research into performance assessment of community renewal. Social network analysis (SNA) is used to compare the characteristic parameters of the community public space network and the resident daily behavior and activity network so as to explore the causes of the inconsistency. This can provide a theoretical basis and referential design approaches for the renewal of old communities. After a thorough social network analysis of public spaces and resident behaviors of Xicun Community, we come to the following conclusions.

First, affected by mountainous characteristics, Xicun Community is incomplete, with a relatively scattered organization and low network redundancy. But a majority of public space nodes are interconnected. The high accessibility can not only save resources but also ensure equality of public space distribution within the community. Therefore, residents communicate with each other frequently, forming a favorable community atmosphere. Compared with the public space network, the resident activity network has a higher network density and clustering coefficient, and a shorter average distance.

Second, in terms of the centrality of network nodes, residents' use frequency of public spaces is influenced not only by accessibility and centrality of space nodes but also by publicity and design methods of the space itself. The community renewal project classifies public space nodes and rationalizes the layout of environmental facilities. Research suggests that design of the kind can effectively differentiate users, not only giving residents convenience but also avoiding influencing the life of neighboring residents.

Third, considering the connections of the node central network, resident activities are also subject to the influence of the enclosed network composed of nodes. When spatial nodes form an enclosed triple cluster and lack correlation with other nodes, resident communication will be more enclosed within a community, which is unlikely to be spread to other residents beyond the cluster. Analysis shows some relatively enclosed clusters in public space nodes of the community. Residents in some of these clusters are influenced thereby, thus preferring to move around within a fixed scope. Their connection with community activities is weak, which is not beneficial to promote cross-community communication. In response to this problem, efforts should be made to connect spatial nodes with other nodes, or seek differentiated

Table 17.5 Summary of node problems. (by Author)

Node number	Problems with nodes	Possible causes
3	In the two kinds of networks, Node 3 has a small effective scale but a high efficiency, restriction, and hierarchy	Node 3 has a poor accessibility. Residents must pass Node 4 first before passing Node 3
4	In the resident activity route network, Node 4 has a small effective scale, low efficiency, and hierarchy but a high restriction. This is inconsistent with the spatial network parameters	Nodes 1, 4, and 5 jointly constitute an enclosed activity area for frequent internal communication among residents. But the connection of this enclosed activity area with other clusters of the community is weak
5	In the resident activity route network, Node 5 has a small effective scale, low efficiency, and hierarchy but a high restriction. This is inconsistent with the spatial network parameters	Nodes 1, 4, and 5 jointly constitute an enclosed activity area for frequent internal communication among residents. As a community-level public space, Node 5 has a poor effect on promoting communication between residents within the group and other groups within the community
6	In both networks, Node 6 has a small effective scale, low efficiency, and hierarchy but a high restriction	Nodes 2, 8, and 6 jointly constitute an enclosed activity area for frequent internal communication among residents. But the connection of this enclosed activity area with other clusters of the community is weak
8	In both networks, Node 6 has a small effective scale, low efficiency, and hierarchy but a high restriction	Nodes 2, 8, and 6 jointly constitute an enclosed activity area for frequent internal communication among residents. But the connection of this enclosed activity area with other clusters of the community is weak
9	Betweenness centrality of Node 9 is inconsistent in both networks	The public space of Node 9 is a unit public space, whose scale and service targets are limited
10	Between centrality of Node 10 is inconsistent in both networks	The public space of Node 10 is a unit public space, whose scale and service targets are limited
15	Betweenness centrality of Node 15 is inconsistent in both networks	The public space of Node 15 is a cluster public space with a poor accessibility, but it has a favorable environment and complete facilities, which hold great appeal to residents
16	In the resident activity route network, Node 16 has a small effective scale, low efficiency, and low hierarchy but a high restriction. This is inconsistent with the spatial network parameters	Node 16 has a poor environment, thus lacking the appeal to attract residents

(continued)

Table 17.5 (continued)

Node number	Problems with nodes	Possible causes
17	In both networks, Node 17 has a small effective network, low efficiency, and hierarchy but a high restriction	Nodes 17, 18, and 19 jointly form an enclosed activity area, of which Node 17 is in a redundant position, while the historic relic Node 18 lacks adequate appeal to attract residents of other clusters
19	In both networks, betweenness centrality is inconsistent with each other	The public space of Node 19 is a district public space with a poor accessibility but a favorable environment and complete facilities, which is very attractive to residents

design of internal nodes to increase the appeal of nodes, avoid the homogeneity of space nodes, and increase the possibilities for residents within the triple cluster to interact with residents beyond the cluster. All this can help achieve the maximization of efficiency.

Fourth, regarding the accessibility of network nodes, though historic relics, Node 3 and Node 17, are believed to be focuses of community renewal, these nodes have actually failed to be fully utilized. In the public space network, they have a low accessibility, and whether residents will pass by these nodes highly rely on the connection with other nodes. This means that historic relics are located in areas far away from the residential areas, and that residents see no need to stop by these historic relics. This shows good agreement with the questionnaire results of resident activities. Only residents nearby a minority of nodes will stop by or pass by these historic relics. It is apt to say that these historic relics are almost forgotten by residents, and have not played the role of increasing residents' pride in their community. This is also an issue requiring the attention of future community renewal.

Meanwhile, this research has the following limitations. Restricted by social network analysis and practical conditions of the research case, we simplify spatial connections into lines without considering the influence of elements, such as distance and spatial visibility on residents' activity selection. Moreover, the case chosen for research is still under construction. Some public space nodes of the community are not included in the network. The construction project can influence residents' activity selection. The influence of community public spaces on residents' daily behaviors and activities is calling for further research.

To sum up, public spaces of the community are a carrier of communication and cohesion within the community, and an important link in the renewal of old residential areas. The renewal process not only needs scientific research methods to facilitate its optimization of spatial layout but should also deeply examine the cultural background of the community so as to deeply learn about rules of resident activities and communication and avoid conflicts between residents' use habits and community spatial renewal. This research extracts the public spatial network and the resident daily behavior and activity network from an old community. After comparing the network structure and characteristic parameters of node accessibility, centrality, and

node connection, we identify inconsistent nodes in these two kinds of networks. Causes behind the inconsistency are explored with practical situations of community construction taken into account. On that basis, optimization strategies are designed for specific spaces. It is hoped that this research can provide theoretical bases and design optimization methods for the renewal of old communities.

Acknowledgements Hereby, we would like to express our heartfelt thanks to the "spatial assessment research of urban underground space supply effectiveness" program for its vigorous support.

References

Boguñá M (2007) The structure and dynamics of networks. J Stat Phys 126(2):419–421

Chang L, Hu H (2018) The creative reconstruction of cultural entertainment facilities of old residential areas from the perspective of active ageing: a study of the 1980s residential areas. Beijing. New Architecture 02:26–31

Gu H (2010) The impact of community public space on community social capital - A review of research and theoretical explanation. Theory Horizon(09), 186–188

Guo B, Li Y, Wang, J (2018) The improvement strategy on the management status of the old residence community in Chinese cities: An empirical research based on social cognitive perspective. Cogn Syst Res. Elsevier Science BV, 52(Dec.),556–570

He Z, He J, Chen X (2014) Community public space in the context of network thinking: analysis of the effectiveness of public space in jiefangzhong road community, Yuexiu District. Guangzhou. New Arch 04:102–106

Hu Y, Wu J, Song W (2022) Coupling effect of environmental transformation and governance of old residential areas in hangzhou from the perspective of "Urban Renewal." Arch Cult 01:117–120

Huang B (2018) Comprehensive geographic information systems, 1st edn. Elsevier, Amsterdam

Kolak MA, Chen Y, Lin Q, Schneider J (2021) Social-spatial network structures and community ties of egocentric sex and confidant networks: A Chicago case study. Soc Sci Med 291:114462

Liu J (2009) Lectures on whole network approach: a practical guide to UCINET. Gezhi Publishing House, Shanghai

Lan X (2021) Being inside: Chinese government and economic development. Shanghai People's Publishing House, Shanghai

Palacios-Marques D, Gallego-Nicholls JF, Guijarro-Garcia M (2021) A recipe for success: Crowdsourcing, online social networks, and their impact on organizational performance. Technol Forecast Soc Chang 165:120566

Porta S, Crucitti P, Latora V (2006) The network analysis of urban streets: A dual approach. Physica A 369:853–866

Reilly KH, Wang S, Gould L, Hannah B, Maria C, Aldo C (2021) Characteristics of the social network of bike share members in New York City. J Transp Health 22:101128

Shi Y, Huang Y (2018) A study on the relevance between physical form and social network of historical district. Planners 08:101–105

Yan S, Zheng X (2021) Promotes physical and mental health: the impact of community public space on social cohesion. Urban Dev Res 02:117–124

Yang C, Xin L (2020) Social contribution evaluation of community renewal in caoyang xincun: based on social network analysis. Urban Rural Plan 01:20–28

Yang X, Wang X (2021) Research on the accessibility of community public space based on the analysis of behavior network and road network distance fitting: a case study of Guangzhou Xinghewan community. Mod Urban Res 04:11–17

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 18
Urban Morphological Transformation in Modern Ningbo: Social Change and Street System

Panpan Jin and Naoto Nakajima

Abstract This paper explores the early modernization of a medium-sized Chinese city, Ningbo. Based on the remapping of the street system in modern Ningbo by every 10 years from 1844 to 1936, the whole process of the late Qing and Republican eras was divided into two periods, with the port opening and the establishment of the municipal system as the critical junctures. The transformation and re-structuring of the street system limited to the walled city in the late Qing to a systematic one covering the whole urbanized area in the 1930s was explored. This transformation was driven by the construction of the Foreign Settlement in the Jiangbei area and then the introduction of municipal ideas by the local gentle and commercial group class.

Keywords Ningbo · Urban form · Port opening · Political reform · Street system

18.1 Introduction

Although it is always regarded that modern Chinese history began in 1912, for that is the node when the last Chinese emperor abdicated the throne and the country entered its republic era, the modernization of Chinese cities started earlier than that. The port opening strategy in the 1840s freed the treaty ports from the feudal ruling system and fostered a productivity revolution, economic growth, and social transformation, making them the driving force behind China's modernity (Wang 2006). In addition, this historical period also marks the introduction of foreign planning concepts that have had a lasting impact on Chinese city development to the present day and on the rise of civic consciousness, which means that the government was

P. Jin (✉) · N. Nakajima
Department of Urban Engineering, the University of Tokyo, 7-3-1 Hongo, Bunkyo-Ku, Tokyo, Japan
e-mail: panpanjin@g.ecc.u-tokyo.ac.jp

N. Nakajima
e-mail: naoto@ud.t.u-tokyo.ac.jp

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_18

no longer the only institution responsible for urban construction after the feudalism dominance for more than 2000 years. Therefore, the period from 1842, the starting point of the port opening policy, to 1949, when the People's Republic of China was founded, is receiving more and more attention in Chinese history research for the dramatic changes in authority, economy, society, and also urban space. One of the most influential early studies of contemporary Chinese cities is the *City in Late Imperial China*. It explored the Chinese cities and their social structures using the central place theory based on quantitative analysis (Skinner 1977). After that, a plethora of research arose, the most pertinent of which was single-city case studies. Among them, the cities that received the most attention are the administrative centers, such as Beijing and Nanjing (Jinnai et al. 1995; Luo 1999); colonial cities, such as Datong (Nakajima 2022); tourist cities, like Hangzhou (Fu 2016); and also those port cities (Wasserstrom 1991; Sun et al. 2019), for these port cities were the first to encounter with the foreign technologies as well as ideas. Among the Chinese port city research, Shanghai, one of the most developed cities in China today, is the primary focus. Its development is consistently cited as a representative of the development of Chinese cities. However, it is not fair to characterize the modernization of Chinese port cities as the Shanghai experience (Esherick 1999). In addition, most contemporary works have a narrow concentration on the construction process, with little concern for the underlying planning concepts.

In this regard, Ningbo City was selected as the research subject. The city has a long history of serving as the regional administrative and economic center, demonstrating classical Chinese ritual-dominated spatial patterns during the late Qing era and initiating its spatial modernization in 1844 following the opening of port.[1] From the port opening to the founding of the People's Republic of China, Ningbo experienced the intervention of Western consular forces, the implementation of the late Qing reform, and the establishment of the Republic of China (including the rule of the Northern Warlords and the Nanking National Government) (Su 2010). In the meantime, the rise of the gentry class, triggered by the privileged economic and cultural environment, stimulated public participation in urban development. Therefore, the study of Ningbo could make the research on modern Chinese cities more complete.

To deal with the complexity of the huge organism, the city, street system, as the most fundamental and also one of the most critical elements, was selected as the focus of this study. The research method applied in the urban form study is mainly the morphological method based on the Conzenian and Muratorian traditions (Paulo and Vítor 2009). In Conzen's study, street systems, partition patterns, and building types were analyzed to trace the development of a place based on the urban plans and historical archives, which carry the "material information of the cities" (Conzen 1960). In the 2000s, the urban morphology method was introduced into Chinese city study (Whitehand and Gu 2006) and is widely employed in urban history research (Liu et al. 2020) and historic city conservation works (Tian et al. 2010).

[1] The five cities are Shanghai, Guangzhou (Canton), Ningbo (Ningpo), Fuzhou (Foochow), and Xiamen (Amoy).

Given the above points, this paper defined the geographic scope as the area that started urbanization in the modern era, including the walled city and three areas outside the city wall (i.e., the Xixiang area, the Jiangdong area, and the Jiangbei area). These areas mainly undertook trading, wharf, and residential functions. The time frame was narrowed down to the period from the port opening (1844) to the time before the war (1936). Based on the remapping of nine historical maps with the help of historical materials, the year 1911 was selected as another milestone for it is when the Republic of China was founded, as well as when the urban development in Ningbo began faster (see Fig. 18.1). Then literature research based on historic maps, local chronicles, archives, and newspaper articles was used to explore the development of planning ideas during rapid political and social evolution.

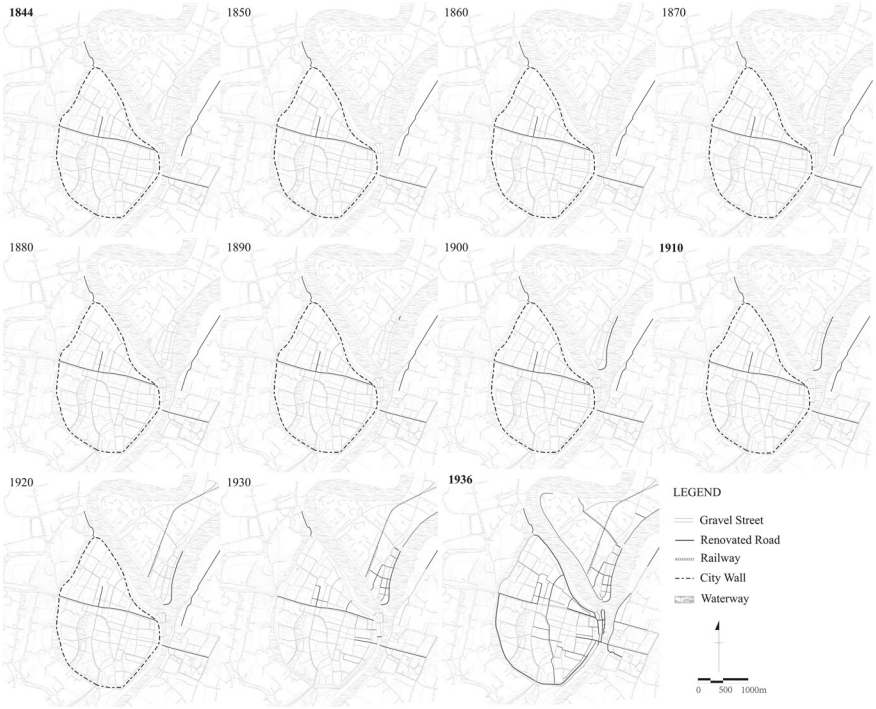


Fig. 18.1 Remapping of the street system (*Source of base map* (Fu 1936; Chen and Ma 1936))

18.2 Street System Controlled by Imperial Ritual and Natural Environment, 1844

18.2.1 Street System Before the Port Opening

The walled city of Ningbo was small and irregularly shaped when compared to other central cities in the same Jiangnan region, such as Suzhou (Fu et al. 2022). Urbanized areas in the late Qing Dynasty mainly covered the walled city with the Jiangxia wharf east of it, and the area east to rivers, the Jiangdong area. Against this backdrop, the street system then mainly focused on these three areas (see Fig. 18.2).

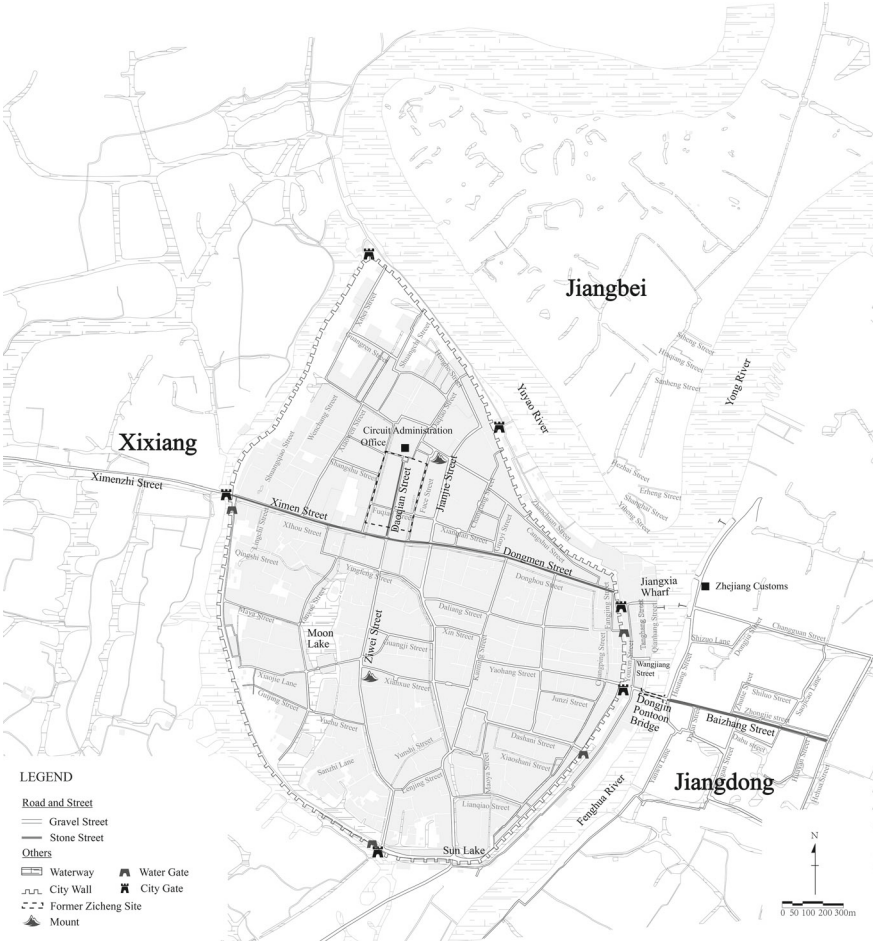


Fig. 18.2 Street system in 1844 (*Source of base map* (Fu 1936; The Library of Congress, 1846))

Inside the walled city, the streets contained axial or spinal ones. The main axial streets (Dongmen Street–Ximen Street) ran directly from the west city gate to the east city gate, connecting the ancient wharf area in the east and the market area in the west. The north–south axial streets (Ziwei Street) meet south of the political center, which used to be the inner city (*Zicheng*), which is one of the most common street patterns in Chinese cities (Chang 1970). Also another north–south axial street, Jianjie Street ran from the south city gate to Ximen Street, directly connected to Daoqian Street, at the northern end of which stood the Circuit Administration Office (*Ning-shao-tai-dao*). These two west–east streets had been one of the most prominent commercial thoroughfares in the city after the disintegration of the Li-fang system during the Song Dynasty (Cao 1731), along which located numerous stores retailing trade, including stores selling silk, ceramics, herbs, and other small business, while Ziwei Street served as the ceremonial axis street, along which there was a Song Dynasty Fengshui Mount. With these axial streets, the area within the walled city can be roughly divided into three parts, the southeast part (commercial section), the southwest part (residential section), and the north part (political section). Generally, the streets inside the south sections were either in the east–west or north–south direction, while the streets in the north section mainly ran from northwest to southeast.

The Jiangxia area east of the walled city and the area along Baizhang Street in Jiangdong shared nearly the same street density as the walled city. As the ancient wharf, the Jiangxia area had a grid-like street network, with the streets parallel to the rivers, such as Tanghang Street, and the streets perpendicular to the rivers, such as Wangjiang Street. The Jiangdong area saw a ribbon development for the two main streets, Baizhang Street and Houtang Street. Baizhang Street was the most crucial street in this area, while the other streets formed perpendicularly to it, as it connected to the walled city through a pontoon bridge, acting as the commercial street for daily goods and a major street for regional traffic communication. Along Houtang Street, there was a wharf area, which housed the old Zhejiang Customs and some guild halls. Therefore, the street was also an important commercial street for seafood trading.

The street system in the Jiangbei and Xixiang areas was less developed, for urbanization in these two areas did not begin before the port opening. Therefore, there was only one Ximenzhi Street in the Xixiang area for the regular market near the west city gate. No bridges connected the Jiangbei area to the old city at the time. Consequently, road construction in this area fell behind the walled city and Jiangdong area. The only routes with definite records then are a few paths perpendicular to the river.

Regarding pavement material, the streets in Ningbo were primarily paved with dirt and gravel in the 1840s. Only Dongmen Street, Ximen Street, and Daoqian Street in the walled city and Baizhang Street in the Jiangdong area had historical records proving they were paved with bar stones. In contrast, most other streets were unpaved gravel and mud roads. According to archaeological research, Dongmen Street and Ximen Street were paved with bricks and had a minimum width of 2.3 m during the Tang era. Additionally, the east section from the political center to the east city gate had more cracked bricks due to heavy foot traffic (Lin 2002a).

18.2.2 The Impact of Imperial Rituals and the Natural Environment

The street system in Ningbo before the port opening was primarily defined by ritual regulations and its natural topographical condition. This street pattern in 1844 discussed above was generally formed during the Tang Dynasty, when Ningbo, then known as Mingzhou, relocated the city from Yinjiang Town to "*Sanjiangkou*", the intersection of three rivers, for the better development of the sea shipping trade and the defensive advantage brought by Yao and Fenghua Rivers (Dai 2015; Qian 1995). As Mingzhou was the location of the city (*Zhou*) and county (*Xian*) governments, the city's layout was influenced mainly by the political core, Zicheng, a walled sub-city. First, as Zicheng contained various government buildings, it was situated in the city's central northwest region, approximately 1.2 km from the Yuyao River. Outside of the moats that surrounded *Zicheng* was the residential settlement. In the late Tang Dynasty, *Luocheng*, the city walls with six city gates outside the residential areas were constructed in a natural curving shape in accordance with the rivers surrounding the city (Lin 2002b). In this regard, the existence of the political center and the city walls determined the street system structure within the walled city, mainly the axial streets.

The topographic condition is an important influencing factor besides the rituals for the street system of Ningbo, especially the waterway. As pre-modern Ningbo was located west to the intersection of three rivers, the waterway ran through the whole city, making most of the urban streets present irregular curves. For instance, the north–south axis, Ziwei Street was not perfectly straight but curved slightly along the river's course due to the tributary of Moon Lake. On the other hand, the existence of the waterway, the mount, and the political center, combined with the fact that the streets were primarily used for pedestrian traffic, in turn, blocked the road's extension, contributing to the presence of dead ends.

18.3 The Early Urban Construction, 1844–1911

18.3.1 Construction of Modern Road System in the Jiangbei Area

After the port opening, road construction in Ningbo City began with the development of the Jiangbei area designated for foreign residents, leading to the formation of a grid-like one (see Fig. 18.3). Firstly, in the foreign settlement along the Yong River, three modern roads were constructed parallel to the river, named Outer Road, Middle Road, and Inner Road according to their distance from the Yong River. These roads ran between the river intersections, "*Sanjiangkou*", and the British Consul. There were also several newly built shorter roads perpendicular to the river that connect the three roads, such as Yiheng Street in the south and Siheng Street in the north. In

addition, in the area along the Yuyao River, a road, Huaishu Road, was constructed, connecting the north and south ends of Jiangbei. Another new-built road is Caoma Road, the road in a race ground for foreigners. The development of these roads, with the construction of a pontoon bridge between the walled city and Jiangbei, made the urbanization of the former fishing village become possible and allowed for the northern expansion of the city.

On the other hand, the street system of the walled city, the Xixiang and Jiangdong area almost came to a standstill, expected for the reconstruction of Rixin Street, located near the east city gate and in the commercial area.

As for the pavement, due to the lack of stone resources, Outer Road was the only one paved with stones, while the other roads were still paved with gravel and mud.

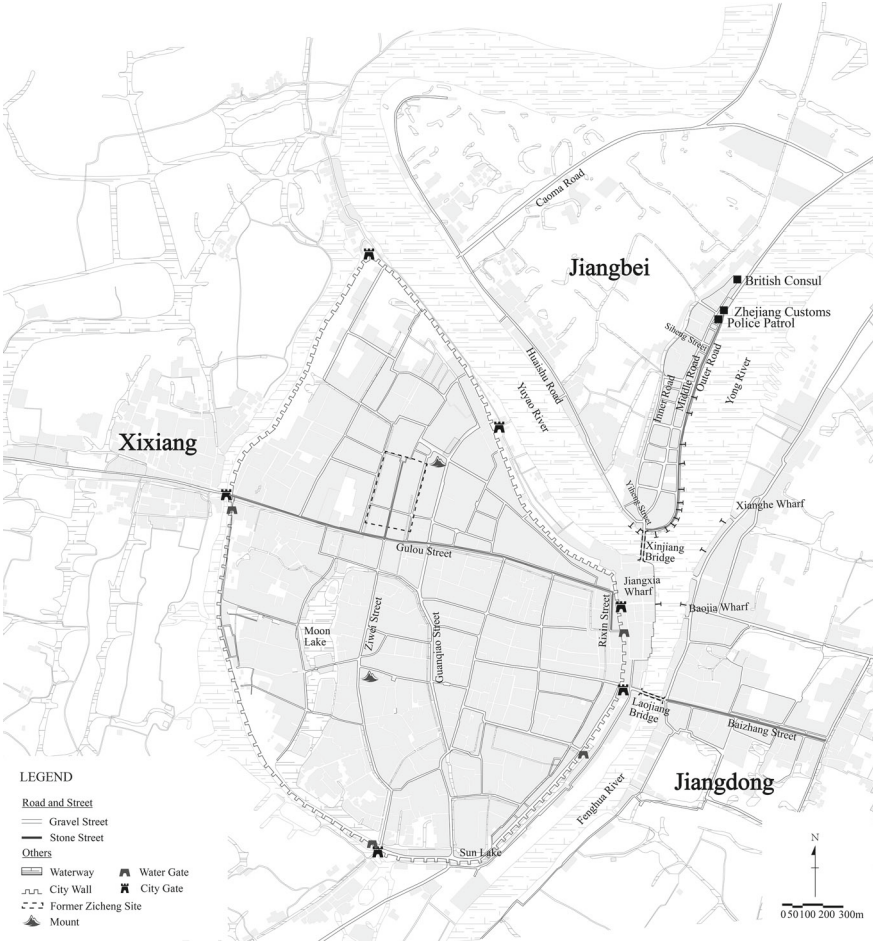


Fig. 18.3 Street system in 1911 (*Source of base map* (Mishiro 1883; Li 1914))

Therefore, toward the end of the nineteenth century, there was only one stone-paved road and six stone-paved streets, all of which saw heavy traffic.

18.3.2 Intervention of the Western Force

From the 1840s to the 1890s, the growth of Ningbo's roads and streets was limited to the Jiangbei area since the foreigners in Ningbo, western consuls and missionaries, were the primary organizers of road construction. Even though it was not a concession area, the British, French, and American consuls designated the Jiangbei area as a foreign settlement upon the port's inauguration. They also established consulates and a police station to protect the lives and property of foreign nationals. In 1884, Henry Charles Joseph Kopsch, an Englishman, and the commissioner of Zhejiang Customs at that time recommended the construction of Ningbo's first road, Outer Road. Although local officials and businesspeople in Ningbo backed the proposal, other foreigners did not. As a result, road development was halted until 1887, when F. Kleinwichter, a German man was appointed as the new commissioner of Zhejiang Customs. A particular organization, Ningbo Road Committee (*Dao-lu-wei-yuan-hui*), was established to take charge of the construction of the road (Hangzhou Customs of the People's Republic of China 2002). The committee, consisting of five foreigners and four Ningbo locals, with financial support from the local government and also the Chinese and foreign business people in Ningbo, completed the construction of a half-kilometer road linking the office of the new Zhejiang Customs and the church located near the intersection of the three rivers. This road was finally constructed with road signs, lights, and chain-link fences along the riverbank.

In the late 1890s, Outer Road expanded mainly to the north. In 1898, the chief of the Tax Department, a German named Paul Georg von Mollendorff, recorded the idea to form the Municipal Committee (*Shi-zheng-wei-yuan-hui*) in a trade report. The Jiangbei Engineering Department then began levying specialized tariffs on items arriving onshore or offshore to fund urban construction. The newspaper supported by German businesspeople in Ningbo, Deyong Business Daily (*De-yong-shang-bao*), released a request for proposals for the project. The construction project was divided into two parts. From 1898 to 1901, the section, which was constructed in 1888, and the docks along the road were improved, and Outer Road extended to the north and connected Baisha Road. And in the second part, which lasted from 1901 to 1902, a new road perpendicular to Outer Road was constructed, south to the new Zhejiang Customs and north to the foreigners' horse racecourse. Therefore, in the Decennial Reports of the Zhejiang Custom, the head, P. J. CreVedon, recoded the road as Riverside Avenue, with modern sewage facilities and lighting facilities.

It is worth noting that in this period, eight soldiers of green-banner troops were sent after the port opening to protect the foreigners in the Jiangbei area. They were called *Xunbu* (police officers) and were directly managed by the British consul. In 1865, a police patrol (*Xun-bu-fang*) was established, and the number of *Xunbu* also rose. The initial reason for the establishment of the police patrol was to protect foreigners from

getting robbed. Eventually, the police patrol was granted the authority to regulate the food trading prices, the street environment, and the regulation of assemblies, which included urban management (Hangzhou Customs of the People's Republic of China 2002).

Another factor contributing to the development of the road system in the Jiangbei area was the construction of a bridge connecting it to the old city, which did not exist before the port opening policy. The establishment of Foreign Settlement and the Taiping Movement, during which citizens of the old city fled to the north bank of the river and remained, boosted the demand for transportation between the two riverbanks in the 1860s. Against this backdrop, Xinjiang Bridge was subsequently constructed with the financial support of local enterprises and foreign investors, becoming an essential transit infrastructure of Ningbo City.

18.4 The Systematic Construction, 1912–1936

18.4.1 The Rapid Development of the Urban Road System, from the 1910s to the 1930s

After a two-decade stagnation in the twentieth century, road construction in Ningbo entered a period of tremendous growth from the 1910s to the 1930s. The development of this period began with the road renovation in the Jiangbei area, followed by the demolition of city walls and systematic construction in the whole city (see Fig. 18.4).

For the former walled city, the city walls had been removed, and a ring road around the former walled city was constructed in its original place by 1936. Following the reconstruction of Dongda Road (the former Dongmen Street), Xida Road (the former Ximen Street), Beida Road (the former Jianjie Street), and the construction of Nanda Road by filling the streams of Moon Lake, the main roads inside the ring road intersected to form a perpendicular grid. Naturally, the area inside the ring road was divided into four sections. Grid-like network was formed within each section. Moreover, it was discovered that during this period, road renovations within the city walls were primarily concentrated in the more developed commercial area in the east, along the main north–south road in the south of the city, and the political center in the north of the city, while the streets west of Moon Lake in the southwest section, which were primarily used for residential purposes, did not receive much attention. Especially in the southeast section, three north–south and three east–west secondary roads were constructed, dividing the entire area into blocks roughly 400 by 400 m. In the north section, the road density was extremely high around the park, which was transformed from the former political core.

The road system in the Jiangbei area was improved considerably, continuing the development of the former period. Along Yong River, Baisha Road, which ran north of Outer Road, was constructed. More north of the port area, Inner Road was reconstructed, and New Road, which connected Inner Road and Caoma Road, was

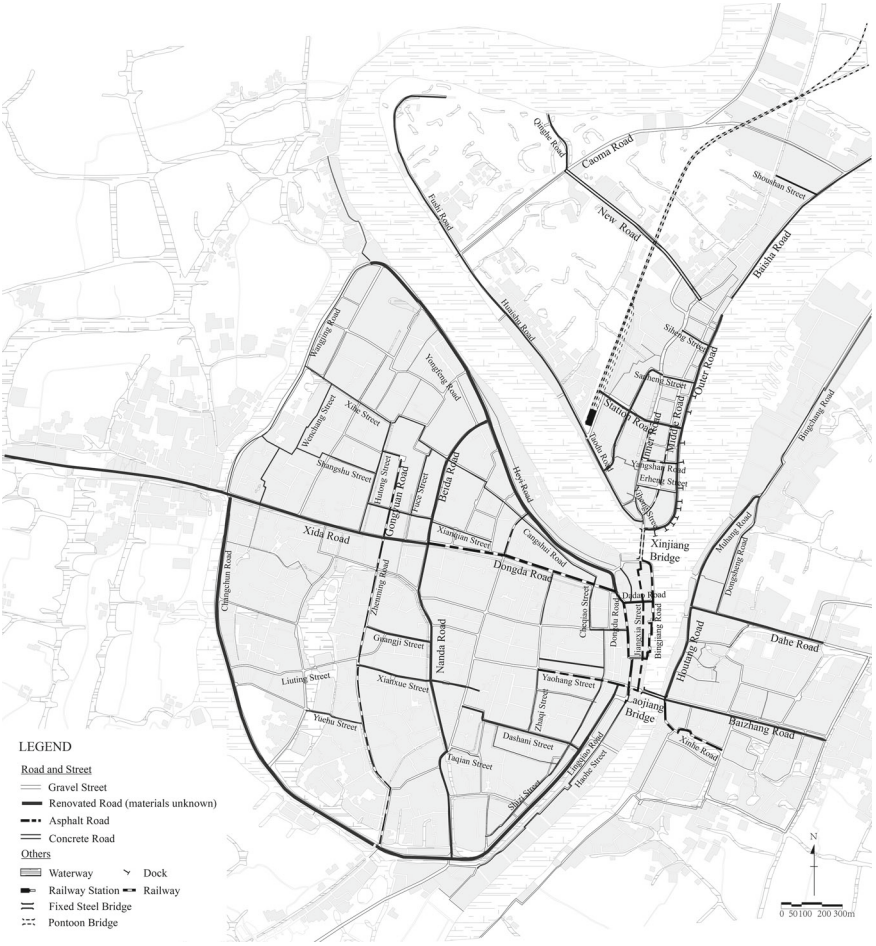


Fig. 18.4 Street system in 1936 (*Source of base map* (Fu 1936))

built. In the southwest part, roads and streets were constructed around the new-built railway station. Station Road was built from the station to Outer Road, connecting land and sea transport in Ningbo. On the other hand, the road system in Jiangdong did not change much, except for the reconstruction of Houtang Road along the river and the construction of a new road named Dahe Road, parallel to Baizhang Road.

During this historical period, the introduction of asphalt and concrete roads represented a significant improvement in construction techniques. Gongyuan Road, which intersected perpendicularly with Xida Street and was located in an area with a high concentration of government agencies, was Ningbo's first asphalt road. In contrast, New Road in the Jiangbei area, which connected the Inner Road and Caoma road, was the city's first concrete road. Then, asphalt roads proliferated in all three areas surrounding Sanjiangkou, including the Jiangxia commercial district east of the

historic town, Xinhe Road in Jiangdong, Middle Road and Yangshan Road in Jiangbei (Fan 2016).

18.4.2 Introduction of Municipal Ideas

After the establishment of the Republic of China in 1911, the new government put up with comprehensive modernization reforms. And practising local self-governance was one of the policies. In Ningbo, self-governance is first presented by the local gentle and commercial groups. Then, a local municipal group formed in 1920 became the forerunner of the municipal government in 1927 when the city was established (Luo 1983).

The street system of Ningbo underwent a rapidly developing stage since the 1910s because the local gentry class realized the importance of municipal construction after Western municipal ideas were introduced into China at that time. Their early practices included founding new schools in the early twentieth century and the proposal for a park building by Chen Xinggeng and other local gentries. Their ideas to develop the urban municipal system mainly came from two means. Firstly, as Ningbo has been celebrated throughout China as one of the most prosperous areas for thousands of years, the notable local families, which were wealthy and also attached importance to education, sent their children overseas for schooling. These young people became the backbone to promote city development. For instance, Gu Baoxing, Chen Dexing, and Chen Qihuai, all active participants in urban construction, had studied in Japan. Furthermore, Zhang Meiyi, the one who was once in charge of the education department in Ningbo, had accompanied Xue Fucheng[2] on a tour of European nations to study modern city design. Another way of introducing Western municipal ideas is learning from practical cases, including the construction of foreigners in the Jiangbei area and the rapid development of Shanghai. In the late 1910s, these gentries noticed that the foreigners had constructed buildings of banks, offices, churches, industries, theaters, hotels, and other modern facilities in the Jiangbei area. At the same time, the ancient city remained largely underdeveloped, with a crowded and deplorable living environment. In the meantime, Ningpo Guild in Shanghai (*Ning-bo-lv-hu-tong-xiang-hui*), in light of the rapid expansion of Shanghai's municipal infrastructure, saw it imperative to transform Ningbo city's underdeveloped state.

In this regard, Zhu Baosan, the head of the association, along with other local gentry and merchants, proposed establishing a local municipal planning department for the Ningbo government in 1920. After the plan was approved by the local government, the provincial government and central government successively produced the first systematical urban construction plan in Ningbo's history, Ningbo Municipal Preparatory Office Project Plan (*Ning-bo-shi-zheng-chou-bei-chu-gong-cheng-ji-hua-shu*) after employing a technician to assess the city's existing situation

[2] Xue Fucheng was the head of Ningshaotaidao from 1884 to 1889 and envoy to England, France, Italy, and Belgium from 1894 to 1894.

a b

Fig. 18.5 Reconstructed roads in 1936 (*Source* Zhe 2004)

(Shenbao 1927; Yin County Construction Department 1934). The plan included the content of removing the city walls, building and rehabilitating urban roadways, and the modernization of municipal amenities. This was inspired by Shanghai's pioneering act of demolishing the city walls in 1912 and Sun Yat-sen's suggestion during his visit to Ningbo in 1916. The second chapter of the document also specifies that an east–west arterial road must be reconstructed in line with the police department's building rules, that the paving materials must be baritone, and that lighting facilities must be installed every five Zhang.[3] By 1925, a section of city walls in the west of the city and two of the city gates, Liangqiao Gate and Dongdu Gate, both located in the east of the walled city, were torn down. And the baritones that once comprised the city walls were used to pave the urban road. After the reconstruction, Dongda Road was widened to 16 m, while Xida Road, the west section, was widened to 12.8 m.

Although only a tiny portion of the plan was executed due to financial constraints, these ideas for the urban organization were mainly retained by successive plans, giving it a unique position in the development of Ningbo. When the Ningbo Government was founded in 1927, the institution was renamed the Yin County Municipal Preparatory Office. Yang Ziyi, the Mayor of Ningbo, presented a city plan that emphasized the restoration of the Laojiang and Xinjiang Bridges and the renovation of roads. In this regard, the city government delineated the city's boundaries and began to organize the municipal construction.

Then, in 1931, when the city system was abolished, and the Yin County Government assumed power over the Ningbo City, the Yin County government proposed the "Five-year plan for Yin County construction." The plan divided road development into three parts and directed the city of Ningbo to nearly complete urban road building before the outbreak of war (Yu 1995) (see Fig. 18.5).

[3] Zhang is a customary Chinese unit of length equal to 10 Chi. 1 Zhang equals 3.33 m.

18.5 Conclusion

The study systematically sorts out the development of the street form of Ningbo from the 1840s to the 1930s and explores the causes of the morphological changes through a wide range of documentation, such as the city chronicles, historical newspapers, and customs archives, together with the old maps.

Overall, the development of Ningbo's street from the 1840s to the 1930s can be divided into two stages. Before the port opening, the street system which mainly covered the walled city and the Jiangdong area had one east–west axial street and one ceremonial street running from the political center to the south city gate, one of the common layouts of traditional Chinese cities at that time. These axial streets divided the whole walled area into four different functional zones. Inside these zones, streets were mainly narrow, irregular, and gravel ones for they were mainly for daily use. Outside the city walls, the Jiangxia port area attached to the walled city also shared the high street density for the high people flow brought by port trading. In the other areas less developed, there may be one major street for transportation, such as Xixiang and Jiangdong, or no major streets but daily streets, such as Jiangbei. From the 1840s, when Ningbo was forced to be a treaty port, to the 1900s, before the polity evolution, Ningbo experienced a slow development period of the walled city and pioneering construction in the Jiangbei area. The street system of Jiangbei was constructed grid-shaped, which adapted to the river direction and the functional requirements. However, the development of this period did not have a decisive impact to contribute to the modernization of the urban form for it was limited to the Jiangbei area. From the 1910s to the 1930s, the road system within the former walled city began re-structuring. City walls were torn down, ring roads and cross-shaped main roads were built, and the inner and outer parts became a whole through the road system construction. New materials, asphalt, and concrete were applied in the road construction.

The attempt to explore the influencing factors through documentation reveals that the streets in pre-modern Ningbo showed a regular street layout due to the ritual system and curved shapes in certain areas for the geographical factors. In addition, for some of the streets had the function of trading and walking transportation, they were paved with stones, while the majority were unpaved gravel and mud streets. In the late twentieth century, the Westerners constructed new streets in the Jiangbei area for better living conditions and port development. It was during this period that modern road facilities, as drainage, lighting, and protection facilities, were introduced into the construction of Ningbo City. However, construction in this period was limited to the Jiangbei area, and the development of road construction failed to spread to the whole town. Then, when the local gentry class and the government realized the importance of municipal construction after gaining access to modern urban municipal ideas by studying abroad experience and reading newspapers talking about modern cities, Ningbo carried out the complete transformation of urban streets with professional departments and talents. Then, the establishment of construction organizations and official departments, together with a Project Plan and a 5-year construction plan

drawn up in 1925 and 1931, respectively, forced Ningbo to start its repaid transformation of the street system through a spreading-type expansion with the construction of cross-river bridges.

Acknowledgements The author acknowledges the financial support from the China Scholarship Council (Grant No. CSC 202106320029).

References

Cao B (1731) Ning Bo Fu Zhi (Ningbo prefecture chronicle). http://x.wenjinguan.co. Accessed 19 July 2023

Chang S (1970) Some observations on the morphology of Chinese walled cities. Ann Assoc Am Geogr 60:63–91

Chen X, Ma Y (1936) Yin Xian Tong Zhi (Yin county chronicle). Yin County Chronicle Office, Ningbo

Conzen MRG (1960) Alnwick, Northumberland: a study in town-plan analysis. Institute of British Geographers, London

Dai M (2015) Tong Zhi Yin Xian Zhi (Yin county chronicle during Tongzhi era). Zhejiang Ancient Books Publishing House, Hangzhou

Esherick JW (ed) (1999) Remaking the Chinese city: modernity and national identity, 1900–1950. University of Hawai'i Press, Honolulu

Fan X (2016) Jin Xian Dai Bao Kan Shang de Ning Bo (News about Ningbo in the modern era). Ningbo Publishing House, Ningbo

Fu S (1936) Yin Xian Cheng Xiang Tu (Map of Yin county). In: Yin Xian Tong Zhi (Yin county chronicles). Yin County Chronicle Office, Ningbo

Fu S (2016) Shan-Shui myth and history: the locally planned process of combining the ancient city and west lake in Hangzhou, 1896–1927. Plan Perspect 31(3):363–390

Fu S, Wang J, Sun G (2022) Reconsidering the morphological understanding of traditional Chinese cities: a study of the early spatial modernization of Suzhou, 1880–1949. Urban Morphol 26(1):24–43

Hangzhou Customs of the People's Republic of China (ed) (2002) Trade report integration of Zhe customs, Ou customs, and Hangzhou customs. Zhejiang People's Publishing House, Hangzhou

Jinnai S et al (1995) Research on the constitutive principles of urban space and the transformation process of modern times in Beijing, China. Hous Res Found Annu Rep 21:115–126

Li H (1914) Zui Xin Ning Bo Cheng Xiang Tu (Latest map of Ningbo city)

Lin S (2002a) Zhe Jiang Ning Bo Shi Tang Song Zi Cheng Yi Zhi (Zicheng Ruins of Tang and Song dynasty, Ningbo, Zhejiang). Archaeol 3:46–62

Lin S (2002b) San Jiang Bian Qian: Ning Bo Cheng Fa Zhan Shi Hua (Transformation of Ningbo city). Ningbo Publishing House, Ningbo

Liu Z, Uyttenhove P, Beeckmans L, Zheng X (2020) Major events and urban development: exploring the spatial impact of China's expositions in the early twentieth century. Plan Perspect 35(5):779–804

Luo H (1983) Wo Dang Ning Bo Shi Shi Zhang Jiu Shi (1927.7–1930.1) (My experience as the mayor of Ningbo city). Ningbo Wenshi Ziliao 8 (Ningbo Cult Hist Mater 8). Ningbo CPPCC Committee of Literature and History, Ningbo

Luo L (1999) Jin Dai Nan Jing Cheng Shi Jian She Yan Jiu (study of recent urban construction in Nanjing). Nanjing University Press, Nanjing

Mishiro S (1883) Zhe Jiang Sheng Ning Bo Fu Cheng Tu (Map of Ningbo, Zhejiang). Retrieved from the Library of Congress, www.loc.gov/item/92682870/. Accessed 19 July 2023

Nakajima N (2022) The Datong city plan (1938): the three week-process of organizing planning ideas and techniques towards the construction of a new urban area under Japanese occupation. Plan Perspect 38(1):99–125
Paulo P, Vítor O (2009) Different approaches in the study of the urban form. J Urban 2(2):103–125
Qian W (1995) Qian Long Yin Xian Zhi (Yin county chronicle in Qianlong period). Shanghai Classics Publishing House, Shanghai
Shenbao (1927) Gong Wu Ju Shi Xing Ce Liang Jian Zhu (Public works bureau implements measurement of buildings). Shen Bao (Shun Pao)
Skinner GW (1977) The city in late imperial China. Stanford University Press, California
Su L (2010) Jin Dai Ning Bo Cheng Shi Bian Qian Yu Fa Zhan (Urban Development and Transformation in Modern Ningbo). Ningbo Publishing House, Ningbo
Sun Y, Hein C, Song K (2019) Planning of public housing in modern Tianjin (1928–1945). Plan Perspect 34(3):439–462
The Library of Congress (1846) Ning Jun Di Yu Tu (Map of Ningbo, about 1846). The Library of Congress, www.loc.gov/item/gm71002469/. Accessed 19 July 2023
Tian Y, Gu K, Tao W (2010) Cheng Shi Xing Tai Yan Jiu Yu Cheng Shi Li Shi Bao Hu Gui Hua (Urban morphology and conservation planning). Chengshi Guihua (City Plan Rev) 34(04):21–26
Wang E (2006) Wu Kou Tong Shang Bian Ju (The changes in the five port cities). Guangxi Normal University Press, Guilin
Wasserstrom JN (1991) Student protests in twentieth-century China: the view from Shanghai. Crown, New York
Whitehand JWR, Gu K (2006) Research on Chinese urban form: retrospect and prospect. Prog Hum Geogr 30(3):337–355
Yin County Construction Department (1934) Yin County Construction Magazine
Yu F (1995) Ningbo Shizhi (Ningbo City J). Zhonghua Book Company, Beijing
Zhe F (2004) NingboJiuying (Old pictures of Ningbo). Publishing House, Ningbo

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 19
Chinatown's Key, Built Form Elements of Sense of Place: Findings from an Immersive Visual Survey

Francisco Alaniz Uribe, Nathan Stelfox, and Emily Kaing

Abstract Cities are made up of multiple diverse cultural areas that are rooted in heritage. These areas evolve over time experiencing pressures for change and redevelopment that can erode their sense of place and perpetuate their marginalization. Chinatown in Calgary is one of those areas with strong historical roots and under redevelopment pressure. An immersive, web-based public engagement process using 360-degree photography was used to measure the community's perception of the importance and impact of built form elements on Chinatown's sense of place. The built form elements prioritized included streetscape design and programming with a preference for pedestrian over vehicular traffic reflecting its historical use; the buildings' architectural language with a complexity of motifs, and the use of traditional materials and construction technics that evoke its original culture; buildings respecting human scale; street-wall permeability; and signage as a visible reminder of the original languages. The findings of this study contribute to the understanding of how the built environment contributes to the sense of place in ethnic and heritage areas. They form the basis for urban design guidelines and contribute to more appropriate redevelopment proposals. Helps build inclusivity and a degree of certainty for the future of marginalized ethnic areas of our cities.

Keywords Sense of place · Marginalized communities · Public engagement · Urban form · Urban design

F. Alaniz Uribe (✉) · N. Stelfox · E. Kaing
University of Calgary, 2500 University Dr. NW, Calgary, AB, Canada
e-mail: falanizu@ucalgary.ca

N. Stelfox
e-mail: nathan.stelfox@ucalgary.ca

E. Kaing
e-mail: emily.kaing@ucalgary.ca

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_19

19.1 Introduction

Cities are made up of multiple diverse areas that are rooted in the past. These areas evolve over time and in many cases retain their origins that are reflected in their local culture and built form. Chinatown in Calgary is one of those areas with strong historical roots and a long-lasting culture. Nevertheless, no area of the city is permanently frozen in time. There are constant forces and pressures for change and redevelopment. The key question is how to accommodate change while retaining the character and sense of place in this historic area of Calgary. The character, identity, and sense of place of Chinatown have different meanings to different people. Recognizing this we must design an engagement process that is as broad and inclusive as possible while at the same time focusing the public's input on the project's objectives.

This research project had two main objectives. First to focus on identifying key elements of the built environment that contribute to the sense of place and identity of Chinatown. Drawing on the public's input we weighted each of these elements levels of impact on people's perception of identity. The second objective of this project was to develop an online, immersive, and visual engagement process that would facilitate conversations with the public. The findings from this study will help in the future drafting of urban design recommendations for the improvement of the public realm and architectural guidelines for future development applications.

A carefully designed visual preference survey was designed to gather the essence of a sense of place and identity as perceived by members of the community. A visual preference survey uses graphic images to gather the opinion of the public regarding their preferred built form. These kinds of surveys help the respondent to have a clear idea of the built form in question and allow for a more accurate assessment of the public's preferences.

19.2 Background

The colonization and growth of cities in Canada included immigration from people of many backgrounds and many nations. Waves of immigration from different nations occurred at different moments in time. While immigration was encouraged in Canada, there was a strict immigration policy that outlined the desirable nationalities versus the not-so-desirables. This was based on racism and a simplistic view of whom might be easier to administer and assimilate. Anglo-Saxons were seen as the most desirable while Italians, Greek, Jews, and Asians were not desirable (Troper 2021). These marginalized immigrant groups would tend to settle close together creating close-knit communities that provided mutual support and eased the struggles of relocating to a new country. These communities would share cultural traits like language, cuisine, religion, and other traditions that defined their culture. They would also bring with them traditional skills and expertise that would help them offer services and open

businesses. All these factors would in the end get reflected in the built form of those immigrant communities.

Chinatown in Calgary is one of these cases. It was first established at the very beginnings of Calgary in the late 1800s but not in its current location. In fact, it was in two previous areas before establishing today's location. Marginalized communities would settle on the least desirable areas of the city. From the beginning, Chinatown was located on the outskirts, as the city continued to grow, and its location became more desirable the community would be violently pushed out and it would have to find a new place. This happened two times until today's current and permanent location next to the Bow River (Lai 1988).

Today's pressures on Chinatown are not the same and not as violent as in the past but it continues to threaten its identity. Chinatown is very centrally located next to the Bow River and in the middle of Calgary's downtown core and business district. There is a lot of demand for land and pressure for redevelopment. While new development is welcomed by the community there is fear that this new development would erode the sense of place and identity of Chinatown.

Urban designers, geographers, sociologists, architects, and many others have studied the concept of a sense of place and have helped to define it as the relationship between a place and its people. It is the product of cultural processes over time within a site. These cultural processes are affected by economic conditions, social interactions, and environmental conditions. These processes are then reflected in the built environment generation after generation (Norberg-Schulz 1979; Sandalack 2005).

In this chronological process, not all phases of development reflect or protect the past. In many cases, new development erases what was before and interrupts the continuity of a place's heritage. The continuity of the different historical layers strengthens the sense of place. The relationships between the different eras of development, when grounded in a place's heritage, foster that relationship between a place and its people (Relph 1976; Trancik 1986). Marginalized communities are more vulnerable to the erosion of their sense of place because they tend to lack the power and agency to control the redevelopment of their communities. For these reasons, it is important to find a way to protect and foster Chinatown's sense of place while making a place for future development.

19.2.1 Chinatown's Evolving Sense of Place

Chinatown as a place was not always populated by Chinese architecture. North American Chinatowns contain several historical buildings; however, their built form elements (windows, frames, and facades) were built prior to the influx of Chinese immigrants and originally did not reflect Chinese culture. What distinguished Chinatowns as a place was the notable higher concentration of Chinese people on the streets, the Chinese storefronts, signs, and placards. The way these businesses and stores operated was by offering their goods on the street and with their goods in the space between the store and the sidewalk. Sometimes their windows were full of

baskets filled with their goods. The use of the public realm in Chinatown was not always restricted to the streets and sidewalks, but the laneways as well, with a high intensity of use (Lai 1997, 1988; Li 2014).

Understanding how the expression of Chinese culture in the built form of North American Chinatowns is not a replica of China itself is important. This knowledge can serve as a guide to draft recommendations and guidelines for future development. Calgary's Chinatown has a sense of place that is not based on its ability to be a close resemblance to China but to express the long tradition of Chinese-Canadian culture within the City of Calgary. Future development in Chinatown can look at its past and traditional Chinese built form as a form of inspiration for urban and architectural design. The streets, sidewalks, plazas, parks, and the buildings that contain them all have visual elements that contribute to the sense of place unique to this community.

This project's main research question then was how to accommodate change while retaining their heritage and sense of place? This research had two objectives. First to focus on identifying key elements of the built environment that contribute to the sense of place and identity. And second, to develop an online, immersive, and visual engagement process that could facilitate conversations with the public during pandemic health restrictions.

19.2.2 Visual Preference Surveys

Visual Preference Surveys were first introduced back in 1979 by Anton Nelessen (Chrisman 2006) but have greatly evolved since then. The general concept of a Visual Preference Survey (VPS) is for participants to score images based on how they react to the contents, either positively, neutrally, or negatively (Institute for Public Administration 2014). In the case of urban planning and design, respondents react to visuals of the built environment and provide feedback on which elements contribute positively or negatively to their experiences. The first VPS conducted used a series of images as a presentation chosen from a variety of urban settings around the world. However, Chrisman (2006) notes that this method has the flaw of assuming that something which works in another city, in another country, will work in this place. Participants did not understand the greater context of that place that led it to the built form they were being shown and therefore did not understand why it may not be applicable to their neighborhood. VPSs have evolved since then to be more place specific, using visual altering technology, virtual reality, and other technology to make VPSs more accurate for participants.

A VPS can either be community specific, conceptual, or generic. A generic VPS uses images of other environments and implies they can be applied in another setting; a conceptual VPS builds the environment from scratch in 3D modeling software and may not reflect an actual space, and a community-specific VPS uses media of a real community and uses image-altering software to change the environment (Institute for Public Administration 2014). The latter two provide a more realistic environment for

participants, and therefore produce more accurate data from the respondents' results (Barajas 2018).

The use of VPS has been applied before in areas where its sense of place is threatened, VPS has helped to better implement preservation strategies for natural areas (Newell and Canessa, 2018, Jorgensen and Stedman 2006) but few studies have used VPS to understand the sense of place and built environment of Chinatown communities (Soetomo et al. 2020).

19.3 Methodology

At the beginning of the project, we reviewed the existing literature and best practices associated with other sense of place and identity studies. This step helped us set the background and confirm our approach to surveying. This phase included

- Literature review of sense of place, identity, and key elements of the built environment.
- Literature review and best practices for visual preference surveying using immersive technology (virtual reality and 360º video and photography).

Once we had completed the literature review it was important to cross reference our findings with the current conditions of Chinatown in order to identify which elements are present on site. This will help define the elements of the built environment that will be the subject of our survey. This phase included

- Mapping current conditions of the public realm and the private realm (buildings, parking lots, and other structures inside the property line).
- Historical evolution research to uncover built form conditions (buildings, street design, land uses) that were present in the past and lost through time.
- Categorization of key elements of the public realm (scale, texture/material, color, signage, urban furniture, land use).

A community-specific VPS was chosen for this project. Up-to-date images of Chinatown were collected and organized by broad themes such as streetscapes, lanes, architecture, and further categorized within each of these (Institute for Public Administration 2014). A robust critique of VPS is the bias it can create between photos not just from changing the desired element, but also from background elements such as weather, people, and cars (Noland et al. 2017). For this reason, images must be as similar as possible and taken under the same conditions to prevent bias. Noland et al. (2017) used eye-tracking software to understand what caught the attention of participants, and found that specific elements such as cars, advertisements, and parking received negative responses while people, pedestrian-related features, and greenery received positive responses. When using a VPS, these elements must be consistent between photos to ensure that these background elements do not influence participants instead of the built form feature in focus.

When choosing a photo-manipulated VPS over a conventional VPS, there are a variety of elements that may be altered including material, shape, size, layout, style, and function. Barajas (2018) mentions that using the same photo for multiple scenarios will prevent inconsistencies in background information, and therefore bias. Photo-manipulated VPS has been considered the standard in academic research given its time and budget (Barajas 2018). This research suggests using one photo per topic, and creating multiple versions of that one photo, with the built form in question being manipulated between each. Also, Rahn (2014) found that VPS worked best when there were just subtle differences between the comparative photos. Rahn suggests changing one specific built form element that participants can focus on and ignore distracting information.

19.3.1 Scoring a VPS

The Institute for Public Administration (2014) mentions several methods for scoring VPS including written ballots, a structured set of self-administered questions, a facilitated discussion, a focus group format, an open semi-structured forum, and an online survey. Before ranking begins, however, Rahn (2014) mentions the importance of making the prompt and description for each photo as concise and consistent as possible so as not to confuse the participants. Also, Ewing (2001) mentions that it is effective to bring in a diverse group of people to view the VPS. In the case of this study on transit design, participants included transit users, transit professionals, non-users, etc. A sample size of 50–100 people, broken down into smaller groups of 10–15, is standard for a VPS (Ewing 2001). Based on this literature review, the most common type is an online questionnaire that asks participants to numerically rank each photo. The St. Paul Case Study from Rahn (2014) used a −3 to +3 ranking and then each photo was given a median score. Ewing (2001) explains that the most common way to assess participants' feedback is with rating/scaling methods, with 1–5 being used for this study.

It is understood that each participant will have their own experience with the environment in question and will score subjectively (Chrisman 2006). One group of people may have a different history and experience with an element of the built environment as opposed to another. Visual Preference Surveys, when not properly planned, will show only what something "looks like" but may not fully capture its identity or what it feels like to be there (Chrisman 2006). Because of this, it would be beneficial to provide a visual experience as immersive as possible for the participants to experience the space in a similar way.

19.3.2 Creating a Mixed Reality

There are multiple methods for creating a mixed reality that can be used in a VPS. Based on this literature review, a common theme is that the more realistic the mixed reality is to the actual environment the more accurate the participants' responses will be. The first example is a combination of sight and sound. Ruotolo et al. (2013) used virtual reality (VR) and audio simulations to create a VPS on the creation of a motorway. When the survey was conducted, participants went through a quick run-through of the experience and what was expected of them. Then, they were given a walkthrough of the VR and began providing feedback. In conclusion, Ruotolo et al. (2013) found that "immersive virtual reality could be considered a valid tool to simulate the multisensory way in which the environment, with embedded sounds, is perceived in everyday life and can offer innovative applications." Indeed, it may allow designers and consultants to understand in advance the possible negative effects of new infrastructure.

19.3.3 Why Use Mixed Reality as a VPS?

Photo-manipulated VPS can help address misunderstood concepts and show participants how they might look when in their community. Participants can easily see a cost–benefit scenario for each option, and then compare them (Steiner and Butler 2007). A VPS can also educate participants on urban design elements, helping people see them in real time rather than relying on a possible pre-existing bias in knowledge, to help them make a decision. Lopes and Lindstroöm (2012) mention that all too often, technology is used later in the planning process once decisions have already been made. Rather, Lopes and Lindström (2012) look at how immersive VR can be used early in the planning process to better integrate community feedback into a design. This works as a continuous feedback loop, with the immersive VPS continuously changing until community concerns are addressed.

19.3.4 Virtual Reality (VR) to Augmented Reality (AR)

While virtual reality refers to the immersive environment where a user is often using a headset that mimics the experience of being in a specific time and place. Augmented reality, however, is a combination of real environment footage with virtual objects (Cirulis and Brigmanis 2013). AR differs from VR by providing a better perception and interaction with the real world over VR, which is self-contained and isolated (Anagnostou and Vlamos 2011). An example of augmented reality is the largely popular Pokemon-Go, which allowed the user to view virtual Pokemon in the environment by looking through the camera of their phone. Augmented reality often

refers to a 3D virtual object that is placed in the environment, such as a building or Pokemon, but in the case of the Chinatown Sense of Place VPS, it would be a layer that is applied to reality rather than a 3D object. This is achieved by changing the type of material instead of replacing the material with a different object entirely.

19.3.5 Hardware and Software Considerations

Visual Preference Surveys (VPS) can be community specific, generic, or conceptual, and the type of technology and software depends on the type. For the purpose of this survey, it is community specific to Calgary's Chinatown and, therefore, a VPS that is as close as possible to current conditions was developed.

To create the augmented reality tour through Chinatown for the immersive VPS, a camera that can capture 360° photos was used, the Insta360 One X. This camera has a dual camera system that can capture 180° on either side with a self-timer that allows the user to remove themselves from the photo. For recording sound compatible with an AR environment, the 360° microphone Zoom H3-VR was used.

19.3.6 Capturing and Editing the Environment

It is important that all photos are as consistent as possible. This includes weather conditions, pedestrian and vehicle traffic, and foliage. The comparative images need to be as similar as possible when they are of the same scene, but when comparing two different environments they need to be reflective of their typical conditions.

Editing 360° photos in Photoshop is different from editing a standard photo as certain steps must be taken to ensure it retains its 360° view. Photoshop's 3D tool allows the user to pan around the environment using the toggle tool and applies edits.

19.3.7 Collecting Feedback

Unfortunately, the software for producing a virtual tour does not have a built-in feedback technology that allows participants to record their thoughts. Rather, secondary software needs to be used to collect feedback. The University of Calgary Qualtrics platform was used for this purpose. The technology has many options to format the survey however the organizer wishes, and the data can be easily analyzed after through the software. This will require the participant to be able to see the Qualtrics survey and the Virtual Tour at the same time, however. This can be done by creating a dual screen on the user's computer (open each window to half size), or by asking the user to open the virtual tour on their computer and the survey on a secondary device such as a smartphone or tablet.

19.3.8 Questionnaire

When designing a questionnaire, it's important to make sure to ask the right questions; make those questions clear, focused, and concise; and keep the questionnaire as short as possible. In order to define the set of questions to be included in the survey it was helpful to understand what other jurisdictions have considered as the main components of a sense of place for their respective Chinatowns and what elements of the built environment they considered needed design guidelines. These precedents provided valuable, previous experience that helped us find a balance between the necessary amount of detail without venturing into a minute examination of the built form.

19.3.9 Questions Based on Precedent Research

While there are many Chinatowns across the world the selection criteria of precedents took into consideration only North American cities. The ten cities included in this research have specific planning documents or significant sections pertaining to the development of their Chinatowns including design guidelines. Plans from three Canadian cities, Victoria, Vancouver, and Edmonton, and seven cities from the United States, Portland, San Francisco, Washington DC, Los Angeles, Honolulu, Boston, and Philadelphia, were analyzed. Based on a summary of the main characteristics of the built environment included in their respective guidelines, several characteristics were identified as the key components contributing to these Chinatowns' sense of place. These characteristics were organized into broader built form categories: materials, parks/opens space, social activities, street programming, streetscapes, and architectural elements. Cities regulated each of these categories to a different resolution of detail, for example, while Edmonton included 12 characteristics for streetscapes San Francisco only considered five. The matrix given in Table 19.1 (Alaniz Uribe et al. 2021) quantifies the different characteristics included in each one of the main built form categories per each one of the precedent cities.

After reviewing in detail each of the different precedents five main categories for the visual preference survey were created: Streetscape, Street Programing and Use, Buildings, Parks and Plazas, and Signage. A set of 23 questions were drafted covering the different key elements of the built environment that contribute to the sense of place. For each of these questions, a follow-up question was included to measure the perception of the importance of that element to be able to assign weight to the relevance of future recommendations. In the last section of the survey, three additional questions were included that were related to the soundscape. These questions showed a static image but included a sound that simulated three different conditions: one with the predominant sound of vehicular traffic, one with the sound of vehicular traffic over cobblestones, and one with the predominant traffic of pedestrians. At the end of the soundscape set of questions, follow-up questions were included that measured

Table 19.1 Precedent cities and built form characteristics included in their guideline documents for their Chinatowns (Alaniz Uribe et al. 2021)

Precedent city	Materials	Parks/ open space	Social programming	Street programming	Streetscape	Architectural elements
Victoria	6	1	1	2	8	7
Vancouver	6	2	1	3	9	7
Edmonton	3	3	1	4	12	3
Portland	7	0	0	3	8	8
San Francisco	0	2	0	0	5	0
Washington DC	2	4	6	4	7	4
Los Angeles	1	4	0	0	2	5
Honolulu	2	3	8	2	5	1
Boston	0	6	2	2	11	6
Philadelphia	0	3	7	4	8	2
Total	7	6	12	4	15	10

the importance of soundscapes for the character and sense of place of Chinatown. Nine sociodemographic questions were included to help us understand the profile of the different community members that participated in the survey. Figure 19.1 (Alaniz Uribe et al. 2021) is an example of the images and options provided.

19.4 Results and Discussions

There were 113 respondents to the survey, some of them did not answer all the questions but most did. The sample of respondents was across ages and from multiple areas of the city.

For each of the built environment questions, recommendations were provided supported by precedents from other Chinatowns across the world and examples from China. These recommendations were drafted not only based on the survey responses but also on precedent studies and our previous body of research.

The recommendations are grouped by five main characteristics that support and enhance the sense of place in various Chinatowns:

- Streetscape.
- Street Programming and Use.
- Buildings.
- Plazas and Parks.
- Signage.

Fig. 19.1 Example of a visual survey question and options, regarding the use of traditional Chinese motifs (Alaniz Uribe et al. 2021 p. 58)

The following is a summary of the results and recommendations for each of these main characteristics. Detailed recommendations and the precedents that support them were provided in the main report for each one of the built environment questions.

19.4.1 Streetscape Recommendations

Table 19.2 (Alaniz Uribe et al. 2021) shows the elements of streetscaping considered in these questions and recommendations, including street dimensions, street lighting, urban furniture, sidewalk materials, and roadway material. The main recommendations are

1. Prioritize the pedestrian environment by expanding current areas.
2. Provide additional lighting fixtures including string lighting.
3. Provide additional urban furniture including sitting areas, waste disposal, and bike racks, all of which should be designed to contribute to the sense of place.

Table 19.2 Streetscape responses (Alaniz Uribe et al. 2021)

Question number	Key built form element	Options	Percentage (%)	Number of responses
Q10	Street dimensions	Current	26.26	26
		Option 1—half pedestrian	32.32	32
		Option 2—full pedestrian	41.41	41
Q12	Street lighting	Current—traditional	26.26	26
		Option 2—string lights	21.21	21
		Option 3—more string lights	52.53	52
Q14	Urban furniture	Current	24.24	24
		Option 1—moveable furniture	21.21	21
		Option 2—artistic furniture	54.55	54
Q16	Sidewalk materials	Current—concrete	12.12	12
		Option 1—red brick	43.43	43
		Option 2—gray cobblestones	44.44	44
Q18	Roadway materials	Current—asphalt	23.23	23
		Option 1—red brick	39.39	39
		Option 2—gray cobblestones	37.37	37

Table 19.3 Streetscape importance for the character of Chinatown (Alaniz Uribe et al. 2021)

Question number	Key built form element	% responses extremely/very important
Q10	Street dimensions	78%
Q12	Street lighting	62%
Q14	Urban furniture	62%
Q16	Sidewalk materials	57%
Q18	Roadway materials	46%

4. Improve the sidewalk and roadway surface with materials similar to red brick or gray cobblestone.

19.4.2 Importance for the Character of Chinatown

As part of the questionnaire, for each of the visual preference questions, a follow-up question asked the participants to weigh the level of importance of each key element. The available responses were

- Extremely Important.
- Very Important.
- Moderately Important.
- Slightly Important.
- Not at all Important.

Table 19.3 (Alaniz Uribe et al. 2021) shows the percentage of responses corresponding to Extremely Important and Very Important combined. These two top values were combined to identify the higher level of importance and weight participants considered for each of the questions. We combined these two responses to better understand what participants could consider a priority. The accompanying graph, Figure 19.2 (Alaniz Uribe et al. 2021), shows the responses' percentage values. These two representations of the findings illustrate the weight given by the participants to each of the key elements of the built environment. The darker the red, the more important participants considered that particular key element to be for the character of Chinatown, and careful guidelines should be prioritized for those elements.

19.4.3 Street Programming and Use Recommendations

Table 19.4 (Alaniz Uribe et al. 2021) shows the aspects of street programming and use considered in the questions and recommendations include the temporary closure and use of the roadway, sidewalk use, the possibility of street vendors and the sale of products on sidewalks, and additional street trees. Table 19.5 (Alaniz Uribe et al.

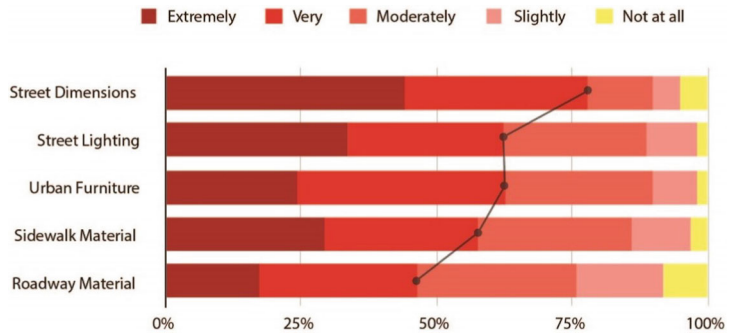


Fig. 19.2 Streetscape importance for the character of Chinatown (Alaniz Uribe et al. 2021)

2021) shows the percentage of responses corresponding to Extremely Important and Very Important combined. Figure 19.3 (Alaniz Uribe et al. 2021) shows the percentage values of all the responses.

The main recommendations are

Table 19.4 Street programming and use responses (Alaniz Uribe et al. 2021)

Question number	Key built form element	Options	Percentage	Number of responses
Q20	Temporary closure and use of roadway	Current	9.18%	9
		Option 1—partial closure of parking stalls	21.43%	21
		Option 2—full closure for festivals	69.39%	68
Q22	Sidewalk use	Current	7.22%	7
		Option 1—patios	21.65%	21
		Option 2—patios and markets	71.13%	69
Q24	Street vendors/ products on sidewalks	Current—no vendors	23.47%	23
		Option 1—some vendors	42.86%	42
		Option 2—more vendors and food trucks	33.67%	33
Q26	Street trees	Current	16.33%	16
		Option 1—25% increase	30.61%	30
		Option 2—50% increase	53.03%	52

Table 19.5 Street programming importance for the character of Chinatown (Alaniz Uribe et al. 2021)

Question number	Key built form element	% responses extremely/very
Q20	Temporary closure and use of roadway	77%
Q22	Sidewalk use	71%
Q24	Street vendors/products on sidewalks	52%
Q26	Street trees	64%

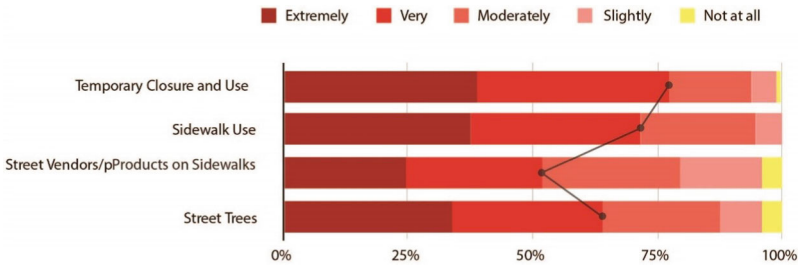


Fig. 19.3 Street programming importance for the character of Chinatown (Alaniz Uribe et al. 2021)

1. Continue to allow seasonal closure of roadways for seasonal events and festivals.
2. Support patios and merchandise display areas by expanding the sidewalks to accommodate space.
3. Allow for a limited amount of street vendors and food trucks that can complement and support current commercial units.
4. Increase the number of street trees.

19.4.4 Building Recommendations

The built form elements considered in these questions and recommendations include the scale of buildings, use of traditional Chinese motifs, building permeability, awnings and balconies, external material/color of buildings and land use, as shown in Table 19.6 (Alaniz Uribe et al. 2021). Table 19.7 (Alaniz Uribe et al. 2021) shows the percentage of responses corresponding to Extremely Important and Very Important combined. Figure 19.4 (Alaniz Uribe et al. 2021) shows the percentage values of all the responses. The main recommendations are

1. While current regulations allow for 14–16 storey buildings, prioritize low-rise character buildings (podium-tower building type) with a human scale focus on the first six storeys.
2. Use Chinese traditional motifs but also modern expressions that are grounded in tradition.

Table 19.6 Buildings responses (Alaniz Uribe et al. 2021)

Question number	Key built form element	Options	Percentage	Number of responses
Q28	Scale of buildings	Current	18.09%	17
		Option 1—straight tower	3.19%	3
		Option 2—mid-rise six-storey	46.81%	44
		Option 3—podium and tower	31.91%	30
Q30	Traditional Chinese motifs	Current	7.53%	7
		Option 1—none	4.30%	4
		Option 2—traditional	53.76%	50
		Option 3—modern	34.41%	32
Q32	Permeability (land use spillage)	Current	15.96%	15
		Option 1—low	10.64%	10
		Option 2—high	73.40%	69
Q34	Awnings and balconies	Current	23.40%	22
		Option 1—awning	34.04%	32
		Option 2—awning and balconies	42.55%	40
Q36	Material/color of buildings	Option 1—red brick	46.59%	41
		Option 2—red terracotta	28.41%	25
		Option 3—ceramic tile accents	25.00%	22
Q38	Land use	Current	14.13%	13
		Option 1—office	6.52%	6
		Option 2—residential	7.61%	7
		Option 3—mixed use	71.74%	66

Table 19.7 Buildings importance for the character of Chinatown (Alaniz Uribe et al. 2021)

Question number	Key built form element	% responses extremely/very
Q28	Scale of buildings	69%
Q30	Traditional Chinese motifs	73%
Q32	Permeability (land use spillage)	60%
Q34	Awnings and balconies	37%
Q36	Material/color of buildings	49%
Q38	Land use	78%

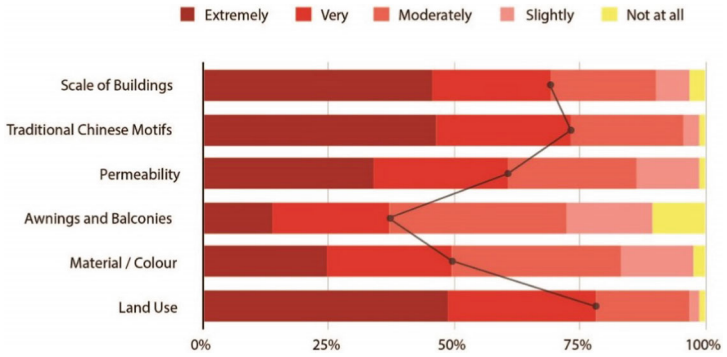


Fig. 19.4 Building importance for the character of Chinatown (Alaniz Uribe et al. 2021)

3. Retain and require a high degree of building permeability at street level with the use of windows and multiple entries.
4. Allow for awnings for commercial units and recessed balconies on residential buildings.
5. Use traditional materials on the exterior of buildings, especially at street level.
6. Use a mix of land uses within buildings, prioritizing commercial use at street level and residential use on upper levels.

19.4.5 Parks and Plazas Recommendations

Table 19.8 (Alaniz Uribe et al. 2021) shows the elements considered in the design of parks and plazas, including the use of hardscape versus softscape in plazas, urban furniture, hardscape material and permanent programming. Table 19.9 (Alaniz Uribe et al. 2021) shows the percentage of responses corresponding to Extremely Important and Very Important combined. Figure 19.5 (Alaniz Uribe et al. 2021) shows the percentage values of all the responses. The main recommendations are

Table 19.8 Parks and plazas responses (Alaniz Uribe et al. 2021)

Question number	Key built form element	Options	Percentage	Number responses
Q40	Hardscape versus softscape (in plaza)	Current	19.35%	18
		Option 1—softscape	55.91%	52
		Option 2—hardscape	24.73%	23
Q42	Urban furniture (in park/plaza)	Current	7.53%	7
		Option 1—fixed	29.03%	27
		Option 2—moveable	12.90%	12
		Option 3—fixed and moveable	50.54%	47
Q44	Hardscape material (in park)	Current	24.73%	23
		Option 1—red brick	29.03%	27
		Option 2—gray cobblestone	24.73%	23
		Option 3—stamped wood concrete	21.51%	20
Q46	Permanent programming (in park)	Current	5.49%	5
		Option 1—table games	37.36%	34
		Option 2—playground	10.99%	10
		Option 3—contemplation garden	46.15%	42

Table 19.9 Plazas and parks importance for the character of Chinatown (Alaniz Uribe et al. 2021)

Question number	Key built form element	% responses extremely/very
Q40	Hardscape versus softscape (in plaza)	60%
Q42	Urban furniture (in park/plaza)	52%
Q44	Hardscape material (in park)	51%
Q46	Permanent programming (in park)	70%

1. Create a balance between softscape and hardscape that responds to the needs of the space. More traffic and programming require hardscape while other areas can contribute with additional planting and landscaping.
2. Provide additional urban furniture for board games, activities, and places to sit and rest, with a combination of fixed and movable furniture.

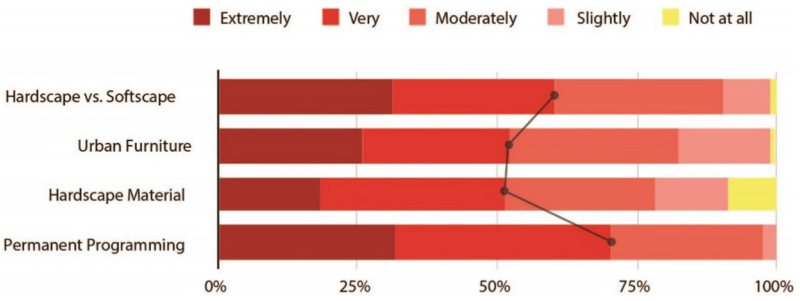


Fig. 19.5 Plazas and parks importance for the character of Chinatown (Alaniz Uribe et al. 2021)

3. Use hardscape materials that can evoke traditional materials similar to brick and cobblestones.
4. Allow for a diversity of programming features on parks and places for multiple age groups.
5. All new designs of parks and plazas should include an inclusive engagement process with members of the community.

19.4.6 Signage Recommendations

Table 19.10 (Alaniz Uribe et al. 2021) shows the different elements of commercial signage considered in the questions and recommendations, including projecting signage, signage lighting, and the language used on signs. Table 19.11 (Alaniz Uribe et al. 2021) shows the percentage of responses corresponding to Extremely Important and Very Important combined. Figure 19.6 (Alaniz Uribe et al. 2021) shows the percentage values of all the responses. The main recommendations are

1. Allow for projecting and hanging signage similar to many original and lost Chinatown signs.
2. Use language on signage that includes an Asian language and is predominant as part of its design.
3. Signage should be lit preferably with LED technology and consider light pollution reduction.

It is important to note that there is also a series of questions at the end of the survey related to the different potential soundscapes of Chinatown (questions Q54–Q56). The results from these questions helped support the findings and recommendations for a pedestrian-oriented Chinatown along all of its streets and open spaces.

Table 19.10 Signage responses (Alaniz Uribe et al. 2021)

Question number	Key built form element	Options	Percentage	Number of responses
Q48	Projecting signage	Current	8.70%	8
		Option 1—cut outs	18.48%	17
		Option 2—hanging signs	47.83%	44
		Option 3—hanging trellis	25.00%	23
Q50	Signage lighting	Current	7.61%	7
		Option 1—back lit panels	16.30%	15
		Option 2—LED	52.17%	48
		Option 3—digital	23.91%	22
Q52	Language of signage	Current	17.39%	16
		Option 1—limited use of asian languages	10.87%	10
		Option 2—only mandarin/cantonese	19.57%	18
		Option 3—multiple Asian languages	52.17%	48

Table 19.11 Signage importance for the character of Chinatown (Alaniz Uribe et al. 2021)

Question number	Key built form element	% responses extremely/very
Q48	Projecting signage	77%
Q50	Signage lighting	71%
Q52	Language of signage	52%

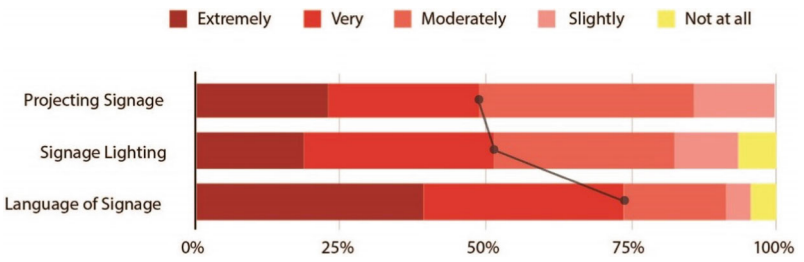


Fig. 19.6 Signage importance for the character of Chinatown (Alaniz Uribe et al. 2021)

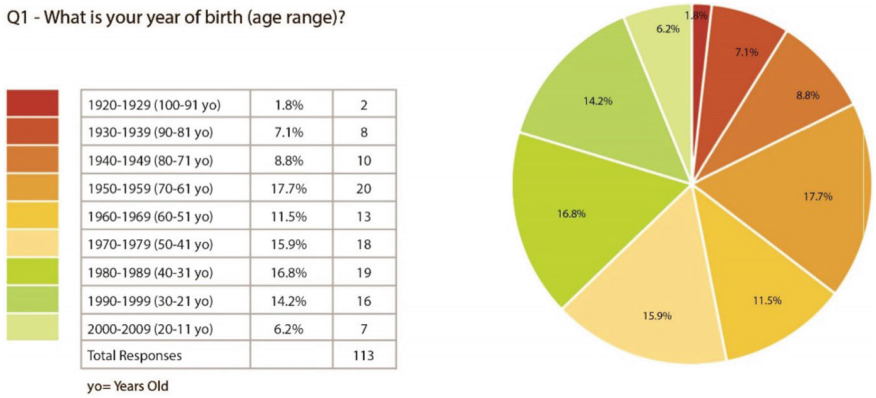


Fig. 19.7 Respondents age groups (Alaniz Uribe et al. 2021 p. 34)

19.4.7 Discussion

Conducting this visual survey online and developing a process to engage with multigenerational participants was challenging. Figure 19.7 (Alaniz Uribe et al. 2021) shows the resulting diversity of participants across all ages. This was helped ensure a robust multigenerational set of survey responses.

There are two sets of questions where we saw how different generations responded differently. First in regards to architectural motifs, while some preferred to see traditional Chinese motifs some wanted to see modern interpretations of Chinese traditional motifs, this could be associated with the different age groups and their different attachment to place. And secondly, there were different preferences for the language used on signs but, in general, the preference was for multiple languages and we believe that reflects the more diverse modern immigration patterns from multiple Asian countries rather than mostly from China.

Curating the current photos' edits to represent potential scenarios is a key component and a delicate balance. For this project it was important to present scenarios that were possible to build and implement within our city's context. Calgary being a winter city, some materials perform better than others under those conditions, limiting the options for the different scenarios.

The use of the set of precedent cities to build the selections of key elements of the built environment was also a very important part of the process. While there might be other elements that are also important and based on the responses on "importance for the character of Chinatown" this selection of key elements proved to be at the core of what the community considers necessary to support its sense of place. It will be a strong foundation for the future set of statutory design guidelines the City of Calgary will be drafting.

There is a lot of depth and potential for additional analysis of the data. For the scope and purpose of this project, there was a priority to guide the municipal government in

making decisions and developing a series of land use policies and design guidelines for future development, but the responses of this survey can also help, with further analysis of the data, to better understand the sense of place and place attachment within immigrant communities.

19.5 Conclusions

From the start, this research project was of great interest to the team. A collaboration between academic researchers and municipal planners with a joint objective to develop a deep understanding of what makes Calgary's Chinatown sense of place important and meaningful to its people. A challenge was to develop an improved way of consulting with the public where better and more detailed information can be communicated to enable the public to develop both well-informed and meaningful participation.

To achieve these goals, it was clear from the beginning that a more immersive and visual process was needed. Sense of place is spatial in nature and to discuss it and understand it, it is necessary to utilize visual communication tools. The structure of a visual preference survey was chosen as the main tool of engagement but the goal was to develop a process that was highly immersive and user-friendly. This was one of the initial challenges that over time became more complicated with the arrival of the global pandemic of COVID-19.

The need to transition from an in-person process to an online process added a layer of complexity and limitation for achieving a highly immersive experience. Initially, the concept was to host in-person focus groups in a multi-screen immersive room where participants would feel a level of virtual reality of being in the location with the different scenarios.

Due to social distancing restrictions being implemented in the middle of March 2020 the decision was made to redesign the process to be a completely online platform. New technical methods were designed and additional work hours were added to the project for the implementation of these new methods. The close collaboration between the research team and the City of Calgary planning team allowed for comprehensive problem-solving of foreseeable barriers to the online implementation.

With the use of new 360º photography, the idea of impressiveness and a user-friendly interface was achieved. Participants were able to visualize the different scenarios and imagine potential changes. We continued to host focus groups online and this allowed for a friendlier environment, especially for those participants who were uncomfortable or not familiar with the technology. There was also the opportunity for individual completion of the survey. Both settings allowed the participants to look at the 360º photos and choose their preferred option. The anecdotal feedback provided by participants showed an appreciation for the platform and ease in understanding the visual scenarios.

In any research project and in any public engagement process, there are limitations and complexities that need to be recognized. In a visual preference survey, there is

always the limitation of the number of images and scenarios that can be offered. The selection of the images was careful and made with the intention to provide feasible scenarios based on precedents and the current built form of Calgary's Chinatown. Nevertheless, there will always be room for additional scenarios and options.

The length of the survey was another limitation. There is a limit to how much time participants are willing to dedicate to answering a survey. Thus, we had to be selective of the number of questions asked and the number of options and scenarios provided for each question since participants had to compare the images to make a decision on which one they preferred. The focus groups varied from one hour to one and a half hours long. All the participants of the focus groups stayed through the whole session so that was a good indication that the process worked and the time allotted was appropriate. In the case of the online survey, individuals did not always complete all the questions and in those instances perhaps the survey was too long.

A second significant limitation was time. We provided a generous time frame for potential participation. The focus groups were well advertised a month in advance of the first session and the survey remained available for completion for over 3 months. Even with these measures, we recognize that the responses represent a limited sample of the community but we believe it to be a rich sample.

We think that the methods used were successful and the innovations did make the experience more immersive and highly visual even when being fully online. We are confident that the feedback provided over the two platforms offers very rich input to the overall planning process and to the recommendations in particular.

The recommendations derived from this feedback are complex and are characterized by certain limitations. In some cases, there is a need for further analysis for on-site implementation. The set of recommendations was drafted based on the participants' preferences, best practices, precedents, and previous research. Some of them are ambitious in nature and might require complex implementation but they are feasible. While the public realm improvement recommendations represent a significant investment they contribute greatly to the quality of the public realm and the sense of place in Chinatown. They could also show the commitment of the city to the preservation and support of one of our city's heritage communities and historically marginalized. This investment will be a visible example of the value our city holds for the Chinese-Calgarian community, and the efforts to strengthen their presence at the core of our city. The public realm is where people enjoy and connect with the sense of place of a community and should be a priority for the future of Chinatown.

This project proved to be a productive collaboration between the University of Calgary and the City of Calgary. It tackled a complex task and gathered valuable material that will help guide future development in the community. It also provided an opportunity to implement a new public engagement process that could be replicated in other communities.

Acknowledgements This project was funded by the municipal government of the City of Calgary. The project was part of the Urban Alliance, a collaboration agreement between the University of Calgary and the City of Calgary. The research team is grateful for the opportunity to work with the City of Calgary and its team, and we extend special thanks to all the participants and facilitators

from Calgary's Chinatown community. Without their enthusiastic participation, this project would not have been possible. We thank you and wish that this work contributes to the continued success of your community. It offers a humble but meaningful contribution to the future thriving of tomorrow's Chinatown.

References

Alaniz Uribe F, Kaing E, Steelfox N, Do K (2021) Chinatown sense of place survey. The City of Calgary.

Anagnostou K, Vlamos P (2011) Square AR: using augmented reality for urban planning. Third Int Conf Games Virtual Worlds Serious Appl 2011:128–131

Barajas C (2018) What are visual preference surveys and why they matter: part 1. AHBE LAB. https://ahbelab.com/2018/03/08/what-are-visual-preference-surveys-and-why-they-matter-part-1/

Chrisman P (2006) Outside the frame: a critical analysis of urban image surveys. Places J 13(3):38–43

Cirulis A, Brigmanis K (2013) 3D Outdoor augmented reality for architecture and urban planning. Procedia Comput Sci 25(C):71–79. https://doi.org/10.1016/j.procs.2013.11.009

Ewing R (2001) Using a visual preference survey in transit design. Public Works Manag Policy 5(4):270–280. https://doi.org/10.1177/1087724X0154002

Institute for Public Administration (2014) The visual preference survey. Presentation, University of Delaware. https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/a/390/files/2014/02/visual-preference-survey-ppt-122ow1r.pdf

Jorgensen B, Stedman R (2006) A comparative analysis of predictors of sense of place dimensions: attachment to, dependence on, and identification with lakeshore properties. J Environ Manage 79(3):316–327. https://doi.org/10.1016/j.jenvman.2005.08.003

Lai DC (1988) Chinatowns: towns within cities in Canada. UBC Press, Vancouver

Lai DC (1997) The visual character of Chinatowns. In: Groth P, Bressi TW (eds) Understanding ordinary landscapes. Yale University Press, New Haven and London, pp 81–84

Li C (2014) Ethnicity, culture and park design: case studies of urban parks in American chinatowns. J Urban Des 19(2):230–254. https://doi.org/10.1080/13574809.2013.870464

Lopes CV, Lindström C (2012) Virtual cities in urban planning: the uppsala case study. J Theor Appl Electron Commer Res 7(3):17–18. https://doi.org/10.4067/s0718-18762012000300009

Newell R, Canessa R (2018) From sense of place to visualization of place: examining people-place relationships for insight on developing geovisualizations. Heliyon 4(2). https://doi.org/10.1016/j.heliyon.2018.e00547.

Noland R, Weiner M, Gao D, Cook M, Nelessen A (2017) Eye-tracking technology, visual preference surveys, and urban design: Preliminary evidence of an effective methodology. J Urban: Int Res Placemaking Urban Sustain 10(1):98–110. https://doi.org/10.1080/17549175.2016.1187197

Norberg-Schulz C (1979) Genius loci: towards a phenomenology of architecture. Rizzoli, New York

Rahn A (2014) Visualizing living streets in North St. Paul: a visual preference survey in the casey lake neighborhood. University of Minnesota. https://core.ac.uk/download/pdf/76346082.pdf

Relph E (1976) Place and placelessness. Pion, London

Ruotolo F, Maffei L, Di Gabriele M, Iachini T, Masullo M, Ruggiero G, Senese V (2013) Immersive virtual reality and environmental noise assessment: an innovative audio–visual approach. Environ Impact Assess Rev 41:10–20. https://doi.org/10.1016/j.eiar.2013.01.007

Sandalack BA (2005) Identity, continuity and place. In: Davis A, Sandalack BA (ed) Sense of place. A catalogue of essays. The Nickle Arts Museum, Calgary, pp 13–28

Soetomo S et al (2020) The power of sense of place for residents of chinatown semarang. IOP Conf Ser Earth Environ Sci [Online] 409(1):12033
Steiner F, Butler KS (2007) Planning and urban design standards. Wiley, Hoboken
Trancik R (1986) Finding lost space: theories of urban design. Wiley, Toronto
Troper H (2021) Immigration to Canada. In: The Canadian encyclopedia. https://www.thecanadianencyclopedia.ca/en/article/immigration. Accessed 11 July 2022

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Part IV
Theoretical Concepts for Understanding the Redevelopment and Revitalisation of Spatial Structures and Directions of Changes in Historic Urban Structures

Chapter 20
Christopher Alexander's Challenge for Implementation: Report from an ESRG Symposium

Michael W. Mehaffy

Abstract The architect Christopher Alexander was one of the most influential figures of late twentieth-century urban and architectural theory. His books *Notes on the Synthesis of Form, A Pattern Language*, and *The Nature of Order* have been influential across a surprising variety of fields. Yet Alexander struggled with implementation over his own career, and in advising others on how to take forward his ideas. One offshoot of this effort has been the Environmental Structure Research Group (ESRG), a research coordination network convened by his student Michael Mehaffy (the author). This paper reports on the proceedings of the group, including its meeting in Krakow, Poland and over Zoom in September of 2022.

Keywords Christopher Alexander · Research coordination network · Environmental Structure Research Group · Pattern language · Deep network

20.1 Introduction

Christopher Alexander, author of "A city is not a tree," *A Pattern Language, Notes on the Synthesis of Form,* and other seminal works, died in early 2022. His later work focussed on how to change the drivers of urban form to produce better quality cities and towns from a human point of view. Former colleagues and students of Alexander, and other collaborators gathered in Krakow, Poland (and over Zoom) in September, 2022 to assess Alexander's work, their own ongoing work in relation to it, and how to actually create what Kevin Lynch termed "good city form" (Fig. 20.1).

The meeting was one of a number of gatherings of a research coordination network called the Environmental Structure Research Group (ESRG), a loose group

M. W. Mehaffy (✉)
Sustasis Foundation, The Dalles, Oregon, USA
e-mail: michael.mehaffy@gmail.com

School of Geographical Sciences and Urban Planning, Arizona State University, Tempe, USA

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_20

Fig. 20.1 Hans Joachim Neis, a long-time colleague of Christopher Alexander, discusses the challenge of implementation at the Environmental Structure Research Group (ESRG) session, a symposium within the 2022 International Seminar on Urban Form in Łodź and Krakow, Poland (*Source* the author)

of academic colleagues focussed upon topics related to Alexander's seminal contributions in the field of architecture and urbanism, and in many other fields where he had surprising influence, including software.

As I noted in the introduction to the session, the ESRG was formed in 2006 as an outgrowth of my work with Christopher Alexander at his European office, which he dubbed "the Centre for Environmental Structure–Europe". I was seconded to support this work by The Prince's Foundation for the Built Environment, where I was Director of Education. The former Prince of Wales (now King Charles) was a supporter, patron and collaborator with Alexander, and recently stated "It is so important that Chris Alexander's work and legacy are being taken forward by you and a network of researchers, and made relevant to new global conditions like rapid urbanization".[1]

The king, whose past work is well known on environmental issues as well as issues of human development and well-being, gives some indication of the pervasive influence of Alexander's ideas. Certainly not a stereotypical Classicist, Alexander instead focuses upon the human quality of built environments, and the degree to which they are adapted to well-being and delight. His philosophy of art in the built environment accords well with Jane Jacobs', who saw the role of art as supporting and illuminating the life of the city. This was in contrast to the view of architecture as the hegemonic insertion of gigantic sculptural artworks, imposed on the city with little or no regard for their impacts on the subtler qualities of daily life and experience. Alexander's view also accords well with Thoreau's, that "the greatest art is to shape the quality of the day".

[1] Personal communication with the author, 28 June 2022.

However, Alexander's critical position towards the mainstream of architectural practice certainly put him in the role of prophet without honour in his chosen profession. Indeed, Alexander was regularly attacked with surprising vitriol in some quarters, much as the former Prince of Wales has been, albeit for different reasons. No doubt Alexander also made his fair share of mistakes, failing to form alliances with friendly people within the profession.

That was one major impetus for forming the ESRG: to bring together sympathetic architects and architectural researchers with representatives of other disciplines, where Alexander's ideas found more fertile ground—often to a surprising degree. The ESRG includes a number of representatives of the software world—about which more will be said later—as well as environmental psychologists, anthropologists, political scientists, biologists, mathematicians, physicists and many others from a remarkably diverse set of fields. All of them are familiar with Alexander's work, and in one way or another, see a connection to their own research. (The ESRG has since been established as a project of the Sustasis Foundation, an NGO formed to take forward planning work during Hurricane Katrina, and using wiki, Agile and other related methodologies represented by ESRG colleagues.)

It is a remarkable fact, and also remarkably little known in the sometimes overly parochial field of architecture, that Alexander's work has had a huge influence in the world of computer science, and in other fields beyond it. One indication is that a Google search of the term "pattern language"—his seminal design methodology introduced in his book *A Pattern Language: Towns, Buildings, Construction* (Alexander et al. 1977) garners over one million hits—certainly a respectable number. But the term "design pattern"—the term computer scientists use for pattern languages of programming—garners *25 million* hits. Something important is going on, surely.

Nor does the influence end there. A cursory perusal of the Google hits shows patterns also applied to sociology, biology, engineering, law, business management and a seemingly endless number of other fields. One can find pattern languages for communication, for music composition, for user experience, for quantum algorithms and for pattern writing (!).

One of the most fascinating is a paper by Newman and Bhat (2009) in the *International Journal of Developmental Biology,* proposing a pattern language model for the growth of multicellular life. In this view, the structure of pattern languages has an analogue deep in the structure of biological growth that accounts for many different phenomena. (This accords with a response to a question that Alexander gave, when I asked if there was any major takeaway for him from the pattern language work; he answered, "yes, I thought I was inventing something, but I now realize I was discovering something".[2])

One may ask, then, how did it happen that pattern languages have been so influential in software and the other fields, yet not as influential in the very field for which they were invented?

My own view is that there is a combination of mistakes that Alexander and his colleagues made in approaching their colleagues, as well as a problem with the very

[2] Personal communication with the author, 21 February 2008.

success of the book—in effect, "trapping" the patterns into a static collection, in contrast to the original intention of a living, evolving, growing set of patterns, as happened in other fields. A third factor is that there are major transformations going on in many fields, and I must admit (as one with a doctorate in architecture) that the architecture profession is shockingly laggard in recognizing and embracing these changes: open-source, rule-based generativity, ecological and systems theory, and related trends. Architecture is still far too preoccupied with the look of things, as a static work of art and instance of "visual culture". Hence, any innovation is seen merely as yet another clever mechanism to generate visual extravagance and personal expression, instead of embracing the actual complexity and richness of city life. And any rule-based system, like the pattern language, is seen as an intolerable restriction on the "freedom of the artist" (responsibility to users be damned).

Thus, architecture (and to some extent urban planning and related professions) is lagging behind in actually applying the insights of complex adaptive systems, networks, generativity and the like, which are reflected in pattern language technology in other fields. This suggests a major opportunity for further development in the planning and environmental design fields.

It is notable that Alexander's contribution mirrors that of the highly influential urbanist Jane Jacobs (Mehaffy 2017), who also made famously trenchant critiques of conventional practice. In her last seminal chapter of her masterwork *The Death and Life of Great American Cities* (1961), Jacobs described the structure of "organized complexity" as a kind of web-network of relationships, in contrast to the simpler two-variable analysis, or statistical analysis, that were dominant methods among the planners of that time.

Similarly, Alexander described a web-network relationship among the variables of a city structure or design problem, which became the genesis of his pattern language methodology. He noted, in his 1965 paper "A city is not a tree", that cities contain interconnected relationships that manifest overlap and "multiplicity of aspect". This was, he said, a "thicker, tougher view of structure" (Alexander 2015). By contrast, a city that severed these essential overlapping relationships was "like a bowl full of razor blades on edge, ready to cut up whatever is entrusted to it. In such a receptacle life will be cut to pieces" (Alexander 2015, p. 32).

That insight led to his development of pattern languages as a design methodology. Specifically, the patterns were elements embedded within a contextual relationship, formed by hyperlink-like structures that connected them to other design elements, working together within a larger web-network. The structure was, he said very similar to the web-like structure of languages—and in fact we humans have used a similar linguistic structure when describing the traditional and contextually related patterns of architecture. Our "modern" methods, however, severed these relationships, much as the tree-like structure of city design severed the life within it.

This fundamental idea, that design elements are not (and must not be) structured into a perfect hierarchy or "tree", but are embedded within a contextual deep contextual network, is at the core of Alexander's work. It led directly to the development of his 1977 book, *A Pattern Language: Towns, Buildings, Construction* (Fig. 20.2), as well as *The Timeless Way of Building* (Alexander 1979), and other works.

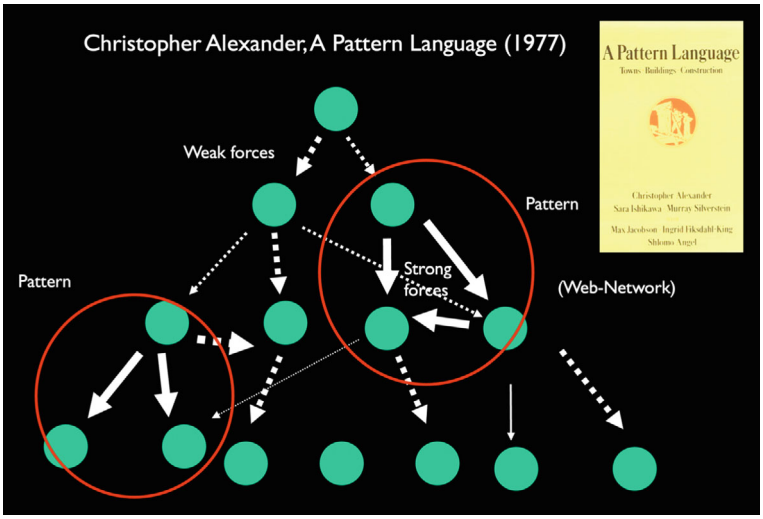


Fig. 20.2 A "pattern language" describes a web-network of relationships that can include overlaps, and regions of "strong forces" as well as other "weak forces", forming clusters or patterns (*Source* the author)

It is perhaps surprising that one of the areas where patterns and pattern languages took the strongest hold was in computer science, and the world of software design. "Design patterns" are now a ubiquitous feature of software design, systems architecture, user experience and other major sub-fields of computer science. It seems that the challenges of designing in web-like networks were particularly urgent for software designers, and Alexander's methodology turned out to be particularly effective there. This was, of course, a world of eminently practical and empirical applications, where feedback was rapid, and unworkable methodologies revealed themselves quickly.

Ward Cunningham, a Software Engineer at Tektronix, was one of the key innovators in developing pattern languages of programming or design patterns. He was also a key developer, with others, of Agile Methodology, now widely used in management as well as software design. Cunningham also invented wiki, originally as a tool for sharing design patterns for programming. He later served as an advisor to Wikipedia, and other notable wiki users, and he became a highly influential advocate for Alexander's methods, and for open-source computing in general (Cunningham and Mehaffy 2013).

Once again, the core structure and all these cases is a kind of "connectome"—a deep network pattern of connectivity that is endlessly extensible, and potentially endlessly complex. Like public space, it includes not only connections, but places where connections do not occur as a fundamentally important attribute. What is important is not random connectivity, but particular patterns of connectivity and disconnectivity, which form very large and very complex networks.

Here one finds considerable overlap with the topic of artificial intelligence, and, in particular, its structure of neural networks. The central process of artificial intelligence is the machine learning through the evolutionary growth of these networks, as they are continuously "trained" on correct or successful patterns. It is not through a simple set of linear relationships that this form of intelligence arises, but through vast cloud-like patterns of connectivity (and disconnection too) across the entire network. Indeed, the actual structure can become so complex that it is "hidden" from human users' ability to view and comprehend it. Nonetheless, of course, human users can exploit and benefit from these structures (as indeed they do in their own brains).

One could say that similar processes occur within the city, as the city and its buildings "learn" and adapt to complex human needs and activities. This is the idea behind my own research on so-called "place networks". This is a kind of "unified field theory" of urbanism, combining insights from Latour's (1996) actor network theory, Thom's (1977) catastrophe theory.

Soon after developing his pattern language methodology, Alexander became dissatisfied with the results. He observed many examples by others of projects that sought to apply the patterns, and he felt they lacked beauty, or what he termed "wholeness". This observation prompted him to embark upon a 25-year research and writing project, culminating in the 2003 publication of *The Nature of Order: On the Art of Building and the Nature of the Universe* (Alexander 2003).

The central concern of this work was the way that order is generated in the human environment, and, more broadly, in technology, culture and nature. Alexander observed that order arose through the spontaneous processes of symmetry-breaking and symmetry formation, as a phenomenon of self-organization (Fig. 20.3). He also observed a characteristic set of geometric properties that consistently recurred as a result of these processes—what he referred to as "fifteen fundamental properties" (Fig. 20.4). He noted that these processes, along with their characteristic geometric properties, could be observed in many natural and biological phenomena. He observed that the resulting structures were quite often profoundly beautiful, in a way that humans found enriching and desirable in their own environments.

Alexander applied these insights to a critique of the way that order is generated in the human environment, and, more broadly, in technology, culture and nature. Alexander observed that these processes, and their resulting geometric properties, were often missing in contemporary structures, with the implication that the structures lacked some important attributes that were needed by human users.

Other researchers have taken forward these topics, and found benefits of health and well-being in so-called "biophilic" characteristics, which have considerable overlap with Alexander's properties (Kellert et al. 2011). Mehaffy and Salingaros (2021) found evidence for a "symmetry deficit disorder" in human environments, with potential impacts on the well-being of urban residents, notably children.

One may ask whether Alexander failed to exploit the opportunities for further development within the pattern language format, and instead turned nearly exclusive attention to the later project. I once asked him if he ever considered engaging the

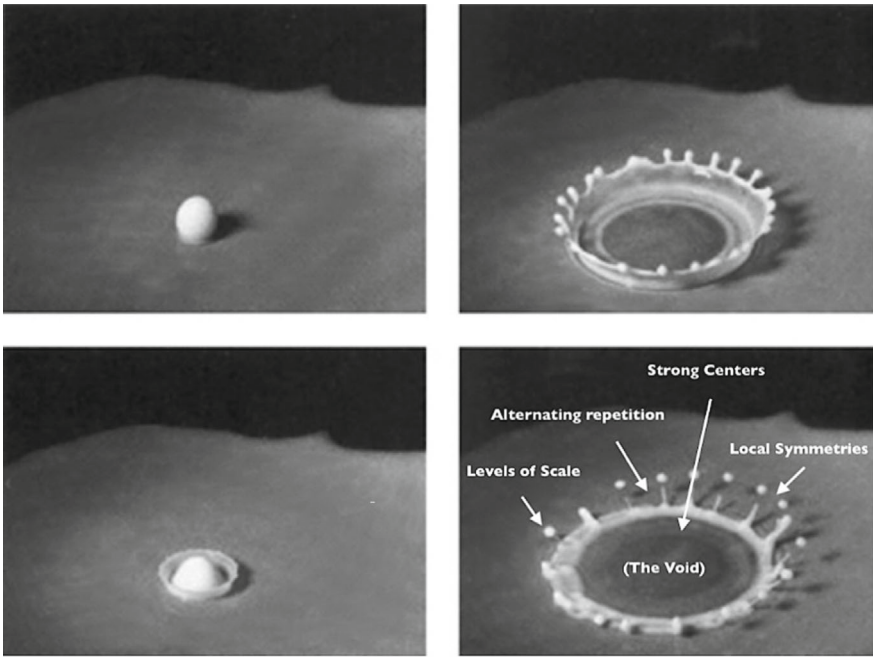


Fig. 20.3 Alexander observed that natural processes generate a consistent set of geometric properties, as a result of symmetry-breaking and reformation. He was able to distil these down to a set of just fifteen (*Source* the author, adapted from Edgerton Digital Collection, MIT)

Fig. 20.4 Alexander's "Fifteen Fundamental Properties" that arise as the result of characteristic order-forming properties in nature—including human nature, and human structure-making throughout most of history (*Source* the author)

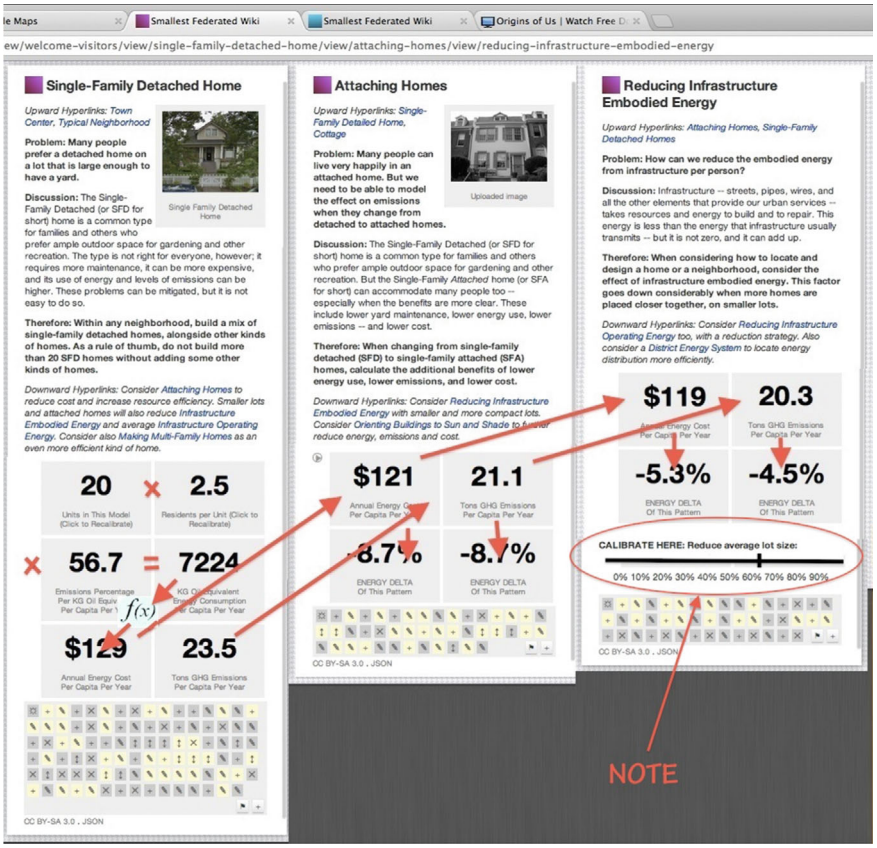


Fig. 20.5 Ward Cunningham's "federated wiki" is able to make numeric calculations, and exchange data between pages and patterns. This technology can serve as the basis of a scenario-modelling tool built on patterns, as this early example by Cunningham and Mehaffy demonstrates (*Source* the author)

pattern language methodology to incorporate some of these geometric insights. He replied, "yes, but I chickened out".[3]

A number of other researchers did indeed pursue related avenues. Ward Cunningham, the inventor of wiki, has developed a new class of wiki that is based on an open-source methodology known as "federated open source". His "federated wiki" is capable of making numeric calculations and serving as a scenario-modelling tool (Fig. 20.5), as demonstrated by Mehaffy (2015).

It is important to note that this system is built on patterns and pattern languages, aimed at developing particular scenario-modelling applications. (An early demonstration is shown in Fig. 20.5). One may ask, however, what of the larger opportunity to revisit pattern languages in the field of architecture and urban design?

[3] Personal communication with the author, 20 February 2008.

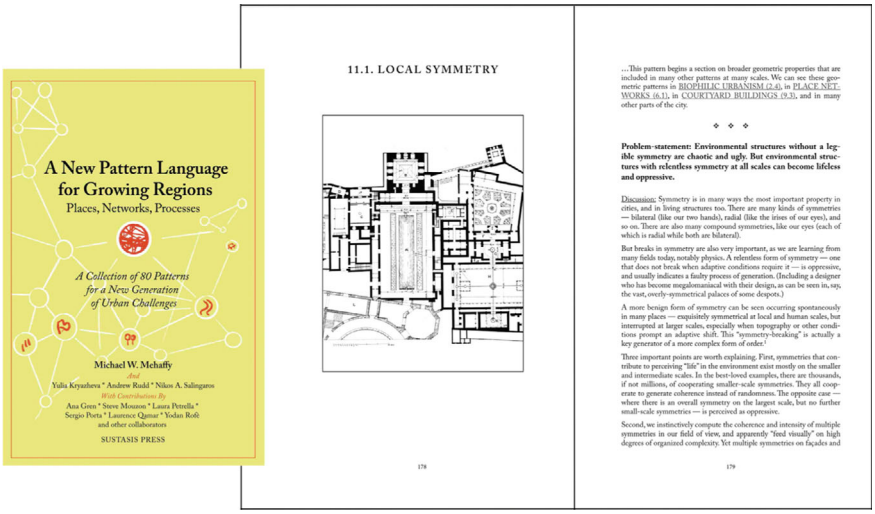


Fig. 20.6 This "new pattern language" adds to the original collection of 253 with 80 new patterns addressing geometric characteristics, rapid urbanization, new technologies, implementation methods, economic issues, governance issues and particular challenges of the Global South including slum upgrading, retrofits, self-help, affordance patterns and other innovative additions to the pattern language repository (*Source* the author)

I and some of my ESRG colleagues concluded that we should pursue this opportunity. One project that occurred as an outgrowth was the 2022 book *A New Pattern Language for Growing Regions: Places, Networks, Processes* (Mehaffy et al. 2020). The book includes many geometric patterns as well as process patterns, as an extension of the insights of Alexander, Jacobs and others. It also includes patterns relating to many new challenges that have occurred since the original 1977 book, including rapid urbanization, informal settlements and new forms of technology (Fig. 20.6).

The book was developed in partnership with UN-Habitat and other collaborators, and launched at the World Urban Forum of 2020. The book also has a companion wiki built in the federated wiki format by Ward Cunningham, available online at http://npl.wiki/assets/home/index.html.

All of these patterns are aimed at providing implementation pathways, and at implementing the New Urban Agenda in particular, and at the broader challenge of more humane habitat. Following my introduction, this was the overriding topic of the ESRG symposium, and the one that many people discussed. While there were too many speakers and comments to record them all, following is a sampling of some speakers.

Hans Joachim ("Hajo") Neis, a long-time collaborator of Alexander, spoke of the urgent need for practical implementation—for actually building—in great detail. He and Alexander collaborated on the Eishin School project, a major new education campus in Japan. Alexander noted that there is a kind of operating system, which he termed "System B", that governs what can be and is built today. This is in contrast to

what he called "System A", the much more direct, intuitive and "unself-conscious" system that governed most acts of building throughout most of human history. The book (with Neis and his wife Maggie Alexander) argues that the overriding challenge is to incorporate some of the most important life-giving characteristics of System A into a reformed System B—or, one could say, a new system, perhaps what we could call "System B prime". It would have a greater capacity to deliver more of the geometric characteristics and the "living structure" that Alexander argued was missing from contemporary human environments, with deepening and tragic consequences.

Other participants spoke of their challenges with implementation, and the efforts to change the current "operating system for growth", including the rules, laws, standards and models, that govern what is built, and that serves to generate it through contemporary processes.

A student from Krakow University of Technology spoke about their challenges in their school, where there is a new emphasis on relevance to human needs and problems, but, at the same time, there are still many practical challenges with implementation.

Yodan Rofè, another former colleague of Alexander and now Director of the Building Beauty education programme in Sorrento, Italy, also spoke of the need to address failed patterns or "antipatterns", and to re-write patterns in response to new information.

Robert Krasser, an architect based in Salzburg, Austria, discussed his efforts to translate some of the pattern language work into German, and to disseminate a "playing card" version of the patterns in *A New Pattern Language for Growing Regions* (Fig. 20.7).

Stephen Marshall spoke of his own work with students at University College London to write patterns, and his own focus on street patterns, as well as his work on the ideas of Patrick Geddes, who in many ways foreshadowed many of the ecological conceptions we discussed.

As moderator, I closed the session with two thoughts. One, the economic dimension is fundamental, but is not getting enough attention. We need to change the way we value resources, and the ways we can shift from a depletion economy to a repletion economy. We also need to recognize the need to supplement (not get rid of) economies of scale and standardization, with economies of place and differentiation. Biological systems use all four, but one of our major challenges is that we only use scale and standardization, and have not learned to integrate economies of place and differentiation as biological systems do so brilliantly. This is also a matter of restoring the necessary channels of feedback, as Jane Jacobs shrewdly observed.

And finally, perhaps the lessons of these web-network structures, these "connectomes" apply much more broadly to our other systemic challenges and failures. We are drowning in what might be called "shallow nets"—systems that cut off, that deplete, that oversimplify, and thereby deliver only short-term benefits to some. We need to learn to join up our systems into "deeper nets" that have the robustness and resilience of ecological systems (Fig. 20.8). This is true not just as a matter of theory, but the essence of practical implementation. These are the tools we need—the new

Fig. 20.7 The card version of the patterns in *A New Pattern Language for Growing Regions*, developed by Robert Krasser and colleagues for use in public involvement processes (*Source* Robert Krasser)

patterns, new ways of collaborating and new ways of building better (more robust, more life-enhancing, more beautiful) kinds of structures in our world.

Fig. 20.8 The author noted that the ecological structure of patterns shares features with the "deep nets" of other complex adaptive systems, including the genome, the connectome and other highly complex natural systems. Perhaps a core problem is the poverty of our "shallow-net" systems by comparison, with their crude and simplistic network (and aesthetic) structures, leading to a growing number of interrelated failures in our technological and cultural systems (*Source* the author)

References

Alexander C (1979) The timeless way of building. London, Oxford University Press
Alexander C, Ishikawa S, Silverstein M (1977) A pattern language: towns, buildings, construction. Oxford University Press, London
Alexander C (2015) A city is not a tree. In: Mehaffy M (ed) A city is not a tree: 50th anniversary edition, Portland. Sustasis Press
Alexander C (2003) The nature of order: on the art of building and the nature of the universe. Oxford University Press, London
Cunningham W, Mehaffy MW (2013) Wiki as pattern language. In: Proceedings of the 20th conference on pattern languages of programs (PLoP 13), Monticello, IL
Jacobs J (1961) The death and life of great American cities. Random House, New York
Kellert SR, Heerwagen J, Mador M (2011) Biophilic design: the theory, science and practice of bringing buildings to life. Wiley
Latour B (1996) On actor-network theory: a few clarifications. Soz Welt, 369–381
Mehaffy MW (2017) Cities alive: Jane Jacobs, Christopher Alexander, and the roots of the new urban renaissance. Sustasis Press
Mehaffy MW (2015) Urban form and greenhouse gas emissions: findings, strategies, and design decision support technologies. Delft NL: A+ BE | Architecture and the Built Environment
Mehaffy MW, Kryazheva Y, Rudd A, Salingaros NA, Gren,A, Mouzon S, Rofe Y (2020) A new pattern language for growing regions: places, networks, processes. Portland, Sustasis Press
Mehaffy MW, Salingaros NA (2021) Symmetry in architecture: toward an overdue reassessment. Symmetry: Cult Sci 32(3):311–343
Newman S, Bhat R (2009) Dynamical patterning modules: a "pattern language" for development and evolution of multicellular form. Int J Dev Biol 53(5–6):693–705. https://doi.org/10.1387/ijdb.072481sn
Thom R (1977) Structural stability, catastrophe theory, and applied mathematics. SIAM Rev 19(2):189–201

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 21
Urban Form and Sustainability. New Adaptive and Resilient Tools and Strategies for the Regeneration of Territories of Unauthorized Production

Francesco Crupi

Abstract The prefiguration of new strategies and tools for the regeneration of the territories of unauthorized production constitutes a field of research full of perspectives for the purpose of building new physical and intangible assets and configurations, capable of raising the levels of settlement and environmental quality, inclusion of social and economic growth. In the current phase characterized by the increase in environmental fragility, by fragmentation and territorial dispersion, by the risks due to global climate change, and by the economic and socio-health crisis caused by the pandemic, these objectives require the implementation of a unified strategy, integrated and inter-scalar, capable of promoting new planning tools based on adaptive and resilient strategies, aimed at recomposing the morphological-functional characteristics of fabrics and the construction of spaces and infrastructures of the public city. A perspective in which we play a fundamental role interventions capable of increasing the complexity of the urban structure, increasing the relationship between the parts, finalizing the design of the voids to the demands of sustainability, investigating the relationships between plan and project, between architecture, city, and territory, at the search for new urban morphologies and settlement models. In this frame of reference, the paper intends to outline the characteristics of the "Roman case", particularly characterized from a historical, morphogenetic, and dimensional point of view, highlighting not only the procedural, methodological and operational approaches, the limits, and criticalities, but also the evolutionary paths that could affect the overall process of urban regeneration and territorial rebalancing.

Keywords Urban regeneration · Resilience · Unauthorized production · Innovative urban planning tools

F. Crupi (✉)
Sapienza University, Via Flaminia 70, 00196 Roma, Italy
e-mail: francesco.crupi@uniroma1.it

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_21

21.1 Introduction

The prefiguration of new strategies and tools for the regeneration of the territories of unauthorized production constitutes a field of research full of perspectives for the purpose of building new physical and intangible assets and configurations, capable of raising the levels of settlement and environmental quality, inclusion of social and economic growth. In the current phase characterized by the increase in environmental fragility, by fragmentation and territorial dispersion, by the risks due to global climate change, and by the economic and socio-health crisis caused by the COVID-19 pandemic, these objectives require the implementation of a unitary, integrated and inter-scalar strategy, capable of promoting new planning tools based on adaptive and resilient strategies, aimed at recomposing the morphological-functional characteristics of the fabrics and, through the re-weaving of relations with the compact city, at the construction of spaces and infrastructure of the public city (Ricci 2017).

In this context, also characterized by the transformation of the production organization (Magone and Mazali 2016), already underway for some time, but which the international geopolitical crisis has accelerated, the importance of entrusting to an innovative system of participatory and cooperative practices emerges, of new institutional geometries, planning tools, and innovative operational references, the aim of raising the levels of settlement and environmental quality, social inclusion, and economic growth, mending the identity ties between settled communities and territories, between settlement dynamics and historical and stratified heritage (Ricci 2019).

The numerous challenges we face require concrete and immediate responses focused on the new disciplinary focuses of urban regeneration, *smart cities, twin transition*, strategies and actions for *adaptation* and *mitigation* to *climate change*, the improvement of natural cycles, and the *decarbonization* of the energy system (European Commission (EC) 2021). It is necessary to implement new cognitive paradigms, such as that of Ecosystem services (Es) (Costanza 1999; MEA: Millennium Ecosystem Assessment (Program) 2005; TEEB 2010; Giaimo et al. 2019), new design metaphors such as *green and blue infrastructures* (European Commission (EC) 2013) which can play a decisive role in the implementation of sustainable and resilient *climate-proof planning* through the integration of urban planning and environmental policies, triggering a new *urban metabolism* (Gasparrini 2015; Gasparrini and Terracciano 2017). Through new open and flexible knowledge and design tools, it is therefore possible to revitalise communities and territories characterized by symptoms of environmental, social, and economic decline, producing high levels of urban, environmental, energy efficiency, and circularity of resources, improving the health and psycho-physical well-being of the inhabitants.

21.1.1 Territorial Imbalances and the Self-production Process of the Spontaneous Metropolis

Starting from the second post-war period, the tendential processes of territorial organization fueled by the massive migratory flows from the south and from the north-eastern regions toward the richer and more industrialized areas of the country lead to the formation of extensive conurbations formed by continuous aggregates of small centers willing to crown around the cities or located along the lines of the main transport infrastructures. The abandonment of vast agricultural areas; the concentration of the industrial apparatus and the workforce in a few areas of the national territory (Hall 1966); and the centralization of organizations with a political, economic, and cultural function will be the cause of strong territorial imbalances between the various geographical areas of the country. Processes that have crossed the multiple forms of settlement, historical, consolidated, urban peripheries, and territories of diffusion, homologating their identity characters and invalidating the concepts of center and periphery (Ricci 2014).

In particular, the proliferation of spontaneous and unauthorized productive forms of settlement that arose alongside and parallel to the main residential phenomenon (Onetti Muda 1983) will characterize the outskirts of many urban centers, especially in central and southern Italy, causing a huge consumption of land, the deterioration of the historical-architectural, landscape and environmental heritage, and the expansion of the physical boundaries of cities, fueling their congestion and ungovernability (Crupi 2018a). The self-production process, the result of a complex and articulated congeries of causes and dysfunctions affecting all the actors of the urban scene, will often be associated with the crisis of the city but will give rise to moments of collective participation, learning, listening (Schön 1983), of sharing, of iteration. Fragmented and interrupted territories, not only in morphological-functional, infrastructural, environmental terms, but above all in their social and economic components, must today, face up to new needs, new forms of production and exchange, new actors, innovations of the plan and project, integrating procedural innovation and operational flexibility (Crupi 2020).

21.1.2 The Path, the Laws, the Tools

In Italy, despite the macroscopic dimensions reached by the phenomenon of building illegality and the fundamental role that it should play in the disciplinary debate, a systematic reflection on the contents and effectiveness of the regulatory provisions adopted and on the ways in which the reorganization can be affected, on the shape and the landscape-environmental quality of these settlements, it is a subject that has not been dealt with much. After the 70 s and 80 s, which saw the production of a substantial set of plans, studies, and research, the phenomenon has been little investigated, particularly in relation to the preponderance of settlement dynamics over

the effectiveness/efficiency of planning tools. The approval of law 457/1978 (Legge 5 agosto 1978, n. 457 2023) provides organic terms for the "recovery" of the existing building heritage and introduces two new urban planning tools: the "Perimeter of degraded areas" (art. 27), and the "Recovery plans" (art. 28), identifying criteria and methods for their implementation and financing. The regional law of Lazio 28/1980 (Legge 2 maggio 1980, n. 28 2023) defines, in the absence of a national framework law on the subject, rules for the recovery of illegal groups through the drafting of "Special variants" (art. 4). The 80 s are a period in which new interpretative models of the "spontaneous metropolis" are developed (Clementi et al. 1925), more frequently used terms such as "recover", "sew" (Secchi 1989), "requalify", precisely because the relationship with the existing city becomes more and more important. Law 47/1985 (Legge 28 febbraio 1985, n. 47 2023), in addition to dictating rules for the control of urban planning and construction activities, the recovery and amnesty of illegal works, governs the criminal aspects and administrative sanctions related to building abuse. In the 90 s, the "Complex-negotiation programs" (Pru, Preu, CdQ, Prusst and Urban) experimented with the themes of "revitalisation", "re-functionalization", "urban rehabilitation", through the coexistence of subjects, of public and private capacities.

In this period, the reference paradigms change: we move from "expansion" to "transformation" (Campos Venuti 1987), from "separation" to public–private "integration". The "contracted town planning" of the 1980s is replaced by "consensual town planning" characterized by the involvement of all stakeholders interested in the development processes and environmental, social and economic sustainability of the interventions. In the last decade, after a period of relative stagnation, there is also a renewed interest in the study and experimentation of practices for the regeneration of unauthorized territories that suggest innovative solutions for the implementation of projects and policies (Zanfi 2017) and the recovery of the landscape (Angrilli 2018). It is necessary to implement new cognitive and design paradigms capable of integrating the planned city with the environmental and landscape context, reconfiguring the morphological structures, design the public space as a place of collective re-appropriation and expression of local identity, giving the green material the function of infrastructure of ecological reconnection and fabric redevelopment.

21.2 Methodology

The contribution adopts a methodology aimed at the synthesis of the themes investigated around three disciplinary needs: a need for contextualization of the phenomenon and the main theoretical-disciplinary, a need for operational and interpretation of the results obtained, consisting of the analysis of the case study, and a need for critical and proactive reflection. In this framework of theoretical and methodological reference, the contribution, starting from the introductory paragraphs, intends to outline the characteristics of the abusive production in Capital, particularly marked

from the historical, morphogenetic, and dimensional, highlighting not only the procedural, methodological and operational approaches, limits and criticalities, but also evolutionary paths that could affect the overall process of urban regeneration and territorial rebalancing. In this context, the paper, after analyzing the phenomenon on the entire municipal territory, focuses on the design of the Print for activities of the city to be restructured VIIa2 "Tor Tre Teste".

21.3 The Hoped-For "Industrial Take-Off" and Unauthorized Production in the Capital

The reasons for the lack of industrial take-off of the Capital are well known, originating from the policies subsequent to national unification tending to characterize Rome as an exclusively bureaucratic and tertiary center (European Commission (EC) 2015b). Unlike the other European capitals, Rome had never existed nor was strategically foreseen a development linked to industry. According to Quintino Sella, the presence of the working masses would have brought with it the risk of unrest and popular uprisings not easily manageable in the place in charge of hosting the administration of the new state (Sella 1888).

21.3.1 From 1883 to 1965

The "Regulatory building plan for expansion" of the city drawn up in 1873 and approved in 1883 provides, in fact, a single area intended for industrial plants of about 28 ha adjacent to the new residential district of Testaccio in the southern quadrant of the city. In the following years, the project for the industrial area of Testaccio will be characterized by the construction of housing only and the construction of the new slaughterhouse (9 ha) near the walls and the river in contact with the railway and with the new Trastevere station. In 1907, a year before the expiry of the 1883 PR, the election of Mayor Ernesto Nathan opens a brief but intense season of renewal that places the capital in the European political and cultural context. Mayor of Rome from 1907 to 1913, Nathan helped to give a decisive and innovative impulse to the development of the city through a new urban planning instrument.

The new Regulatory Plan (Pr) approved in 1909 provides for new industrial areas for a total of 227 ha to be built in the southern quadrant of the city near the right and left banks of the Tiber, respectively, in the Pietra Papa area, and on the Via Ostiense as well as along the Almone River. However, even the project for the new industrial center in Ostiense will not have the desired development. The only areas to have productive implementation will be those located along the Via Ostiense around the large nuclei of the SAR (Anglo-Roman Company, owner of the gas workshops), and of the general warehouses, in addition to those located along the right bank of

the Tiber where they will locate companies dedicated to market production (Molini Biondi, Mira Lanza) for a total of 38 ha.

In the following years, despite the heavy defeats, the hoped-for "productive take-off" was faced several times by the Municipal Administration (AC). The new Regulatory Plan of 1931 drawn up under the fascist regime provides for industrial areas for a total of 310 ha located both in the south, between Testaccio and Magliana, and in the north, in the area of Tor di Quinto and via Salaria. Nevertheless, even the forecasts of the Pr of 1931 will only be implemented to a minimum part (47 ha) (Fig. 21.1). With the drafting of the "General variant 1941–42", the development of the city envisaged by the previous Pr in each direction has, for the first time, a prevalent development axis (Rossi 1984–2011). The shape of the new Rome designed for the "twentieth anniversary" is configured by a "comet" and divided into four zones. In the tail of the comet, extended between the E42 complex being built and the sea, industries, commerce, and large infrastructural equipment (airport and seaplane base) are expected. The variant involves the construction of two new industrial areas, the first, located to the south-west between the Tiber, the Rome-Lido Railway and the Acilia-Dragoncello area of about 1,200 ha, and the second, located to the east between via Tiburtina and the via Prenestina of about 1,630 ha. For the latter, the institutive Law 346/1941 (Legge 6 febbraio 1941 n. 346 2022) provides for the establishment of a specific body, with the aim of proceeding with the expropriation and urbanization of the areas to be sold «at a controlled price to the companies concerned» (Rossi 1984–2011). This is an innovative measure that promotes, for the first time, generalized expropriation by anticipating one of the issues at the center of the political and disciplinary debate in the following years. Presumably it was also for these innovative elements that the Variant did not reach approval.

However, with the law 187/1952, the "Ente industrial zone of Rome" was also suppressed and its powers devolved to the Municipality of Rome. Immediately after the war, thanks to the Institute for Industrial Reconstruction (IRI), public entrepreneurship introduces elements of technological and managerial innovation that have positive reverberations also on private entrepreneurship. A new productive fabric emerges, the creator of the so-called "Italian miracle" that aims to gain national and international market shares, especially in the manufacturing and trade sectors.

In the Capital, in the face of substantial stability in the number of employees, the increase in small businesses implicitly denounces the uncontrolled spread of production facilities. Despite the lack of forward-looking planning and large complexes, in this period the Roman industry can count on numerous and qualified companies operating in the sectors of technological innovation such as Fatme, Voxson, Autovox, Fiorentini and Contraves, television entertainment, cinema and music RAI, Cinecittà and RCA, and the pharmaceutical company Galter, LEO (Fig. 21.2).

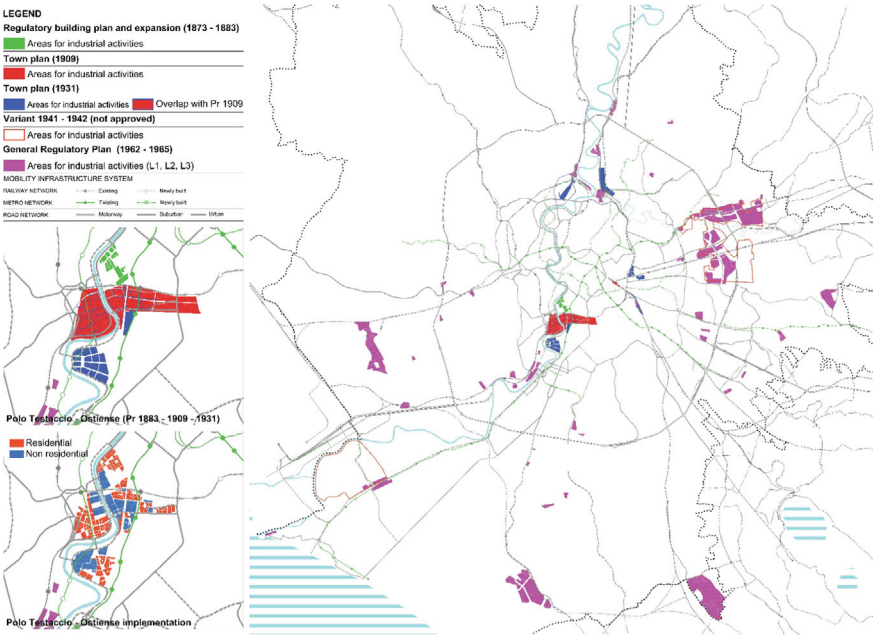


Fig. 21.1 1883–1965. Compendium of municipal urban planning tools for industrial and handcrafted destinations. On the left, the Polo Testaccio-Ostiense (graphic elaboration by the author)

Fig. 21.2 Left, former LEO penicillin factory in Via Tiburtina. Right, former Voxson electronics factory, in Via di Tor Cervara (photos by the author, 2022)

21.3.2 From 1965 to the 2000s

To respond to the new, pressing demand for spaces and equipment for industrial and craft activities, the 1962–65 General Regulatory Plan (Piano Regolatore Generale–Prg) provides for settlements for about 2,070 ha divided into three sub-areas, L1 for large- and medium-sized industries, L2 for small and small industry crafts, and L3 intended for industries of any type and service equipment, subordinating their transformation to the adoption of Particular Plans (PP) or Agreed Subdivision Plan

(PdLC). Compared to the previous decade, in the 1970s there were structural changes in the economic and social life of the country. It affirms a widespread industrialization process characterized by a strong cyclical adaptability and greater production efficiency guaranteed by many small- and medium-sized enterprises specialized in weaving with the territory a dense network of relationships to economic character-productive and socio-cultural (Bagnasco 1977; Becattini 1979).

At the beginning of the 70 s, the persistent absence of an economic planning of the productive development of the city which is accompanied by poor urban management, delayed with respect to the preparation of the implementation tools, exacerbates the problem of the uncontrolled and indiscriminate diffusion of unauthorized constructions destined for located productive activities now throughout the municipal area: along the bends of the Tiber, on the major traffic routes, on the edge of the Gra, near the large industrial areas envisaged by the Prg of 1962–65, or in the Pontine plain. Activities that squeeze the city from many sides, creating volumes of traffic and commuting phenomena that contradict the choices of the Prg (Leone 1981). Among the causes of the phenomenon there is certainly the increase in the population of the city passed in the period 1946–1975 from 1.2 million to 2.7 million inhabitants, together with the inability and inertia of various administrations to put a decisive halt to the devastation of the territory. The need and urgency to proceed with the implementation of the industrial zones provided for by the Prg is the subject of the Agenda presented to the City Council (CC) on November 26, 1971 with which the processing of the PP relating to the most important industrial areas such as Tor Sapienza (PP 8/L), Tor Cervara (9/L), and Tiburtino 18/L is formally started.

At the same time, the Circumscriptions try to trigger, with the drafting of the so-called "Variants Circumscriptions" (VC), an embryonic process of recovery of the industrial and handcrafted areas spontaneously sprung up in a widespread form throughout the territory for a total of 2,032 ha of which about 81% free from buildings. At the end of the 70 s, after a long procedural process, the lack of regional approval of the VC re-proposes the theme of the recovery of unauthorized building production. That this is a speculative phenomenon is testified by some research conducted at the end of the 70 s by the AC which detect rented real estate units equal to 63% of the total in the illegal areas, and about 34% in areas subject to implementation planning (Onetti Muda 1983). In 1978, with the Variant of the Prg for the urban recovery of the building nuclei that were not in conformity with the indications of the Plan, the urban recognition of some important illegal industrial and handcrafted settlements was carried out for a total of 1,277 ha (Fosso dell'Omo, Idrovore della Magliana, Santa Colomba, etc.) for which the Lazio Region subsequently prescribes the removal and recourse of a specific variant.

Almost immediately the idea of a traditional urban variant faded since, according to many orientations (Onetti Muda 1983), the change of urban destination would have increased the rents without supporting the entrepreneurial and productive fabric, the Municipality initiates, pursuant to of the art. 27 of Law 865/1971, the drafting of the Plans for Production Settlements (PIP) with the aim of acquiring areas to be allocated to new production activities and facilitating relocation operations of illegal buildings established in a chaotic and irrational way in the area.

Unfortunately, even these experiences did not have the desired effects. While reaching regional approval, the plans were only partially implemented. The experience was limited to the creation of the "Acilia" PIP for an area of approximately 106 ha. In the 90 s, some integrated-complex programs were also promoted (Law 493/1993; Ministerial Decree of 22 October 1997) affecting the productive fabric of the city (Prusst Asse Tiburtino, Pru Magliana and Corviale).

Different, however, are the settlement dynamics affecting the southern sector of the city which, since the 1950s, was included in the intervention areas of the "Cassa per il Mezzogiorno" (Law 646/1950) (Legge 10 agosto 1950 n. 646 2022). In implementation of Law 634/1957 (Legge 29 luglio 1957 n. 634 2022), with Presidential Decree 562/1966, the Consortium for the Industrial Development Area of Lazio (Rome & Latina) was established and, in the early 1970s, the first Territorial Regulatory Plan for the area was approved (DCRL 129/1972) pursuant to and for the purposes of which the settlements of "Santa Palomba" (345 ha) and of "Castel Romano" (194 ha) are built (Fig. 21.3). The Consortium, within the framework of the regional and sectoral planning forecasts, promotes activities aimed at the creation and development of industrial, craft, and wholesale production functions.

However, even in the face of these measures, the persistence in the Capital of a complex and composite articulation of the productive assets that escapes any model of rational organization, together with administrative inertia, calls for a profound

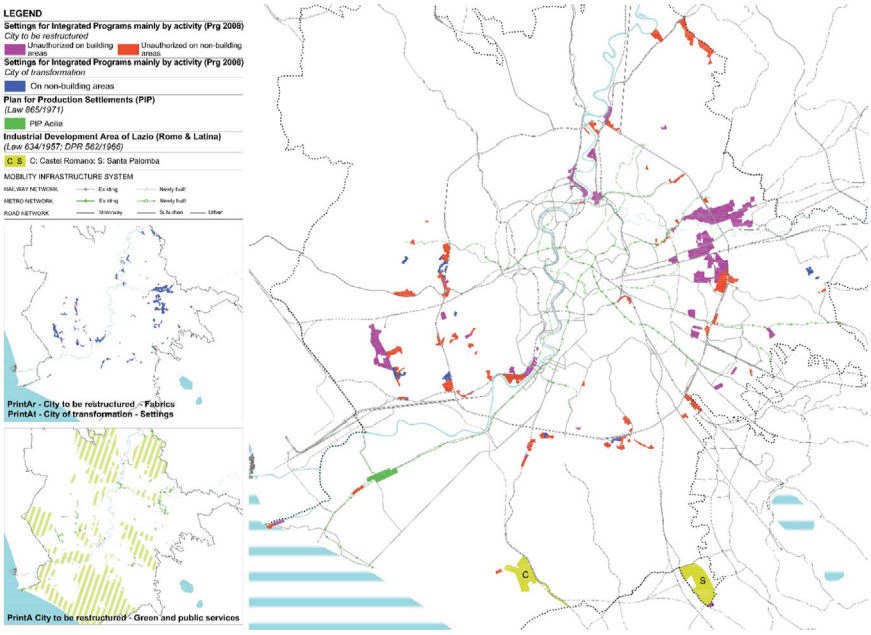


Fig. 21.3 Prg Roma '08, Settings for Print mainly for the activities of the City to be restructured, and the City of transformation. PIP Acilia and ASI Lazio (Rome & Latina) (graphic elaboration by the author)

reflection aimed at the prefiguration of new strategies and tools that accompany the new phase of modification of the economic-productive model.

21.4 The Programs Integrated into the New Regeneration Strategy of the Prg '08

The new General Regulatory Plan (Prg) of the City of Rome approved in 2008, after more than 40 years of existence of the old Plan of 1965, takes as priority the strategies of organization of the physical and functional structure of the city, and urban and metropolitan rebalancing (Marcelloni 2003), through the definition of new rules, new instruments, new procedures, and new implementing mechanisms (Ricci 2009) and a strong procedural connotation. The principles that inform the project contents of the Prg are based on overcoming the isolation of the municipal plan, the separation of structural and operational components, the updating of disciplinary contents (environmental sustainability, mobility, urban regeneration and equalization), characterizing the Prg as «emblematic place of anticipation, confluence and updating of the most significant elements of disciplinary innovation» (Ricci 2009).

In the Prg, the urban and metropolitan integration and rebalancing strategy capable of counteracting the phenomena of settlement spread and promoting processes of regeneration of the city and the territory prefigures a «double level of morphological-functional, socio-economic reorganization and management that makes clear the need for an inter-scalar and integrated approach: a reorganization on a large scale» (Ricci 2009) around a polycentric urban structure made up of 18 centralities at urban and metropolitan level, and «a reorganization on a small scale […], aimed at the widespread requalification of local systems» (Ricci 2009) structured on the identification of a total of 196 Integrated Programs (Legge 17 febbraio 1992, n. 179 2022) of which 85 mainly residential setting of the City to be restructured, 80 settings mainly for city activities to be restructured, 15 mainly residential settings of the consolidated city, and 16 settings of the City of transformation, of which 5 mainly residential and 11 mainly for activities, considered the new tools for the ordinary implementation of the regeneration policies of the existing city, capable of ensuring a high level of operation and conferring urban quality, environmental, social, and economic, through the involvement of public and private subjects and financial resources and the coordination of interventions. The Integrated Programs (Print), «intervening on all the causes of degradation and on the factors of economic growth» (Abis 2003), radically modify the nature, contents, and objectives of the old implementation tools, contributing to the implementation of the overall strategy di Piano which establishes the primacy of the disadvantaged city. A strategy that meets the management profile in the administrative organization of the city divided into 15 Municipalities to which the activation of participatory processes is entrusted.

21.4.1 Print Mainly for Activities of the City to Be Restructured

The Prg '08 identifies 80 settings for Print mainly for the activities of the City to be restructured (PrintAr) concerning both the nuclei built in part legally and in part illegally on areas for industrial and handcrafted use (pursuant to Prg 1962–65) for about 1,376 ha, and the nuclei built illegally on areas that cannot be built for industrial and craft purposes, for about 1,024 ha for a total of 2,400 ha (Fig. 21.3). Agglomerations in which activities related to residence, manufacturing, mining and construction industries, trade, agriculture, transport, services, public administration, information and telecommunications technologies (ICT) are located. Unfortunately, there is no shortage of contaminated sites (brownfields) that require environmental remediation and restoration.

21.4.2 Print Mainly for the Activity of the City of Transformation

The Prg '08 identifies 11 settings for Print of the City of transformation (PrintAt) which concern, for almost all free areas, with the exception of small built lots without fabric requirements, generally not buildable according to the Prg 1962–65, often located adjacent to the nuclei of the City to be restructured, on the edge of the GRA or in external areas intended for Agro Romano (Fig. 21.3). These are settings for a total of 121 ha, aimed at satisfying the needs of residential or productive settlements, at achieving building compensation objectives and activating private competition in the financing of public works and services (Comune di Roma Prg '08, NTA, Art. 60 2022g).

21.4.3 Procedural Process and Implementation Mechanisms

In the PrintAr and PrintAt, the choice of priority interventions, access to urban planning incentives, the landing of compensations, and the determination of the Extraordinary Urbanization Contribution (CSU) (Comune di Roma Prg '08, NTA, Art. 20 2022c; Roma Capitale, DAC 11 dicembre 2014, n. 128 2014) take place through listening, analysis, evaluation, and planning (Crupi 2017). Briefly, the procedural process that initiates the Prints, which can be of public or private initiative, is divided into three phases concerning the start of the procedure, the formation of the Preliminary Program including the publication of the Call for solicitation of participatory contributions and intervention proposals, and the approval of the Definitive program.

For the PrintAr, the implementation mechanisms aimed at both encouraging the participation of private individuals and obtaining free areas to be allocated to purposes

of public or general interest provide for a double regulatory regime based on the equal determination of building rights that takes into account the destination of pre-existing use of the land in order not to favor the rise of free rents. In summary, participation in the Print allows individuals to double the territorial building index (ET) from 0.3 to 0.6 m^2/m^2, of which 0.3 m^2/m^2 subject to the CSU and, in Roma Capitale, to find building allowances and land to be used for purposes of public or general interest (landing of compensations, construction of social housing, etc.).

For direct interventions falling into fabrics, the standard prescribes a building index (EF) equal to 0.3 m^2/m^2 (Comune di Roma Prg '08, NTA, Art. 53 2022f). The acquisition of green areas and public services is guaranteed, as an alternative to expropriation, by the "compensatory assignment" mechanism (Comune di Roma Prg '08, NTA, Art. 22 2022e). The rules, in fact, provide, in the case of participation in the Print, that the areas destined to green areas and public services are acquired by attributing to the area for which the sale of a territorial building index (ET) of is expected 0.06 m^2/m^2 and the transfer of buildability to the fabrics of the City to be restructured or to other "compensation setting" (Comune di Roma Prg '08, NTA, Art. 18 2022b), assuming the intended uses permitted therein. In the case of direct intervention, the buildability in favor of the property is equal to 0.04 m^2/m^2, to be concentrated on 10% of the area, against the sale to the Municipality of the remaining 90%. In this case, the building rights accrued must be used for the construction of private non-residential volumes (small sales structures, public businesses, and private services) also in order not to generate further needs for public areas. The urban planning incentives for the renewal of the building stock provide for an increase in the existing Gross Floor Area (GFA) calibrated according to the type of intervention (Comune di Roma Prg '08, NTA, Art. 21 2022d), while the payment to Rome Capital of the CSU, aimed at the construction of works and services public, is commensurate with the real estate valuations generated by the new settlement forecasts.

The Plan prescribes ecological-environmental standards (permeability index, tree and shrub density) for each intervention inside the fabrics, which contribute to improving the levels of environmental and settlement quality. To encourage the formation of functional mixes to support new development policies, economic growth, and social cohesion, the Prg provides for the PrintAr, that a share not exceeding 20% of the GFA can be destined for housing functions, while a share not less than 30% must be reserved for production functions.

For the PrintAt, which concern almost totally free areas, the implementation rules provide for the attribution of a territorial building index ET of 0.3 m^2/m^2 for each area, for a portion equal to 0.06 m^2/m^2, at the disposal of the owners, and for the remainder at the disposal of the Municipality, which will use it for public purposes and of general interest, with priority for building compensation. The private building quota may be doubled, provided that the CSU applies to the additional GFA (Comune di Roma Prg '08, NTA, Art. 20 2022c; Roma Capitale, DAC 11 dicembre 2014, n. 128 2014).

21.4.4 The Tools and Procedures for Participation

Roma Capitale recognizing citizen participation as a fundamental method of supporting decisions on urban transformation subordinates the approval of each print to the completion of a "participatory process", necessary to illustrate the urban planning program to citizens, collect the requests of the community, promote transparency, and produce social inclusion. This process is governed by a specific regulation (Comune di Roma. Deliberazione di CC 2 marzo 2006 n. 57 2022), which intends to involve, through structured and non-occasional tools and procedures, all political, economic and social actors, associations, committees, companies, organizations, and institutions, promoting local entrepreneurship and a transparent use of resources. To this end, it provides for the establishment, at the municipal level of the "Town House" and, at the municipal level, of the "Town Halls", special offices designed as places available to citizens to learn about the work of the AC and acquire information on the most important urban transformation projects. The set of data concerning the technical, localization aspects, and the progress of the procedural process of the various intervention programs are also made available on the website of the Municipality of Rome. Finally, the municipalities are entrusted with the preparation of the "Municipal Charter of Objectives" (Comune di Roma Prg '08, NTA, Art. 13 2022a), an act of political-programmatic orientation of fundamental importance for orienting choices on the territory and activating participatory processes.

21.5 The Print Mainly for Activities of the City to Be Restructured VIIa2 "Tor Tre Teste"

The contribution also focuses its attention on the elaboration of the Print masterplan by activity of the City to be restructured VIIa2 "Tor Tre Teste", located in Town Hall V, between via Casilina and via di Tor Tre Teste about 9 km from the center. The area constitutes a polarity of strategic interest for the organization of the city and the entire Alessandrino area, as well as representing an area of great ecological and environmental value. The area is inserted in a historical, archaeological, and environmental context characterized by the presence of valuable historical-monumental testimonies, such as ancient communication routes, towers and farmhouses, and naturalistic sites, such as the park of the "Mistica". However, this is a cultural heritage that is not sufficiently usable due to a fragmented urban structure that does not allow proximity relationships, between the various components of the fabric, and between the different settlements of Alessandrino, Torre Spaccata, and Tor Tre Teste. The PrintAr which has an area of 23.20 ha, despite having, in accordance with the Prg 1962–65, building destination for small industries and crafts (L2; PP 25/L), has a predominantly uneven and unfinished productive and commercial fabric both from legal fabrics, and from unauthorized and spontaneous fabrics. Specifically, the area is

Fig. 21.4 Prg Rome '08, PrintAr VIIa2 "Tor Tre Teste". Above, territorial framework. Below, photos of the settlement (graphic elaboration and photos by the author, 2023)

characterized by the presence of two shopping centers and some medium-sized handcrafted production activities, partly abandoned, and by a small residential settlement (Fig. 21.4).

In relation to the system of infrastructures for mobility, the area is served by two important public transport lines, the underground line "C", with the "Torre Spaccata" station and the "Roma-Giardinetti" railway, while the road mobility is affected by the failure to adapt and upgrade Via Casilina. With reference to the planning process, the "Casilina—Tor Tre Teste" area was the subject of two municipal council resolutions (nos. 284/2006 and 651/2006) with which the "Preliminary Urban Planning Program" was drawn up and issued the public competition announcement. However, despite a fair amount of private participation, the Print approval procedure was blocked when the Prg '08 (Roma et al. 2008) was approved, which changed both the Print perimeter and the implementation methods. The new Deliberation of the Capitoline Council DGC 8/2021 (Roma Capitale, DGC 15 gennaio 2021, n. 8 2022) has interrupted the procedure of formation and approval of the Print "Casilina—Tor Tre Teste", reshaping the "Preliminary Urban Planning Program", as amended and renamed—Integrated Program VIIa2 "Tor Tre Teste"—and approving the relative "Call for solicitation of participatory contributions and private intervention proposals".

In line with the characteristics of the new ecological-environmental regeneration strategy, and with the guidelines contained in DGC 8/2021, the masterplan has

the general objective of guaranteeing a drastic reduction in the release of climate-altering substances into the atmosphere, high levels of energy self-sufficiency and to mitigate the effects induced by *climate change* (Fig. 21.5). This through the reclamation of contaminated sites, the integration of the planned city with the landscape and the environment, the morphological redefinition of fabrics, the provision of new ecological-environmental devices, the use of eco-compatible technologies, materials nature based (European Commission (EC) 2015a), the recycling and reuse of resources, the use of systems for the production of energy from renewable sources, the creation of a functional transport network with low environmental impact, and the enhancement of cycling and pedestrian mobility. The interventions on fabrics must be able to increase the complexity of the urban structure, increase the relationship between the parts, the social and functional mixité, the typological variety, the quality and permeability of open spaces and urban morphologies, and ecosystem performance. In particular, the objectives and the design hypotheses contained in the masterplan foresee for the environmental system:

- The creation/completion of the municipal ecological network through the prefiguration of new green corridors for the reconnection of environmental components for the enhancement of historical and archaeological emergencies.

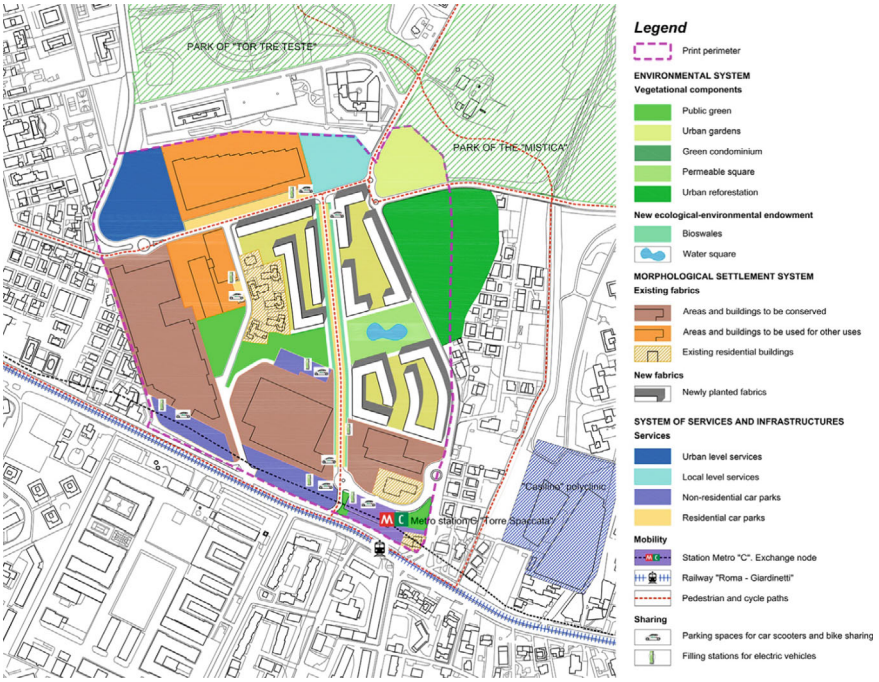


Fig. 21.5 Masterplan (graphic elaboration by the author)

- The creation of cycle and pedestrian paths to complete and integrate existing ones with the function of increasing the use of the naturalistic and historical-archaeological heritage and ensuring its accessibility and usability even for users with reduced mobility.
- The provision of areas to be allocated to urban gardens.
- The construction in correspondence of the new *neighborhood boulevard* of bioswales, spaces rich in vegetation, designed with the aim of reducing the speed of the surface runoff and establishing, together with the *water square*, a system for the collection, purification, and recycling of water rain.
- The construction of a *water square* (Boer 2013) conceived as a multifunctional public space which, in the event of heavy rains and extreme climatic events, is transformed into a rainwater collection and storage basin, with the aim, both to relieve the pressure on the sewage system, and to reuse the stored water in periods of drought and water stress.
- The provision of an area destined for "Urban forestation" (Roma Capitale 2021b; Mirabile et al. 2015; Bianco et al. 2014) designed to increase ecosystem functionality, contribute to the reduction of climate-altering emissions, improving the microclimate, mitigating pollution, and acting as a reservoir for carbon sequestration.

For the settlement-morphological system:

- The identification of lots to be used for the conservation/maintenance of existing functions (commercial and residential).
- The recovery and reuse of disused and/or degraded production areas, through the establishment of multifunctional and adaptive services, capable of activating policies for training, work, and social inclusion (*business incubators, coworking, fablab, business center*, etc.).
- The demolition of disused buildings and replacement with new residential fabrics for mainly residential use (*social housing, co-housing and supplementary services for housing*).

For the mobility system:

- The construction, at the site of the power line to be buried, of an ordering axis of the new urban plan (*neighborhood boulevard*) (Risorse per Roma Spa 2021).
- The adaptation and safety of the existing road network, the construction of new intersections, the provision of new parking lots, refueling columns for electric vehicles, specific parking lots for cars, scooters, and bike sharing with the extension of these services to entire scope.
- The creation of an integrated cycle/pedestrian network capable of increasing the levels of usability and accessibility to public and private services.
- The enhancement and enhancement of the "Torre Spaccata" metro line C stop, with particular attention to the creation of an intermodal interchange complete with related functions (parking and service equipment).

For the system of services and equipment:

- The increase in the supply of local public services supplementary and complementary to existing services outside the PrintAr perimeter.
- The increase in the supply of public services at the urban level.
- The identification of strategic functions in the vicinity of the rail/road intermodal junctions (metro stations C "Alessandrino" and "Torre Spaccata") (Risorse per Roma Spa 2021).

21.6 Results and Discussions

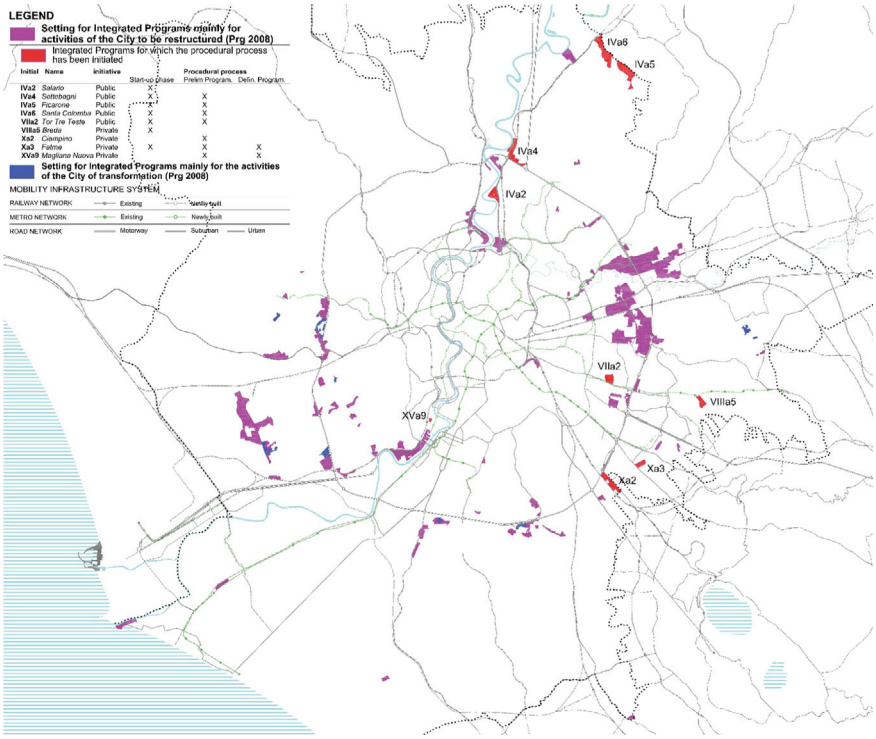
With reference to the analysis of the 80 settings for PrintAr, out of a total of 2,400 ha, 1,700 are destined for fabrics, 495 for greenery and public services (equal to over 20% of the total, essential for the completion of the municipal ecological network), and remaining 205 ha to infrastructure for mobility (roads, railways, etc.). Of the 1,700 ha destined for fabrics, about 500 are occupied by abandoned buildings or buildings in a bad/very bad state of conservation, 200 ha of vacant lots, and the remaining 1,000 are buildings in a normal/fair state of conservation (Graph 21.1). A research conducted by the writer (Crupi 2018b) and updated for the purposes of this publication has verified, in the hypothesis of a broad adhesion of private individuals to the PrintAr, and in the hypothesis of a doubling of the GFA available to owners in the PrintAt, the possibility of creating approximately 64,279 equivalent rooms of which 45.1%, equal to 28,977 rooms, deriving from building renovation and functional conversion, and 13,824 rooms equal to 21.5% to be used for residential functions. A maneuver that would allow Roma Capitale to find approximately 11,237 rooms to be used for purposes of public or general interest, ordinary urbanization charges (COU) equal to 491.91 million euros, and extraordinary urbanization charges (CSU) equal to 195.70 million euros for a total of 687.61 million euros (Table 21.1).

With reference to the design verification of PrintAr, VIIa2 "Tor Tre Teste", the masterplan includes conservation areas equal to 59,647 m^2, areas intended for functional conversion and reuse of existing buildings equal to 28,658 m^2, demolition for a surface area equal to 50,851 m^2 and areas to be allocated to the New urban plan (NIU) equal to 40,610 m^2 (Table 21.2). The project is completed by 72,329 m^2 destined to urban planning standards and new ecological-environmental endowments (*bioswales, water square, urban forestry, urban gardens*, etc.) (Table 21.3 and Fig. 21.5). For the calculation of the admissible GFA, the formula taken from the Announcement was applied (Roma Capitale 2021):

$$\text{GFA/admis} = \Sigma(\text{Free areas} \times \text{ET}) + \Sigma(\text{Partially built up areas} \times \text{ET}) + \Sigma\,\text{GFA/existing}$$

From which: GFA/admis = (23,436 × 0.6) + (0) + (30,510) = 44,572 m^2

Areas expressing building rights = 74.287 × 0.6 = 44.572 m^2.



Graph 21.1 Prg Rome '08. On the left, PrintAr morphological-functional division and state of conservation of fabrics and free areas (hectares). On the right, PrintAr and PrintAt, breakdown of ordinary and extraordinary expenses by category of intervention (million €.) (graphic elaboration by the author)

The masterplan hypothesis provides that the entire admissible GFA, net of any urban planning incentives, equal to 44,572 m^2, is mainly intended for residential functions. In particular, considering the serious level of housing hardship reached in the capital, the project provides that 60% of the GFA, equal to 26,743 m^2, is intended for *social housing* and *co-housing* interventions including supplementary services for housing, commercial establishments, and special residences, designed to foster a culture of sustainable and collaborative living, while the remaining part, equal to a GFA of 17,829 m^2 to free building. With reference to the new urban layout, the building blocks follow the boundaries of the lots creating, on the new *neighborhood boulevard*, two built wings that interrupt near the square and the water square, allowing the creation of an important ecological-environmental corridor. The morphologies of the settlement system allow the formation, within the lots, of large condominium spaces characterized by distribution avenues, resting places, and areas used as vegetable gardens and gardens that interact with the outside. The *neighborhood boulevard*, characterized by tree-lined rows, wide sidewalks, *bioswales,* and a cycle/pedestrian path, as well as constituting a new road network between via

Table 21.1 Prg Rome '08, Integrated programs mainly for the activities of the City to be restructured and the City of transformation. Estimate of the equivalent rooms achievable, amount of the CSU and ordinary charges (COU), by category of intervention

	Total rooms equ	Res. rooms equ	Public rooms. equ	CSU	COU	CSU + COU
	n.	n.	n.	mln €.	mln €.	mln €.
Print mainly for activities of the city to be restructured						
New construction works (NE)	25,623	5,125		84,68	217,38	302,06
Building renovation interventions (RE, DR, AMP)	20,192	4,038		26,88	104,19	131,07
Functional conversion interventions (CDU)	8,785	1,757		72,01	53,60	125,61
Total 1	54,600 (*)	10,920	5,430	183,57	375,17	558,74
Print mainly for the activity of the city of transformation						
New construction works (NE)	9,679	2,904	5,807	12,13	116,74	128,87
Total 2	64,279	13,824	11,237	195,70	491,91	687,61

(*) Quota not including 6,347 stanzas deriving from the "compensatory assignment" mechanism

Table 21.2 Prg Rome '08. PrintAr VIIa2 "Tor Tre Teste". Functional destinations, urban planning standards, new ecological-environmental endowments, and admissible GFA

Storage	Reuse	Demolitions	New urban plan (NIU)	Standards and new ecological-environmental endowments	GFA/ admis
m^2	m^2	m^2	m^2	m^2	m^2
59,647	28,658	50,851	40,610	72,329	44,572

Table 21.3 Prg Rome '08, PrintAr VIIa2 "Tor Tre Teste". Urban planning standards and new ecological-environmental endowments

Urban level public services	Local public services	Public parking	Public green, *bioswales,* and *water square*	Urban gardens	Urban forestation	Total
m^2	m^2	m^2	m^2	m^2	m^2	m^2
11,122	6,233	7,132	17,261	7,145	23,436	72,329

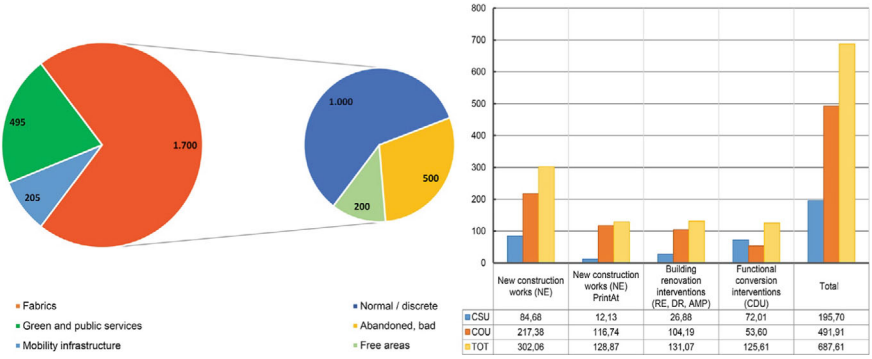


Fig. 21.6 Prg Rome '08. PrintAr. Top left, list of the PrintAr who have started the procedure. In the center, PrintAr and PrintAt, state of implementation (graphic elaboration by the author)

Casilina and via Della Bella Villa, performs the indispensable social function of meeting place between passers-by and inhabitants of the neighborhood.

Fourteen years after the approval of the Prg, only nine PrintAr are being investigated, of these only two, XVa5 "Magliana Nuova" and Xa3 "Fatme", both privately owned, have reached the approval of the Definitive Program. Of the remaining seven, five have received the approval of the Preliminary Program and the Call for solicitation of participatory contributions and intervention proposals, and two have started, in the Municipal Council, the procedure of approval of the Preliminary Program (Fig. 21.6). The situation is even more bleak for the PrintAt where no area has yet started the formation procedure of the Preliminary Program.

In relation to the implementation of participatory processes, the "House of the City" is today essentially an empty place with no activity, the "Town Hall Houses" and the "Municipal Charter of objectives" have not been activated; the meetings organized on the occasion of the presentation of the programs have almost always proved to be an opportunity to impose decisions already taken, while the contents of the Roma Capitale website do not appear to be sufficient to guarantee adequate levels of information, participation, and interaction. More generally, the failure to implement the PrintAr and PrintAt is due both to political, bureaucratic, and technical-administrative difficulties linked to the complexity of the procedural requirements, and to the very long times that discourage the participation of many private operators who prefer to pursue the path of direct intervention, or take advantage of deregulatory forms (LR 21/2009; LR 7/2017). In addition, the need to integrate public and private resources, concertation and coordination actions, and the multidisciplinary nature of the hypothesized objectives require the use of professionals who are practically absent in local administrations today. Despite the proliferation in recent years of legislative measures in support of urban policies (Legge 7 agosto 2012 n. 134 2022; European Commission (EC) 2022; Governo Italiano (GI) 2021) in our country there is a lack of structured public resources for the redevelopment/regeneration of cities.

21.7 Conclusions

In retracing the procedural, methodological, and operational approaches introduced by the Prg '08 in planning, the territories of unauthorized production, alongside obvious elements of innovation, contained in the regeneration strategy of the existing city, the lack of clear political governance, funding sufficient public, and a hypertrophic bureaucratic apparatus, are hindering its implementation. Criticalities that urge the clarification of concrete proposals, debate, and comparison. They concern

- The implementation of a clear strategy for the Roman production areas also within the framework of the European sector policies.
- The ability of public administrations to rediscover that urban and design continuity constitutive of political alternations without which it is impossible to guarantee the implementation of programs and projects already started or the start of those planned.
- The prediction of appropriate functional mixes capable not only of helping to reverse the strategy of urban regeneration, but also to generate new urban morphologies and settlement models consistent with the new shape of the contemporary city.
- The provision of implementing rules of an equitable nature to be used also in a complementary and integrated form, including, in addition to free and compensatory supplies, the extraordinary contribution and the loss of the concession charges, also the use of market-based mechanisms.
- The integration of physical regeneration interventions with employment, training, and cultural policies, aimed at socio-economic development and social inclusion.
- The modulation of withdrawals on the building stock and on urban transformations (according to a balanced mix of incentives and disincentives), to be used as a tool capable of influencing settlement choices, facilitating anti-cyclical urban planning policies (Curti 2004), overcoming fragilities territorial and favor a balanced and coherent urban development.
- The introduction of new methods of financing the public city, capable of intercepting the vast range of resources, both nationally and community, deployed on the issues of resilience, the eco-digital transition, such as those proposed by the *Green New Deal* (European Commission (EC) 2019) or deriving from post-pandemic relaunch programs such as National Recovery and Resilience Plan (Governo Italiano (GI) 2021).
- An overall rethinking of participation practices with the launch of "participatory processes" already in the initial stage of preparing the preliminary program.

These reflections recall, more generally, the need to place the development of the Capital's productive contexts at the center of the political and theoretical-disciplinary debate, recognizing its value and enormous potential as an engine of development, cohesion, and social innovation. The opportunity to experience a new generation of sustainable and inclusive urban planning tools based on the new disciplinary focus

of *smart cities*, *green and blue infrastructures*, adaptation and mitigation strategies to climate change, promoting morphological and spatial quality and environmental sustainability, stimulating the involvement of established communities, institutions, and the entrepreneurial fabric. Tools to facilitate "adaptive" and "temporary" reuse strategies, recovery, reuse, and functional conversion of free, disused, underused, or polluted areas (*brownfields*), promoting the diversification of functional mixes, the development of activities related to residency, creative and cultural industries, circular economy, tourism, hi-tech, and ICT productions, capable of producing greater economic benefits than the costs associated, and to transformation operations, and to possible reclamation works. Objectives that must include an update of the forms and uses of urban space through new ecological-environmental and functional devices (Crupi 2021), and interventions capable of increasing the complexity of the urban structure, increasing the relationships between the parties, finalize the design of the voids to the demands of sustainability by investigating the relationships between plan and project, between architecture, city, and territory in search of new urban morphologies and settlement models. Finally, we need a decisive change of pace that includes the radical simplification of bureaucratic and urban-building procedures and the strengthening of public structures capable of avoiding the inefficiencies and mistakes of the past, and to promote visions of the future consistent with the challenges we face.

References

Abis E (ed) (2003) Piani e politiche per la città, metodi e pratiche, FrancoAngeli, Milano

Angrilli M (2018) Piano progetto paesaggio. Urbanistica e recupero del bene comune, FrancoAngeli, Milano

Bagnasco A (1977) Tre Italie. La problematica territoriale dello sviluppo italiano, Il Mulino, Bologna

Becattini G (1979) Dal 'settore' industriale al 'distretto' industriale. Alcune considerazioni sull'unità di indagine dell'economia industriale. Rivista di Economia e Politica Industriale 1:7–2

Bianco P, Ciccarese L, Jacomini C, Pellegrino P (2014) Impacts of short rotation forestry plantations on environments and landscape in Mediterranean basin. Rapporti 196. ISPRA—Istituto Superiore per la Protezione e la Ricerca Ambientale, Roma. https://www.isprambiente.gov.it/it/pubblicazioni/rapporti/resolveuid/61b787ca27f94c1e8c2ee21d41e82d80. Accessed 24 Jun 2022

Campos Venuti G (1987) La terza generazione dell'urbanistica, FrancoAngeli, Milano

Clementi A, Perego F (eds) (1983) La metropoli "spontanea". Il caso di Roma 1925–1981: sviluppo residenziale di una città dentro e fuori dal piano, Edizioni Dedalo, Bari

Comune di Roma Prg '08, NTA, Art. 13 (2022a) Norme generali per gli interventi indiretti. http://www.urbanistica.comune.roma.it/prg-2008-vigente/elaborati-prescrittivi/1-nta.html. Accessed 12 Jun 2022

Comune di Roma Prg '08, NTA, Art. 18 (2022b) Ambiti di compensazione. http://www.urbanistica.comune.roma.it/prg-2008-vigente/elaborati-prescrittivi/1-nta.html. Accessed 12 Jun 2022

Comune di Roma Prg '08, NTA, Art. 20 (2022c) Contributo straordinario di urbanizzazione. http://www.urbanistica.comune.roma.it/prg-2008-vigente/elaborati-prescrittivi/1-nta.html. Accessed 12 Jun 2022

Comune di Roma Prg '08, NTA, Art. 21 (2022d) Incentivi per il rinnovo edilizio. http://www.urbanistica.comune.roma.it/prg-2008-vigente/elaborati-prescrittivi/1-nta.html. Accessed 12 Jun 2022

Comune di Roma Prg '08, NTA, Art. 22 (2022e) Cessione compensativa. http://www.urbanistica.comune.roma.it/prg-2008-vigente/elaborati-prescrittivi/1-nta.html. Accessed 12 Jun 2022
Comune di Roma Prg '08, NTA, Art. 53 (2022f) Ambiti per i Programmi integrati (Città da Ristrutturare). http://www.urbanistica.comune.roma.it/prg-2008-vigente/elaborati-prescrittivi/1-nta.html. Accessed 12 Jun 2022
Comune di Roma Prg '08, NTA, Art. 60 (2022g) Ambiti per i Programmi integrati (Città della Trasformazione). http://www.urbanistica.comune.roma.it/prg-2008-vigente/elaborati-prescrittivi/1-nta.html. Accessed 12 Jun 2022
Comune di Roma, Deliberazione del Consiglio Comunale 12 febbraio 2008, n. 18 (2022) Approvazione del Nuovo Piano Regolatore Generale del Comune di Roma. http://www.urbanistica.comune.roma.it/images/uo_urban/prg_vigente/del_cc_18_120208.pdf. Accessed 12 Jun 2022
Comune di Roma. Deliberazione di CC 2 marzo 2006 n. 57 (2022) Regolamento per l'attivazione del processo di partecipazione dei cittadini alle scelte di trasformazione urbana. https://www.comune.roma.it/PCR/resources/cms/documents/regolamento_partecipazione2006.pdf. Accessed 12 Jun 2022
Costanza R (1999) The value of the world's ecosystem services and natural capital. Nature 387:253–260. https://doi.org/10.1016/S0921-8009(98)00020-2. Accessed 19 Jun 2022
Crupi F (2017) Roma senza tema. Abusivismo, rigenerazione, periferie, progetto, Youcanprint, Tricase (LE), pp 421–433
Crupi F (2018a) Roma: l'autopromozione del territorio nella costruzione della città pubblica. In: Moccia FD, Sepe M (eds) XI giornata studio INU. Interruzioni, intersezioni, condivisioni, sovrapposizioni. Nuove prospettive per il territorio. Urbanistica Informazioni s.i., vol 278. Inu Edizioni, Roma, pp 74–79
Crupi F (2018b) Fiscalità urbana e governo del territorio. Tra integrazione delle riforme e complementarietà degli strumenti. In: Talia M (ed) Il bisogno di giustizia nella città che cambia. Planum Publisher, Roma-Milano, pp 122–128
Crupi F (2020) Roma: rigenerare i territori dell'abusivismo. Tra innovazione procedurale e flessibilità operativa. In: Urbanistica Informazioni s.i., no 289. Inu Edizioni, Roma, pp 1–5
Crupi F (2021) Costruire la città pubblica. Nuovi standard per un nuovo welfare. In: Ricci L, Crupi F, Iacomoni A, Mariano C (eds) Città pubblica e nuovo welfare. Una rete di reti per la rigenerazione urbana. In Urbanistica Dossier On line, no 22. Inu Edizioni, Roma, pp 44–49
Curti F (2004) Valutazione dei progetti urbani e fiscalità urbanistica. Paper presentato a Bologna ne I sabati dell'urbanistica, seminari organizzati dalla Provincia di Bologna
European Commission (EC) (2013) Building a green infrastructure for Europe. https://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructure_broc.pdf. Accessed 22 Jun 2022
European Commission (EC) (2015a) Towards an EU research and innovation policy agenda for nature-based solutions & re-naturing cities: final report of the Horizon 2020 expert group on 'Nature-Based Solutions and Re-Naturing Cities' (full version), Publications Office. https://data.europa.eu/doi/10.2777/479582. Accessed 12 Jun 2022
European Commission (EC) (2015b) Programma operativo nazionale plurifondo Città metropolitane 2014–2020 "PON METRO". http://www.ponmetro.it/wp-content/uploads/2016/10/Decisione-2.pdf. Accessed 09 Jun 2022
European Commission (EC) (2019) Green Deal Europeo. Communication from the commission to the European parliament, the European council, the council, the European economic and social committee and the committee of the regions. COM (2019) 650 final. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019DC0640&from=IT. Accessed 20 Jun 2022
European Commission (EC) (2021) Fit for 55' delivering the EU's 2030 Climate Target on the way to climate neutrality. Communication from the commission to the European parliament, the European council, the council, the European economic and social committee and the committee of the regions Bruxelles. COM (2021) 550 final. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0550&from=IT. Accessed 20 Jun 2022
Gasparrini C (2015) In the city on the cities. List, Trento

Gasparrini C, Terracciano A (2017) Dross city. Metabolismo urbano e progetto di riciclo dei drosscape. List, Trento
Giaimo C, Santolini R, Salata S (2019) Performance urbane e servizi ecosistemici. Verso nuovi standard. In: Giaimo C (eds) Dopo 50 anni di standard urbanistici in Italia. Verso percorsi di Riforma. Inu Edizioni, Roma, pp 63–69
Governo Italiano (GI) (2021) Piano Nazionale di Ripresa e Resilienza (PNRR). Approvato dal Consiglio dei Ministri del 12 gennaio 2021. http://www.governo.it/sites/new.governo.it/files/PNRR_2021_0.pdf. Accessed 20 Jun 2022
Hall P (1966) Le città mondiali, Il Saggiatore, Milano
Legge 10 agosto 1950 n. 646 (2022) Istituzione della Cassa per opere straordinarie di pubblico interesse nell'Italia meridionale (Cassa per il Mezzogiorno). http://www.edizionieuropee.it/law/html/35/zn63_02_001.html. Accessed 05 Jun 2022
Legge 17 febbraio 1992, n. 179 (2022) Norme per l'edilizia residenziale pubblica. https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:legge:1992-02-17;179. Accessed 07 Jun 2022
Legge 2 maggio 1980, n. 28 (2023) Norme concernenti l'abusivismo edilizio ed il recupero dei nuclei edilizi sorti spontaneamente. https://www.consiglio.regione.lazio.it/consiglio-regionale/?vw=leggiregionalidettaglio&id=9070&sv=vigente. Accessed 17 Apr 2023
Legge 28 febbraio 1985, n. 47 (2023) Norme in materia di controllo dell'attività urbanistico-edilizia, sanzioni, recupero e sanatoria delle opere edilizie. https://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=1985-03-02&atto.codiceRedazionale=085U0047&elenco30giorni=false. Accessed 17 Apr 2023
Legge 29 luglio 1957 n. 634 (2022) Provvedimenti per il Mezzogiorno. http://www.edizionieuropee.it/law/html/35/zn63_01_008.html. Accessed 04 Jun 2022
Legge 5 agosto 1978, n. 457 (2023) Norme per l'edilizia residenziale. https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:legge:1978-08-05;457. Accessed 17 Apr 2023
Legge 6 febbraio 1941 n. 346 (2022) Norme per la creazione e per l'esercizio della nuova zona industriale di Roma. https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:legge:1941-02-06;346~art10-com1. Accessed 04 Jun 2022
Legge 7 agosto 2012 n. 134 (2022) Conversione in legge, con modificazioni, del decreto-legge 2 giugno 2012, n. 83, recante misure urgenti per la crescita del Paese. https://www.gazzettaufficiale.it/eli/gu/2012/08/11/187/so/171/sg/pdf. Accessed 25 Jun 2022
Leone AM (ed) (1981) Il Recupero degli insediamenti abusivi. USPR Documenti n. 1, Tipografia Operaia Romana, Roma
Magone A, Mazali T (2016) Industria 4.0. Uomini e macchine nella fabbrica digitale, goWare e Edizioni Angelo Guerini e Associati, Milano
Marcelloni M (2003) Pensare la città contemporanea. Il nuovo piano regolatore di Roma. Editori Laterza Bari-Roma
MEA: Millennium Ecosystem Assessment (Program) (2005) Ecosystem and human well-being: a framework for assessment. Island Press, Washington, DC. http://pdf.wri.org/ecosystems_human_wellbeing.pdf. Accessed 20 Jun 2022
Mirabile M, Bianco PM, Silli V, Brini S, Chiesura A, Vitullo M, Ciccarese L, De Lauretis R, Gaudioso D (2015) Linee Guida per la Forestazione Urbana Sostenibile di Roma Capitale. Rapporti ISPRA 129. https://www.isprambiente.gov.it/it/pubblicazioni/manuali-e-linee-guida/resolveuid/46b9fceb06314e9baf197ee1736900e9. Accessed 26 Jun 2022
Onetti Muda G (ed) (1983) Indagine sull'abusivismo produttivo. Situazione delle aree industriali romane, Litostampa Nomentana, Roma
Boer F, Jorritsma J, Van Peijpe D (eds) (2013) De urbanisten and the wondrous water square. Nai Uitgevers Pub Pubblisher
Ricci L (2009) Piano locale e… Nuove regole, nuovi strumenti, nuovi meccanismi attuativi. FrancoAngeli, Milano
Ricci L (2014) Governare il cambiamento: più urbanistica, più piani. In Franceschini A (eds) Sulla città futura. Verso un progetto ecologico. List, Trento

Ricci L (2017) Governare la Città contemporanea. Riforme e strumenti per la rigenerazione urbana, in Urbanistica 160:91–96

Ricci L (2019) Governare la città contemporanea. Una nuova questione urbana. In: Ravagnan C (ed) Rigenerare le città e i territori contemporanei. Prospettive e nuovi riferimenti operativi per la sperimentazione, Aracne, Roma

Risorse per Roma Spa (2021) Programma integrato VIIa2 "Tor Tre Teste". Carta dei Valori. https://www.comune.roma.it/servizi2/deliberazioniAttiWeb/showPdfDoc?fun=deliberazioniAttiAllegato&par1=R0NE&par2=MzY0Mw==&par3=Mg==. Accessed 12 Jun 2022

Roma Capitale (2021) Print VIIa2 "Tor tre Teste", Bando di sollecitazione dei contributi partecipativi e delle proposte di intervento. https://www.comune.roma.it/servizi2/deliberazioniAttiWeb/showPdfDoc?fun=deliberazioniAttiAllegato&par1=R0NE&par2=MzY0Mw==&par3=MQ==. Accessed 12 Jun 2022

Roma Capitale, DAC 11 dicembre 2014, n. 128 (2022) Approvazione del Regolamento concernente la 'Determinazione del contributo straordinario di urbanizzazione. https://www.comune.roma.it/web-resources/cms/documents/AC_Delib_128_12.2014.pdf. Accessed 12 Jun 2022

Roma Capitale, DGC 12 marzo 2021 n. 17 (2022) Approvazione del Regolamento Capitolino del verde pubblico e privato e del paesaggio urbano di Roma Capitale. https://sso.comune.roma.it/web-resources/cms/documents/REG.VERDE._CU20190006955-RC.2018.37726.pdf. Accessed 05 Jun 2022

Roma Capitale, DGC 15 gennaio 2021, n. 8 (2022) Interruzione della procedura di formazione e approvazione del Programma Integrato "Casilina—Tor Tre Teste". Rimodulazione del Programma di Assetto Urbanistico Preliminare, di cui alle deliberazioni di Giunta Comunale nn. 284 e 651 del 2006. https://www.comune.roma.it/servizi2/deliberazioniAttiWeb/showPdfDoc?fun=deliberazioniAtti&par1=R0NE&par2=MzY0Mw==. Accessed 12 Jun 2022

Rossi PO (1984–2011) Roma guida all'architettura Moderna 1909–2011, Editori Laterza, Roma-Bari

Schön DA (1983) The reflective practitioner: how professionals think in action. Basic Books, New York

Secchi B (1989) Un progetto per l'urbanistica. Piccola Biblioteca Einaudi, Torino

Sella Q (1888) Discorsi Parlamentari, Roma, vol II, 278–279

TEEB (2010) The economics of ecosystems and biodiversity ecological and economic foundations. Kumar P (Eds). London and Washington, Earthscan. http://www.teebweb.org/wp-content/uploads/Study%20and%20Reports/Reports/Ecological%20and%20Economic%20Foundations/TEEB%20Ecological%20and%20Economic%20Foundations%20report/TEEB%20Foundations.pdf. Accessed 2 Jun 2022

Zanfi F, Formato E, Curci F (eds) (2017) I territori dell'abusivismo. Un progetto per uscire dall'Italia dei condoni, Donzelli Editore, Roma

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 22
Historic Neighborhoods' Preservation: Applicability of Morphological Regions as a Tool to Protect the Urban Memory and Urban Space of a Black Community Neighborhood in Uberlândia, Brazil

Glauco Cocozza

Abstract The article relates morphological aspects with the preservation of urban space, architectural heritage, and social and cultural memory of a historic neighborhood in Uberlândia, Minas Gerais, Brazil, applying a morphological analysis in the neighborhood originally known as Nossa Senhora da Aparecida, current Patrimônio, a black community built at the end of the nineteenth century, after the end of slavery. The article presents the urban formation of this small area isolated of the urban fabric, its urban evolution, the constructive aspects, and how the current urbanization processes of the city de-characterizes the neighborhood and erases an important urban memory. The research uses the methodology of morphological regions identification to distinguish the different areas of the neighborhood, differentiated through their building elements and typological patterns. The work ends by presenting simulations of possible scenarios to occur, if urban laws adopt morphological parameters, proposing new urban restrictions that would guarantee the preservation of the historical characteristics.

Keywords Morphological regions · Urban morphology · Urban history · Urban preservation

22.1 Introduction

This article aims to rescue the morphological aspects and identify morphological regions of the Patrimônio neighborhood in the city of Uberlândia, a worker and black origin community, and spatially segregated. This urban segregation is a historical fact,

G. Cocozza (✉)
Research Group of Urban Morphology and Contemporary Landscape, PPGAU, FAUeD, Federal University of Uberlândia, Uberlândia, Brazil
e-mail: glauco.cocozza@ufu.br

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_22

common in the cities of the region, mainly for the black community and historically with lower purchasing power, and it brings with it the faces of an excluding society, in which it printed in the urban spaces of the small cities, a separation between the workers wealthier class and blacks, newly freed from years of slavery.

The article presents a study of neighborhood transformation, the urban characteristics of its origin, then separated from the urban fabric, until its incorporation with the growth of the city. The article investigates the morphological elements and how the growth of the city is changing the spatial and social characteristics, identifies the morphological regions existing in the area, and finalizes by simulating how the development of the region should be if the current urban laws are maintained.

22.1.1 Background

Social and urban segregation is at Brazilian cities genesis, result of historical, economic, and social processes that transformed a rural society to a predominantly urban. Historically, this segregation was responsible for the emergence of several spaces that contain the traces of this exclusion, physically and structurally disconnected from other parts of the city, but which also present strong cultural traits, resistance, adaptation to local conditions, printing the traces of a history that needs to be rescued. Rescuing these urban spaces is essential to understand their role in the city's conformation, and as a safeguard of an urban memory that tends to disappear, without leaving the past that many want to forget and hide.

> Segregation occurs, therefore, as a result of economic and social conditions, an expression of social organization and the unequal production of urban space, which is accentuated by the process of (re)structuring the intra-urban space, in which the expulsion of the poor is verified. And the redistribution of the rich, through a tearing real estate dynamic, marked by induced segregation and urban self-segregation (Moreira Junior 2010, p. 135)

Understanding the genesis allows us to revisit urban processes that are registered in different urban spaces. The study of urban morphogenesis makes it possible to trace the historical paths in which they were responsible for inserting urbanization patterns at certain period (Costa and Netto 2016), and thus reconstituting the original characteristics of each space. This urban "archaeology" is premised on understanding the morphological aspects that defined spaces that are being disfigured by the lack of understanding of urban, historical, and cultural values in Brazilian cities.

> In morphogenesis, the guiding thread of morphological description and analysis is precisely the elapsed time. A morphogenetic analysis involves the combination of examination of spatial manifestations and documentation that together allow the establishment of a morphological chronology. (Krafta 2014, p. 64)

Two points deserve to be highlighted: the first is about which spaces deserve to be valued and planned according to urban and architectural characteristics, and the second is how to incorporate these values in the formulation of laws capable of protecting and at the same time developing areas with values that often do not

have the same visibility in relation to other spaces. This premise touches on issues of heritage, in the sense of preservation, but with a focus on issues of identity and belonging, mainly of recognition, through issues that bring with them stories that must be visited and thought of as spaces of urban and social memory.

> The urban form is a continuous process [...] and, although it is possible to describe or characterize a city in a precise period, in order to understand it well we cannot neglect the study of previous periods that conditioned its development and that literally gave it shape (Panerai 2014)

Moving from theory to practice is one of the great demands of urban morphologists, and with their analyses, they seek to introduce the importance of the physical form of the city as parameters for urban legislation and planning. Deconstructing paradigms is not an easy task, and studies of the form of the city, although not recent, provide an in-depth and current view of certain attributes of our cities. What is sought in this work is the incorporation of this knowledge provided by urban morphology as a tool for new readings of urban space and its application in urban planning.

The effectiveness of some urban control instruments is questioned by different authors (Sposito 1998; Maricato 2013) who observe, with a certain pragmatism, that the urban policies, legislation, and actions contains gaps that can be filled with morphological readings. The land subdivision and the zoning laws presented a great advance in relation to the way of ordering the growth of our cities, but little progress in terms of contemporary city design, mainly due to the lack of understanding of the details and diversity of urban spaces.

Among the various possibilities of tools to fill this gap, the concept of morphological regions stands out as a possibility of understanding the urban space and improving the parameters of urban zoning. According to Oliveira and Monteiro (2014), Morphological Region "*is an area that has a unit, with regard to its shape, that distinguishes it from the surrounding areas. However, the boundaries between regions vary in terms of robustness*". According to Oliveira and Monteiro (2014), the methodology that identifies the Morphological Regions "*is a composite element of different maps identifying different areas in terms of types of plan, types of built fabric and types of land uses*".

22.1.2 Methodology

The method used was a combination of tools, morphogenesis, and morphological regions. Starting from the identification of the original morphological characteristics of the neighborhood, we could find its urban genesis, and from the reading of its morphological elements, the identification of spatial patterns to establish urban development scenarios based on its elements. The methodology was divided into two stages, the first with the cartographic survey, analysis of plans and maps, and the identification of the morphological elements. The second step consists of identifying

the morphological regions, generating a table with the main physical characteristics of the urban area of the Patrimônio neighborhood. At the end of this stage, we performed a simulation of scenarios based on the current urban coefficients and on coefficients that respect the characteristics of each morphological region.

22.2 Uberlândia Urban Morphology

22.2.1 The Genesis of the Patrimônio Neighborhood

The Patrimônio neighborhood is one of the oldest, dating from the end of the nineteenth century, when the city was concentrated on the hill above the São Pedro stream (Fig. 22.1). The region was inhabited at the end of the nineteenth century by black community who migrated to the place as a result of the abolition of slavery, which took place in 1889. As a result, the number and size of slave quarters decreased, at the same time that the black communities increased, spreading through the marginalized areas of the city—among them the Patrimônio.

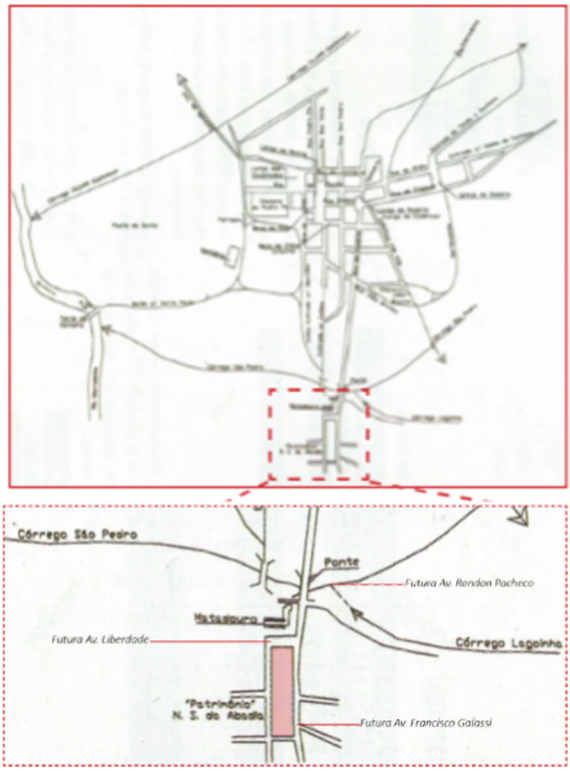


Fig. 22.1 The "Patrimônio", or before called "Nossa Senhora da Abadia", was at first a small piece of land. This long block corresponds to the first orange block on the map above. Public Archive of Uberlândia, 2020

Fig. 22.2 "A house probably built in the first years of the century, made of rammed earth, in whose construction half-timbered, adobes, clay tiles were used. It is a remnant of the old Rua da Chapada, today Avenida Rio Branco, one of the places that, like the Heritage, was where the bulk of the black population in Uberlândia was located". Public Archive of Uberlândia, 2020

These urban settlements were called "Patrimônio" (Patrimony), in which a farmer, or a group of them, offered land to a church or saint, in which they would organize an initial nucleus of the new agglomeration (Fig. 22.2). These donation patrimonies, to saints or churches, were common until the end of the nineteenth century. They found there a cheap place to build their houses, situated near to the huts and farms, and there they sold their labor power. The population of Patrimônio, in the first decades of the twentieth century, gradually increased with low-income residents, who were away from the central areas of the city due to marginalization or due to real estate appreciation. The neighborhood is the result of this initial marginalization on the margin of the São Pedro River, on the other side of the river that gave rise to the urban core of Uberlândia.

The city has developed a lot since then. It went from a simple village to the main city in the interior of Minas Gerais and the region, with about 700 thousand inhabitants. This development quickly reached the region of the Patrimônio, and the expansion project for the area incorporated the few streets and blocks that previously defined one of the edges of the city. The expansion dates from 1947, when the project for the expansion was presented to the city hall of Uberlândia and implemented shortly afterward (Fig. 22.3). In 1965, date of the known oldest aerial photo, the city began its process of urban expansion, still structured by the central region in the highest and flattest part of the city, and limited to the north and south by the São Pedro and Tabocas Rivers. Crossing the streams would mean going against the former excluded areas, and inevitably the Patrimônio neighborhood would be the object of incorporation by urban growth. This development took place through the Copacabana neighborhood, which incorporated the small area of Patrimônio (Figs. 22.4 and 22.5) in its layout.

Currently, even with the growth of Uberlândia City and the implementation of several subdivisions in its surroundings, the neighborhood still maintains, even if partially, an atmosphere that refers to the past, due to its residents, but also due to the existence of some elements that refer to its urban origin, resisting the transformation process. When walking through the neighborhood, it is common to see people sitting

Fig. 22.3 Aero photo of the Patrimônio neighborhood and surroundings in 1965. Public Archive of Uberlândia, 2020

Fig. 22.4 Neighborhood road system in 1965. Streets from other neighborhoods. Image adapted by the author from Public Archive of Uberlândia, 2020

on the sidewalk, small groups gathered on the corners talking, movements in bars and cafeterias.

Figure 22.6 refers to the project to expand the Copacabana neighborhood (purple), next to the Patrimônio (orange), and its surroundings (gray). The morphological analysis indicates how the original, more irregular layout was incorporated by an orthogonal model, characteristic of Brazilian cities. Through the project and the city

Fig. 22.5 Overlay of a recent photo on a 1965 photo. Google, accessed in 2017 (recent photo), 2020

plan, the differences between the old plots can be noticed and how their limits were sewn into the new. In Fig. 22.6, the red line shows the limit of the two phases: on the one hand, irregularity, with plots of varying sizes, and a road system with narrow and irregular streets, and on the other side, blocks and a regular road system, with plots patterned in a checkered mesh that gives order to the previously irregular design.

22.2.2 Morphological Regions of the Patrimônio Neighborhood

The historical development revealed how the neighborhood was shaped to the city's growth and how the spatial characteristics are printed in the details of its urban fabric, in the shape of the blocks and plots, and especially in the existing building typologies. Even the neighborhood being incorporated into the new plot, historical remnants help us to reconstitute its history and to define which urban elements can be susceptible to maintenance as a neighborhood memory.

In recognition of this diversity, areas with similar morphological patterns were identified. The following morphological attributes were used as parameters: plot size, land use and occupation, size of the roads, plot shape, percentage of intra-plot occupation, public and private space, number of setbacks, and architectural typologies. Figure 22.7 refers to the identified regions and their main characteristics. Altogether, nine regions were identified, with their own characteristics and that must be understood as a result of the neighborhood transformation and consolidation process (Fig. 22.8).

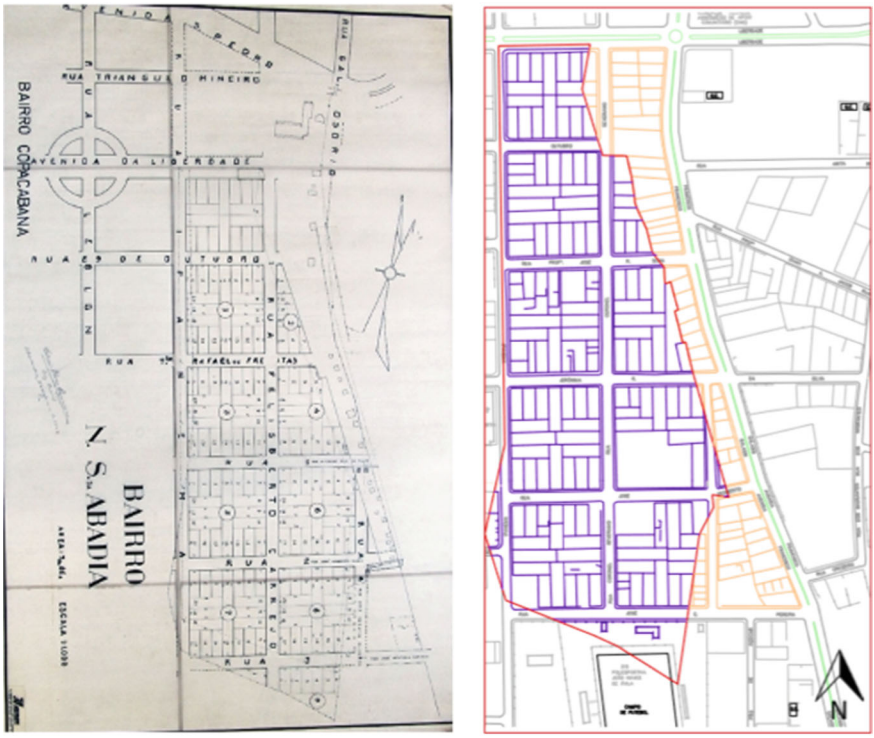


Fig. 22.6 Subdivision of the plots of the first block of the old Bairro Nossa Senhora da Abadia, current Patrimônio, project presented to the city hall in 1947. Nicanor Desenhos Técnicos, 2020

PLANTA	PERSPECTIVA	TIPO	DESCRIÇÃO
		1	Casas térreas, características muito antigas, uso residencial, espaço privado
		2	Casas térreas, características antigas, uso residencial, espaço privado
		3	Casas térreas, com afastamento, uso residencial
		4	Sobrados contemporâneos com lotes grandes, de maior poder aquisitivo
		5	Prédios de uso apenas residencial
		6	Uso comercial ou misto, em sua maioria sobrados, com afastamento
		8	Poliesportivo do Patrimônio, uso recreacional, educacional e lazer: espaço público com restrições
		9	Centro de Tecelagem, espaço público com restrições

Fig. 22.7 Morphological regions and their description. Author, 2020

Fig. 22.8 Different typologies of building in the neighborhood. Personal archive, 2020

Morphological region (1): Single-storey houses

This remaining typology is found in some blocks dispersed in the middle of the Patrimônio neighborhood, appearing before the 1965s. It is characterized by residential use, with only one floor, and the presence of distances is directly related to the size of the plot or, that is, have no setback. The architectural style refers to the gabled roof, without much detail, with simple finishing and materiality. The building has a small area compared to other buildings in the city.

Morphological region (2): Single-storey houses

A large part of the residences found belong to this category, differing from the typology of single-storey houses (1) due to their construction period, between 1965 and 1979, in addition to their constructive characteristics and materiality. It appears that in most cases, these buildings are surrounded by walls on all four sides of the land, related to the presence of garages. They may or may not have clearance, depending on the size of the plot in which they are inserted. The gable roof is present in most cases.

Morphological region (3): Recent single-storey houses

It is the most recent single-storey residential typology and one of the most similar to the buildings found in the rest of the city. It usually has a staggered roof, leaving behind the gable roof. Because of the garages, the presence of walls continues, but with contemporary materiality and a greater number of openings for contact with the street, in addition to aesthetic details on the facade. The presence of setbacks is verified in most cases and, consequently, the presence of gardens and backyards.

Morphological region (4): Two-storey houses

The typology of townhouses that have only residential use was found in a region within the Patrimônio neighborhood, with buildings that have contrasting characteristics with the rest of the area. It can be seen that they are typologies of greater purchasing power, with two floors and generally starting from an architectural project. Note the predominance of contemporary materials, new shapes and striking volumes, details of frames and facades, in addition to light colors. With all this, its implementation is usually distinguished by large plots and the presence of setbacks on all sides.

Morphological region (5): Buildings

Tall buildings are standardized by their residential use and found on only a small portion of land. They have five to ten floors, with large plots and clearances on the four sides of the land, standing out in the landscape for their size. They usually occupy up to 60% of the plot and remain with the large walls around the implantation. Colors often vary in shades of pale yellow and with contemporary materiality.

Morphological region (6): Mixed-use two-storey houses

Mixed use is predominant along the analyzed area, being organized from north to south in some connectivity axes. Most of them are two-storey houses with a commercial ground floor and occupy more than 60% of the plot, some with distances. They usually do not have outstanding characteristics, bringing the perception of greater concern with functionality. The colors vary according to the trade used in the building, and contact with the street is given only in the commercial part, isolating the residential use on the second floor.

Morphological region (7): Agglomeration of vacant plots

Some portions of vacant plots are empty in the middle of the heritage district, probably the result of strong real estate speculation. This makes it possible to have a region classification for this “typology”. Most of these are irregularly shaped.

Morphological region (8): Patrimônio multi-sports arena

A place for sports that serves the entire city of Uberlândia. Its use takes place through education and leisure, being a public space accessible during business hours and has a good green area.

Morphological region (9): Weaving center

Fios do Cerrado (weaving center) is a non-profit organization created to support and promote the ancient art of spinning and weaving manually.

22.2.3 Occupancy Simulation According to Urban Law

The neighborhood is undergoing a rapid transformation. Its location, near to downtown, to city's arterial avenues, and to areas with the highest real estate growth, press for a rapid superimposition of the old structures by new buildings and commercial establishments. Conniving with this transformation, the government does little to try to brake certain actions that will completely de-characterize the neighborhood in the near future. Urban legislation, through urban restrictions, treats the entire area as homogeneous, not observing the historical and constructive characteristics, the social issues that are consolidated in the structure of the neighborhood.

Within this context, some central questions guided the scenarios on how to plan through its morphological characteristics:

1. How are the first urban features present in the current design?
2. What is the current physical situation of the neighborhood?
3. What is the maximum occupancy scenario that can reach, considering the current urban restrictions?
4. What would be the ideal occupation scenario, taking into account the morphological characteristics of the neighborhood, which has a strong historical character?

To answer these questions, simulations were made based on the historical cartographic survey, on the current legislation, and based on a proposal for legislation developed during the investigation, based on the morphological regions found in the reading of the urban space.

The first simulation corresponds to the phase that goes from its emergence until the year 1965, the period in which the first aerial photographic records are available to produce this simulation (Fig. 22.9). The volumetric study was based on two satellite photographs from 1965 to 1979. The houses in the neighborhood that had been built in 1979 were analyzed, as well as which disappeared or were modified. It is noticed that the occupation is very sparse and is concentrated around Avenida Francisco Galassi. The plots were irregular and quite large, with single-storey and very simple houses. The urban fabric was formed in an organic way, without many rules in the division or angulation. Some of these still remain today.

The second simulation corresponds to the volumetric model of the present day (Fig. 22.10). Note that there are still many vacant plots in the neighborhood, as well as different sizes. It is observed that there was a greater growth around Avenida Francisco Galassi, the main road axis. Most of the buildings on the avenue are commercial or mixed use. The tallest building in the neighborhood is on this avenue and has 11 floors. A housing complex with six blocks was built on the edge of Avenida Liberdade, with four floors each, which is one of the densest points in the neighborhood. The landscape is composed of low-rise buildings, with multiple colors, but it is threatened by the rapid urban transformation of the city.

For the following simulations, the urban parameters of the urban land zoning law of the Uberlândia Municipality were used, which include the occupancy rate, utilization

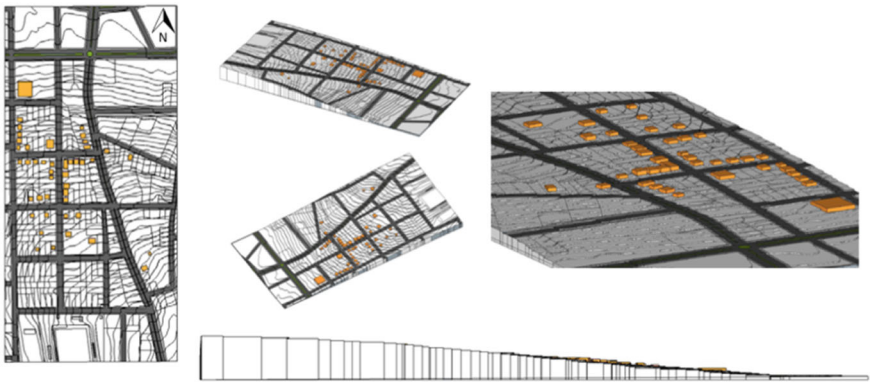


Fig. 22.9 Simulation of the neighborhood in the 60 s within the current urban fabric. Author, 2020

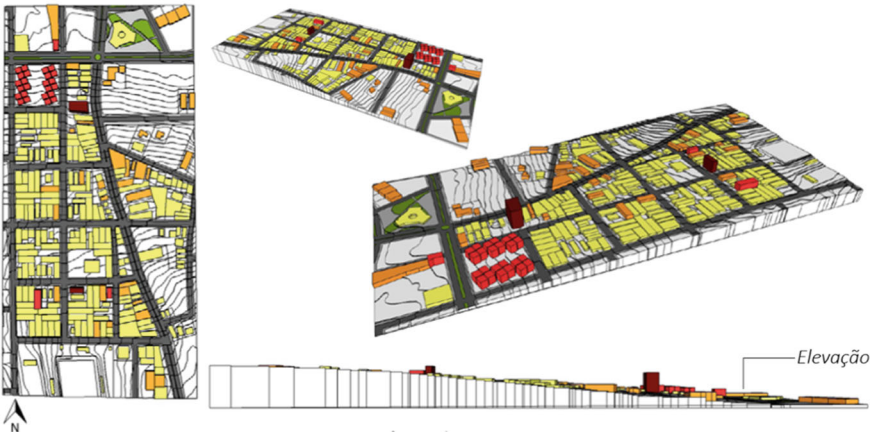


Fig. 22.10 Simulation of the current situation in the neighborhood. Author, 2020

coefficient, removals, minimum test and minimum area of the plot. The study area contains two zones, the RZ2 and the ARZ. Table 22.1 presents the parameters that were selected for the simulation of the maximum constructive potential following the current legislation.

When elaborating this simulation, it was considered that the older buildings would have no value for the real estate market, and would be replaced by buildings respecting the maximum construction potential. It is noticed that verticalization will predominate in this simulation, demonstrating how the legislation allows building in order to de-characterize its urban space. The population, in the first decades of this century, was gradually increased by low-income residents, who were removed from the central areas of the city due to marginalization or due to real estate appreciation. If the

Table 22.1 Urban restrictions of the studied area

	Urban restrictions					
Zone	Maximum occupancy rate (%)	Maximum utilization coefficient	Minimum frontal distance (m)	Side standoff and minimum bottom (m)	Minimum façade (m)	Minimum area of the plot (m)
Residential zone 2 (RZ2)	60 ou H2v > 4 pav 40 (1)	2,75	3 (3)	1,5 (3)	10	250
Arterial road zone (ARZ) (Av. Francisco Galassi)	70 (2)	4	3,0 (3)	1,5 (3)	10	250

(1) 60% allowed on the first floor, for multifamily residential use, for common use areas
(2) Allowed 70% on the first two floors above the street level, for commercial and/or services and common areas of any use. Allowed 80% underground without occupying the projection of the front clearance
(3) In accordance with Chapter V of Complementary Law 525, which provides for the zoning of land use and occupation in the municipality of Uberlândia

constructive potential is exerted to the maximum, all the historical and cultural character, which dates back to the occupation of the last century, will disappear amid so many tall and new buildings (Figs. 22.11 and 22.12). The legislation, therefore, is not concerned with maintaining the historicity of this region. Table 22.2 shows the urban parameters that were followed for the elaboration of the model. Buildings with 4, 6, 10, and 15 floors were built, following the setbacks defined by urban legislation.

The last simulation performed is the Ideal Potential Built (Fig. 22.13). It was based on the morphological regions identified in the research. The result of the analyses carried out in the Patrimônio area (plot, land use and occupation, dimension of the roads). The simulation was developed taking into account that development in the neighborhood cannot be frozen; this means that some houses in disrepair state and very small or large plots were rethought (demolished houses or re/dismembered).

There is a less dense neighborhood than in Potential Maximum. The neighborhood receives only a few tall buildings, respecting the historical characteristics of the place. In general, the single-storey houses in a regular state were maintained and some commercial and mixed-use buildings were installed along Av. Francisco Galassi and the plots were dimensioned in a more organized way. The following urban restrictions were considered, based on the justifications that follow, related to the morphological regions.

Observing the restrictions in Table 22.3, it can be said that:

In morphological regions 1 and 2, characterized by old single-storey houses, an optional removal was placed because these residences follow the pattern of building on the front of the plot. The utilization coefficient was 1.5, so that future constructions

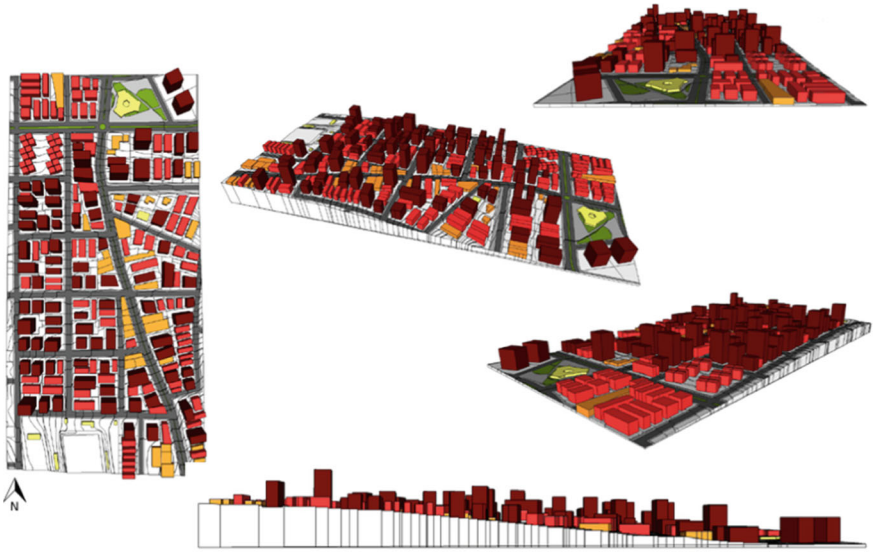


Fig. 22.11 Simulation of the maximum construction potential. Author, 2020

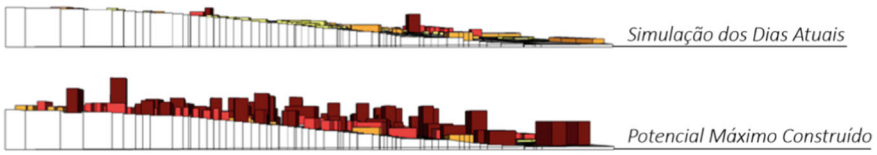


Fig. 22.12 Simulation of the current situation in the neighborhood. Author, 2020

Table 22.2 Constructive potential of the studied area

Maximum constructive potential Occupancy rate 60% Utilization coefficient 2,75				
No. of floors	High (H) (m)	Minimum front distance (H/10 + 2,10)	Side standoff and minimum bottom (H/10 + 1,5)	Minimum area of the plot (m^2)
4	12	3,3	2,7	300
6	18	3,9	3,3	300
10	30	5,1	4,5	300
15	45	6,6	6	400

would not overshadow the historicity of the place. The minimum frontage is 10 m, so that future buildings have the internal quality of the spaces.

In morphological regions 3 and 4, characterized by recent single-storey houses and two-storey houses, respectively, the utilization coefficient is already higher, 2.75,

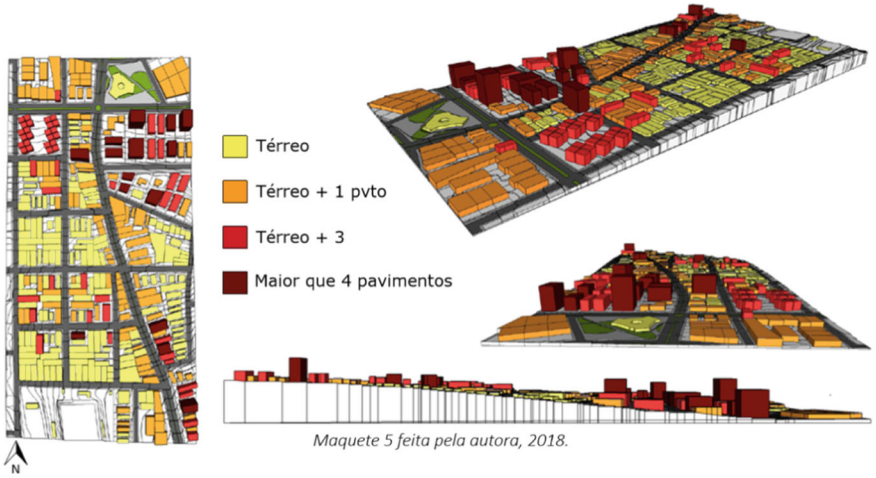


Fig. 22.13 Simulations based on new urban coefficients. Author, 2020

in order to allow a controlled growth of the template and density. Front, side, and back clearances become mandatory, respecting the quality of ventilation and lighting. This category includes houses with higher purchasing power. This ideal scenario seeks to encourage the development of the neighborhood, but in a healthy way, considering the specific conditions of each morphological region.

In morphological region 5, which corresponds to buildings for residential use, no maximum size is proposed. The objective is to encourage good verticalization. It seeks to promote vertical development in strategic regions, close to the Rondon Pacheco structural avenue, which can support the high flow of people and vehicles. The density, therefore, can be higher. Front, side, and back distances are also mandatory, as well as a minimum plot area of 250 square meters, in order to obtain buildings with urban environmental quality.

In morphological region 6, characterized by mixed-use two-storey houses (commercial and upper residential ground floor), there is a maximum height of 10 m and a utilization coefficient equal to 2. This is because, in the ideal scenario, we sought to preserve and encourage the construction of this typology, concentrated on Francisco Galassi Avenue. This avenue has a street profile of only 19.5 m, which is not enough to allow many vertical floors. However, existing buildings have a very short span; therefore, a minimum facade length of 10 m is proposed in order to seek a better quality for the building.

In morphological region 7, corresponding to vacant plots, no maximum template is placed. This is because the city cannot have its development frozen; growth takes place organically and often unpredictably, even within what is permitted. In the Ideal Potential, buildings were created related to their surroundings. In places with many single-storey houses, for example, it was avoided to place tall buildings, which would harm the urban landscape. Or in places with stores, the typical two-storey house was

Table 22.3 New urban restrictions of the studied area

New urban restrictions							
Morphological region	Maximum occupancy rate (%)	Maximum utilization coefficient	Maximum high (m)	Minimum frontal distance (m)	Side standoff and minimum bottom (m)	Minimum facade (m)	Minimum area of the plot (m)
1	70 (2)	1,5	10	Facultativo	1,5 (3)	10	250
2	70 (2)	1,5	10	Facultativo	1,5 (3)	10	250
3	60 ou H2v > 4 pav 40 (1)	2,75	20	3 (3)	1,5 (3)	10	250
4	60 ou H2v > 4 pav 40 (1)	2,75	–	3 (3)	1,5 (3)	10	250
5	60 ou H2v > 4 pav 40 (1)	2,75	–	3 (3)	1,5 (3)	10	250
6	70 (2)	2	10	3 (3)	1,5 (3)	10	250
7	60 ou H2v > 4 pav 40 (1)	2,75	–	3 (3)	1,5 (3)	10	250
8	60 ou H2v > 4 pav 40 (1)	2,75	–	3 (3)	1,5 (3)	10	250
9	60 ou H2v > 4 pav 40 (1)	2,75	–	3 (3)	1,5 (3)	10	250

(1) 60% allowed on the first floor, for multifamily residential use, for common use areas.
(2) Allowed 70% on the first two floors above the street level, for commercial and/or services and common areas of any use. Allowed 80% underground without occupying the projection of the front clearance.
(3) In accordance with Chapter V of Complementary Law 525, which provides for the zoning of land use and occupation in the municipality of Uberlândia.

maintained, encouraging mixed land use. And in regions 8 and 9, which are the Sports Center and the Weaving Center (unique buildings), the original characteristics were maintained, since both constructions work very well where they are located.

22.3 Conclusions

The urban space is endowed with different urban narratives that draw stories present in different elements of our cities. Urban morphology helps us to observe these elements, decoding the spatial attributes of each location, making them visible under

a certain point of view and evidencing their characteristics. It is this visibility, or invisibility, that motivated the study of the heritage district. The morphological analysis revealed how the neighborhood changed over the years, until it almost lost its characteristics that are in the genesis if nothing is done, what little remains will disappear amid the rapid real estate transformation of the place.

The low interest in public power and society means that this history is slowly being erased from the urban memory of Uberlândia. Could it be because it is an area of low-income origins? Or for the excellent location and appreciation of the land? The fact is that the legislation through urban zoning is fault, and is not concerned with aspects of these urban characteristics.

Was created an ideal scenario, even knowing that it approaches on utopia, but it brings to highlight an important discussion about the morphological particularities. The homogenization of a large area is a mistake, even more with different historical layers, and with dynamic processes. With the current legislation, real estate development will de-characterize all this historical process.

The study of morphological regions revealed how the diversity of typologies in a small portion of the city of Uberlândia enriches the potential of conditioning factors for urban planning. It is necessary to incorporate urban morphology in the planning of urban areas, as opposed to planning methods that do not show their formal, historical, and cultural characteristics. The invisibility of several Brazilian neighborhoods, whose origin is the result of the historical segregation promoted by excluding urban processes, allows us to draw a portrait of Brazilian urban diversity.

References

Costa SA, Netto MG (2016) Fundamentos de morfologia urbana. C/Arte, Belo Horizonte

Krafta R (2014) Notas de aula de Morfologia Urbana. Editora UFRGS, Porto Alegre

Maricato E (2013) Brasil, cidades: alternativas para a crise urbana. Vozes, Petrópolis

Moreira Junior O (2010) Segregação urbana em cidades pequenas: algumas considerações. Editora UFPR, Curitiba, no 20, pp 133–142

Oliveira V, Monteiro C (2014) Regiões morfológicas: a aplicabilidade de um conceito da morfologia na prática de planeamento. Revista de Morfologia Urbana 2(2):105–108

Panerai P (2014) Análise Urbana. Editora Universidade de Brasília, Brasília

Public Archive of Uberlândia (Arquivo Público de Uberlândia), 2020, viewed 8 March 2020. https://www.uberlandia.mg.gov.br/prefeitura/secretarias/cultura-e-turismo/arquivo-publico/

Sposito M (1998) Capitalismo e Urbanização. Contexto, São Paulo

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 23
Multiscale and Multi-Temporal Simulation of Change of Urban Structures in the Subarctic East Siberian Metropolis of Yakutsk

Sébastien Gadal, Mounir Oukhattar, Jūratė Kamičaitytė, Moisei Zakharov, Walid Ouerghemmi, and Ismaguil Hanadé Houmma

Abstract In the last twenty years, the Metropolis of Yakutsk has experienced significant changes characterised by intense urban growth, densification, and urban structure changes in a complex geographical environment: extremely low temperature during six to seven months, impacts of permafrost dynamics and relative melting, seasonal exposure to ice breakup on the suburban areas. The urban structure and land-use changes conditioned by the urban growth and environmental impacts are analysed at two geographic scales: the meso-urban level with the use of the Landsat-5 TM, Landsat-8 OLI, and Sentinel-2 MSI satellites images covering the period from 2010 to 2020; and at the regional level with the DMSP-OLS PL (1995–2013) and VIIRS-DNB (2015–2020) sensors. The recognition of the urban structures and land use transformations at both scales are based on the use of the combined machine

S. Gadal (✉) · M. Oukhattar · M. Zakharov · W. Ouerghemmi · I. H. Houmma
Aix-Marseille University, CNRS, ESPACE UMR 7300, Aix-en-Provence, France
e-mail: sebastien.gadal@univ-amu.fr

M. Oukhattar
e-mail: mounir.oukhattar@etu.univ-amu.fr

M. Zakharov
e-mail: moisei.zakharov@etu.univ-amu.fr

W. Ouerghemmi
e-mail: walid.ouerg@gmail.com

I. H. Houmma
e-mail: ismaguil.hanade-houmma@etu.univ-amu.fr

M. Zakharov
Department of Ecology and Geography, Institute of Natural Sciences, North-Eastern Federal University, Republic of Sakha-Yakutia, Russia

J. Kamičaitytė
Cultural and Spatial Environment Research Group, Kaunas University of Technology, Kaunas, Lithuania
e-mail: jurate.kamicaityte@ktu.lt

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_23

learning data processing. The simulations of the urban structures and land use evolutions to 2030 at the meso-urban and regional scales by Markov chain cellular automata give comparable results of the future trends of the Yakutsk metropolis: reduction of vegetation, forests areas (due to forest fires) and agriculture zones; the increase of bare soil, water surfaces and new urban areas.

Keywords Urbanisation forms · Territorial structures · Remote sensing · Geo-simulation · Yakutsk metropolis

23.1 Introduction

The city of Yakutsk, capital of the Republic of Sakha-Yakutia, had around 330,000 inhabitants in 2023. The metropole is characterised by a spatial and territorial dynamic that is unique in the Russian Arctic regions. Since the 1990s, it experienced continuous demographic and urban growth, while many other pioneer and Arctic cities experienced significant demographic decline or became ghost towns (Gadal et al. 2022). During the Soviet period, under the momentum of central Soviet authority, Yakutia, with its vast natural resources, was a pioneering area for the economic development of the Far East (Péné-Annette et al. 2017). This led to a significant demographic and urban growth, with high levels of net emigration from other regions of the USSR (Vinokurova et al. 1994; Sukneva 2021; Fedorova 1998). Demographic dynamics was particularly intensive in the 1970 and 1980s in the regions and towns of the east, south and west of the Sakha-Yakutia Republic, due to the high demand for labour to support mining activities. It accounted for up to 70% of population movements in Yakutia during this period (Fedorova et al. 2003). With the end of the USSR, most of the pioneering towns linked to the extractive economy lost their populations. During the same period, the rural exodus and the process of territorial integration of the urban centres of central Yakutia were the drivers behind the urban growth of the metropolis of Yakutsk.

Managing urban sprawl in metropolitan areas such as the Siberian metropolis of Yakutsk has become a major challenge in recent years. With new perspectives on sustainable urban growth, it is becoming more and more important to design, develop and implement appropriate land use and management practices (Zhao 2010). New approaches to remote sensing and spatial modelling are crucial in providing valuable information for decision-makers and planners to take informed actions. At the current state of knowledge, various methods exist for mapping spatiotemporal changes in the dynamics of land use units and artificial areas (Bhatti and Tripathi 2014; Lo and Choi 2004; Powell et al. 2007). For example, to study the process of urban sprawl, multi-date and multi-sensor analyses have been widely applied (Wilson et al. 2003; Zeng et al. 2005). In addition, urban planners and local stakeholders also use predictive geo-simulation models to estimate changes in urban fabric (Zanganeh Shahraki et al. 2011). However, given the great spatial variability of the processes and factors influencing urban sprawl, there are controversial views in the literature on the

advantages and limitations of each approach. Among the range of factors, according to Zhao (2010) socio-economic characteristics in particular, social attitudes towards residential plots influence, for example, the types of transport networks and land use patterns in peri-urban areas. Similarly, people's travel distances also have a significant influence on urban sprawl (Kenworthy and Laube 1996). The importance of these socio-economic and physical characteristics in understanding the dynamics of urban change has been highlighted in several research studies (Bhatti et al. 2015; Longley and Mesev 2000). Serra et al. (2008) have analysed the importance of the joint and complementary use of biophysical and socio-economic data to study the main factors responsible for land use and land use change in a Mediterranean region. Similarly, another study by Almeida et al. (2005) showed the importance of using urban infrastructure and socio-economic indicators to understand the probability of urban growth. Other factors, such as population growth, employment and the evolution of built-up areas have also been used as important indicators in modelling urban growth (Fulton et al. 2001).

Nevertheless, urban growth is an inevitable process that, if treated meticulously, can be considered an indicator of any region's social and economic development. This study presents a combined machine learning approach to address the variable growth dynamics of urban and peri-urban areas of Yakutsk metropolis in a geo-simulation Markov chain cellular automata model. Four exploratory scenarios are developed based on a different rate of change in land use and land cover (LULC) and different land development conditions. The specific objectives of this study includes (1) time series LULC classification using ISODATA (Iterative Self-Organizing Data Analysis Technique) and Mahalanobis distance for the period of 2010–2020; (2) multi-scale and multi-temporal simulation of different exploratory scenarios and accuracy assessment using actual land changes; (3) prediction of future LULC for 2030 through the modelling approach (Cellular automat Markov chain) designed to examine spatio-temporal LULC dynamics; and (4) temporal analysis of night-time DMSP OLS and VIIRS satellites data to monitor and understand the evolution of urbanisation between 1995, 2020 and to forecast in 2030 in the Yakutsk metropolitan region. The objective is to set up multi-scale analysis and evolution models based on two methodological fields in artificial intelligence based on a combined approach in machine learning. The interest in cognitive terms of this study is to understand the evolutionary processes of urbanisation and metropolisation in a complex geographical environment characterised by an extreme continental subarctic climate (urban territory subjected to negative temperatures for more than 6 months of the year that can reach −55 °C), impacted by global warming with the increase in temperatures, the relative melting of the permafrost (with the problems of constructions, destructions, carbon emissions etc.) and the annual exposure to ice breakup with flooding on peri-urban areas and satellite villages. The spatial analysis integrates data collected in the field materials combined with the LULC modelling for the geo-simulated evolutions of the Yakutsk metropolis.

23.2 The Metropolis of Yakutsk

The study area includes the Yakutsk metropolis with the peri-urbanized metropolitan region of Central Yakutia (Fig. 23.1) located in the subarctic or sharply continental climate zone of Eastern Siberia and in the central part of Yakutia. The number of ~~its~~ inhabitants of Yakutsk (62°05′N 129°45′E) which increased from 192,000 in 1990 to 339,664 in 2020, makes up a little more than a third of the population (35,36%) of the entire Republic of Sakha (Yakutia) (Figs. 23.2 and 23.3). The Yakutsk as city located in the valley and river terraces of Lena River. The total area of the metropolitan region is 52410,59 km^2. It is bordered to the west by Gornyi ulus, to the north by Namsky ulus, to the east by Megino-Khangalassky ulus, and to the south by Khangalas ulus. The territory of the Yakutsk metropolis is a hilly plain located to the north of the Prilenskoe Plateau. The predominant altitudes are about 250 m above sea level (ASL). The absolute maximum of altitude is 286 m ASL and the minimum is about 86 m ASL is located in the Tuymaada Valley. Most of the area of the district is covered by the closed deciduous forest of the boreal taifa (Fig. 23.1). The dominant tree species are larch and Siberian pine, with small plots of other species, such as spruce, birch, aspen, and others. The climate of the metropolis, as well as that of the whole of Central Yakutia, is extreme continental with long and harsh winters (the average temperature in January is about −40° C) and short but hot summers (the average temperature in July is 19° C). There is characteristic low rainfall throughout the year and dry summer.

23.3 Multisensor's Remote Sensing Data for Multi-Scalar Analysis

The dataset used include the Landsat-5 TM, Landsat-8 OLI, and Sentinel-2 MSI images (Table 23.1). The Sentinel-2 MSI image has three spatial resolutions and thirteen spectral bands. Ten spectral bands of Sentinel-2 were used, excluding the coastal aerosol, water vapour, and cirrus bands that have a spatial resolution of 60 m. The other spectral bands have been reorganised into two combinations. The first combination includes only four spectral bands (blue, green, red, and near infrared) at a resolution of 10 m. The second combination consists of six bands (red edge 1 to 4 and two short-wave infrared (SWIR)) at a resolution of 20 m. Seven spectral bands at a resolution of 30 m were used from Landsat 8 OLI Collection 1, excluding the panchromatic and thermal infrared (TIR) bands. The DMSP/OLS (VNIR) and VIIRS DNB night images were chosen to reconstruct all the data allowing the modelling of the evolution processes of urban structures in the metropolis of Yakutsk.

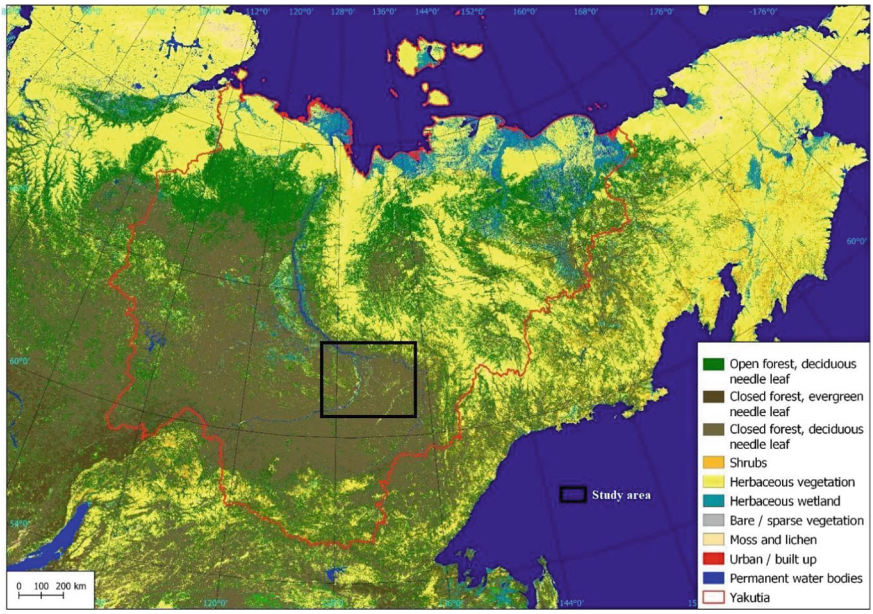


Fig. 23.1 Study area at the scale of the Yakutsk metropolis. (Moisei Zakharov, CNRS ESPACE UMR 7300, 2023) (Buchhorn et al. 2020)

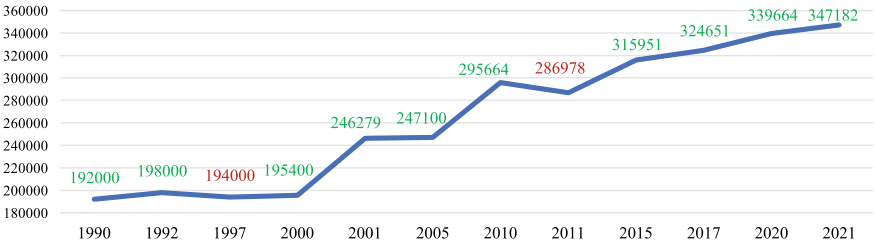


Fig. 23.2 Population evolution in the metropolis of Yakutsk during the period from 1990 to 2021. (Census: https://14.rosstat.gov.ru/chisl_sostav)

23.4 Methodology

The Landsat-5 TM, Landsat-8 OLI series, and Sentinel-2 MSI datasets constitute the geographic-based data used to simulate the urban land use land cover changes in the Yakutsk metropolitan territory until 2030. Regarding the research object, the geo-simulation of the urban growth, and the dominant geographical features of the study area; four classes of land uses were cartography, namely bare soil (unused land and open spaces), urbanisation (residential, commercial, industrial and transport), vegetation (agriculture, trees, shrubs, and meadows) and water bodies (open water, streams, canals, and rivers) (Anderson 1976). Considering the spatial extent

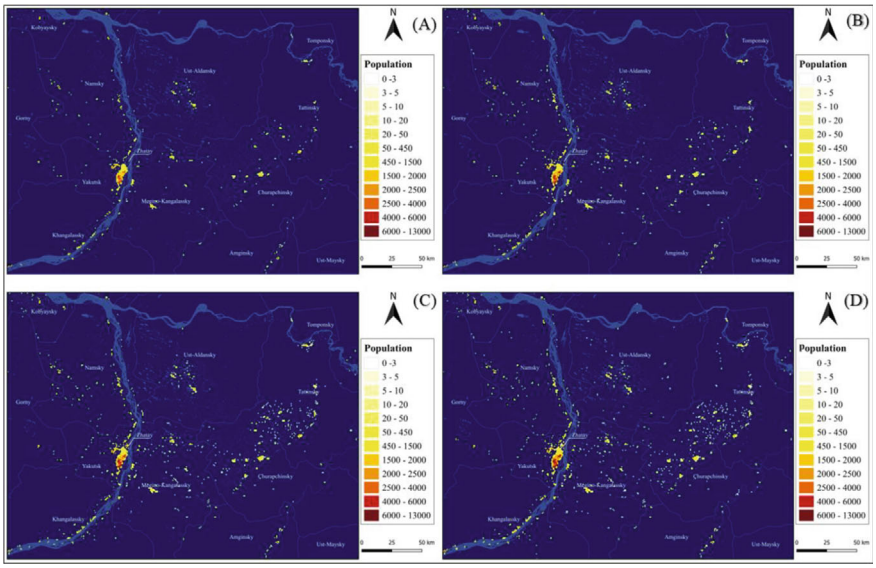


Fig. 23.3 Spatial distribution of the population in the year 2001 (**a**), 2010 (**b**), 2015 (**c**) and 2020 (**d**) using a 100m^2 grid that covers all buildings in the Yakutsk metropolis (Census: https://14.rosstat.gov.ru/chisl_sostav). Sébastien Gadal, Mounir Oukhattar, Moisei Zakharov, Jūratė Kamičaitytė, Walid Ouerghemmi, CNRS ESPACE UMR 7300, 2021

Table 23.1 Satellite data characteristics

Data	Landsat-5 TM	Landsat-8 OLI		Sentinel-2 MSI		DMSP/ OLS	VIIRS DNB
Date of images	2010	2015	2020	2015	2020	1995 to 2013	2015 to 2020
Acquisition date	From 02/ 07/2010 to 31/08/ 2010	From 02/ 07/2015 to 31/08/ 2015	From 02/ 07/2020 to 31/08/ 2020	From 01/ 07/2015 to 31/08/ 2015	From 01/ 07/2020 to 31/08/ 2020	1995 2001 2013	2015 2017 2020
Projection	WGS 84/UTM zone 52N						
Spatial resolution	30–120 m	15−30 m	15−30 m	10−60 m	10−60 m	2,7 km	742 m
Source	USGS. earth explorer					DMSP night-time lights (mines.edu)	VIIRS night-time light (mines.edu)

of the subarctic metropolis of Yakutsk, the subclasses of the four identified land use classes have been aggregated to minimise intra-class confusion. This is aimed at highlighting the forms of the urban structures of the subarctic metropolis of Yakutsk. The approach developed combines three phases of data processing (Fig. 23.4): (1)

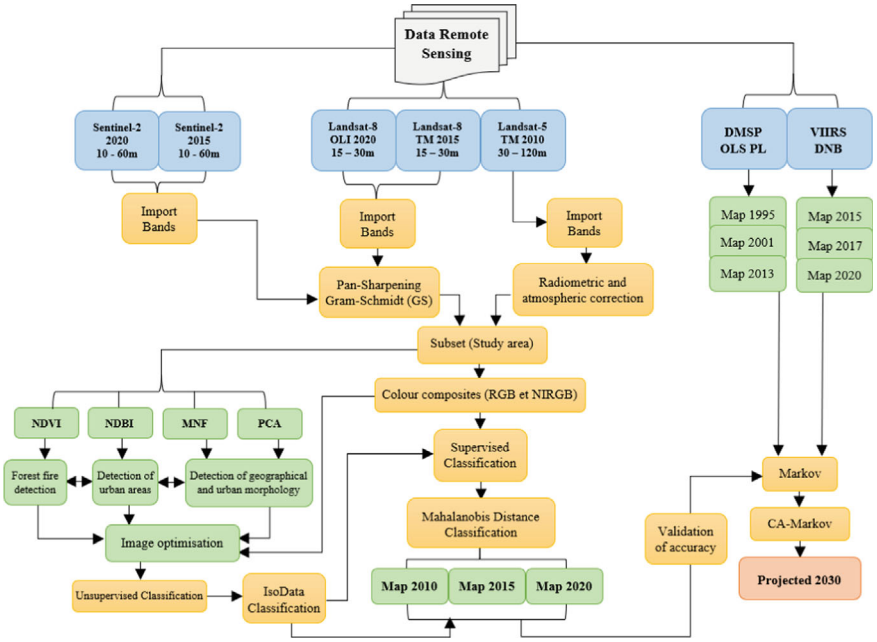


Fig. 23.4 Methodological flowchart

A LULC classification approach that aims to test the best classification algorithm against the diverse types of remote sensing sensors used (Landsat-5 TM, Landsat-8 OLI, and Sentinel-2 MSI) to obtain the LULC maps of 2010, 2015, and 2020. (2) The kappa index and overall accuracy were used for the validation of LULC classification results from Landsat and sentinel-2 data. (3) The CA-Markov cellular automaton simulation was subsequently used to predict the spatial distribution of LULC classes for 2030. Similarly, DMSP and VIIRS nightlight remote sensing images are used for modelling the urban changes in 2030 at the metropolitan region of Yakutsk.

23.4.1 LULC Classification of the Yakutsk Metropolis Areas

Data pre-processing. Atmospheric corrections and radiometric calibration were applied to Landsat-5 TM/8 OLI and Sentinel-2 MSI data. For the Landsat-8 OLI and Sentinel-2 MSI sensors, the RGB and NIR bands were stacked and then cut to cover the study area. Gram-Schmidt's panoramic sharpness (GS) algorithm was applied to resample these images at resolutions of 15 m for Landsat 8 images and 10 m for Sentinel 2 data respectively. Landsat-5 TM data were not resampled at 15 m because they do not contain the panchromatic band.

ISODATA unsupervised classification. The ISODATA clustering algorithm is an improved version of the k-means clustering algorithm (Jensen 2005). The ISODATA algorithm calculates the class averages evenly distributed across the data space and then iteratively groups the remaining pixels using minimum distance techniques. Each iteration recalculates the averages and reclassifies the pixels relative to the new averages. This process continues until the number of pixels in each class changes below the selected pixel change threshold or the maximum number of iterations is reached (Kantakumar and Neelamsetti 2015).

The ISODATA classifier gave the best result after testing algorithms and comparisons of the subarctic metropolis the LULC maps modelled. The classification combines a coloured composition (RGB and NIRGB), indices (NDVI, and NDBI), PCA, and MNF neo-images. This processing step is necessary to filter and merge the best results to have an image optimisation that has achieved high classification accuracy. This step also allowed the identification of the dominant LULC classes in the study area which were subsequently mapped by a supervised classification approach using the Mahalanobis distance algorithm (Fig. 23.4).

Supervised classification by Mahalanobis distance. Mahalanobis distance is a direction-sensitive distance classifier. It uses statistics for each input data class. The Mahalanobis distance is like the maximum probability classification, but it assumes that all class covariances are equal, and therefore, it is a faster method of calculus (Eskandari et al. 2020). During the image processing, no specific distance threshold value was used, allowing the algorithm to rank all pixels at the closest training data (Randazzo et al. 2021). In this study, after testing and visually comparing the LULC results of six supervised classification algorithms (Support Vector Machine, Spectral Angle Mapper, Parallelepiped, Minimum Distance, Maximum Likelihood and Mahalanobis Distance), the Mahalanobis Distance algorithm gave the best-supervised classification result (Table 23.4). The Mahalanobis algorithm was used to classify the four dominant LULC classes in the study area identified by the ISODATA classifier from the coloured compositions (RGB and NIRGB) of the Landsat and Sentinel-2 data (Fig. 23.4).

23.4.2 Prediction of Future LULC Dynamics

The cellular automat Markov (CA-Markov) model was used to predict the LULC change of the Yakutsk metropolis in 2030. CA-Markov is a Change/Time or Environment/Simulation probabilistic model based on the LULC maps generated from the Mahalanobis and ISODATA classifiers. The classified LULC maps for 2010, 2015, and 2020 were used to acquire the dynamic change for the LULC classes between 2010 and 2015, 2015 and 2020 (Klimsiak 2016; Gidey et al. 2017) generating intermediary maps of LULC potential transitions and LULC transition probability matrix from 2010 to 2015, from 2015 to 2020, and 2020 to 2030. Thus, the transient probabilities and adequacy zones are created by running the Markov probabilistic matrix before running the CA-Markov geo-simulation processing (Jazouli et al. 2018).

23.4.3 Evaluation of the Accuracy of the Classification

The LULC maps of 2020 from Landsat-8 OLI and Sentinel-2 MSI have been validated using 2020 RGB "natural" colour composition images from WORLDVIEW-3 satellite with a resolution of 30 cm through visualisation on the Google Earth platform. To do this, 300 ground checkpoints were considered to evaluate the accuracy of the 2020 cartographic results of each classification method (ISODATA and Mahalanobis distance) using the overall accuracy index (OA) and the Kappa coefficient (K). This made it possible to verify and compare the performance of the algorithms in their ability to classify LULC units from Landsat-8 OLI and Sentinel-2 MSI data. The Kappa index and overall accuracy are two indicators that provide information on the synthetic accuracy of all LULC classes. The specific accuracy of each class of LULC is provided by user accuracy (UA) and producer accuracy (PA). These indices are calculated from the following equations (Eqs. 23.1, 23.2, 23.3 and 23.4):

$$UA = \frac{Number\ of\ pixels\ correctly\ classified\ in\ each\ category}{Total\ number\ of\ reference\ pixels\ in\ this\ category(row\ total)} \times 100 \tag{23.1}$$

$$PA = \frac{Number\ of\ correctly\ classified\ pixels\ in\ each\ category}{Total\ number\ of\ pixels\ classified\ in\ this\ category(Total\ column)} \times 100 \tag{23.2}$$

$$OA = \frac{Total\ number\ of\ correctly\ classified\ pixels\ (Diogonal)}{Total\ number\ of\ reference\ pixels} \times 100 \tag{23.3}$$

$$K = \frac{N\sum_{i=1}^{r}(x_{ii}) - \sum_{i=1}^{r}(x_i + Xx_{+1})}{N^2 - \sum_{i=1}^{r}(x_{ii}Xx_{+1})} \tag{23.4}$$

where: $\mathbf{r}$ = number of rows and columns in the error matrix, $\mathbf{N}$ = total number of observations (pixels), $\mathbf{X_{ii}}$ = observation in row i and column i, $\mathbf{X_{i+}}$ = marginal total of row i, and $\mathbf{X_{+i}}$ = marginal total of column i.

23.5 Results and Discussions

23.5.1 LULC Change Analysis

The LULC maps (2010, 2015, 2020 and 2030) obtained by supervised and unsupervised classification of Landsat-5 TM/8 OLI and Sentinel-2 MSI images are presented in Figs. 23.5 and 23.6 respectively. These cartographic results present the current and future changes of four dominant LULC classes of the subarctic metropolis Yakutsk. These mapped LULC classes include 4 types of land use/land cover: bare soil (yellow

colour), vegetation (green colour), water bodies (blue colour) and urbanisation (red colour).

The comparative analysis of the results from these two sensors and by LULC classification methods reveals a difference in the results obtained by supervised and

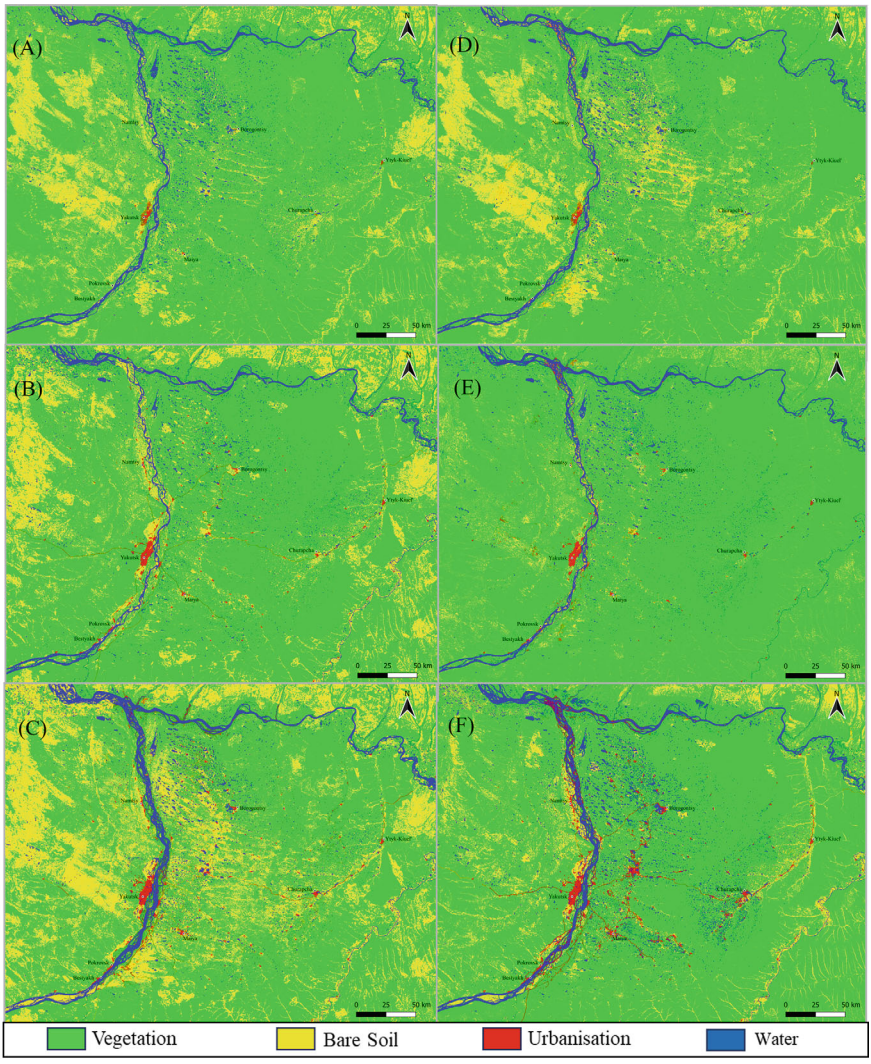


Fig. 23.5 Transformation and geo-simulation of the urban structures of central Yakutia 2015–2020 based on Landsat-5 TM **a**, **b** and Landsat-8 OLI **b**, **d** by ISODATA **a**, **b** and Mahalanobis distance **d**, **e**. Geo-simulation of the urban structures in 2030 by cellular-automat Markov chain **c**, **f**. (USGS earth explorer: https://earthexplorer.usgs.gov/). Sébastien Gadal, Mounir Oukhattar, Moisei Zakharov, Jūratė Kamičaitytė, Walid Ouerghemmi, CNRS ESPACE UMR 7300, 2021

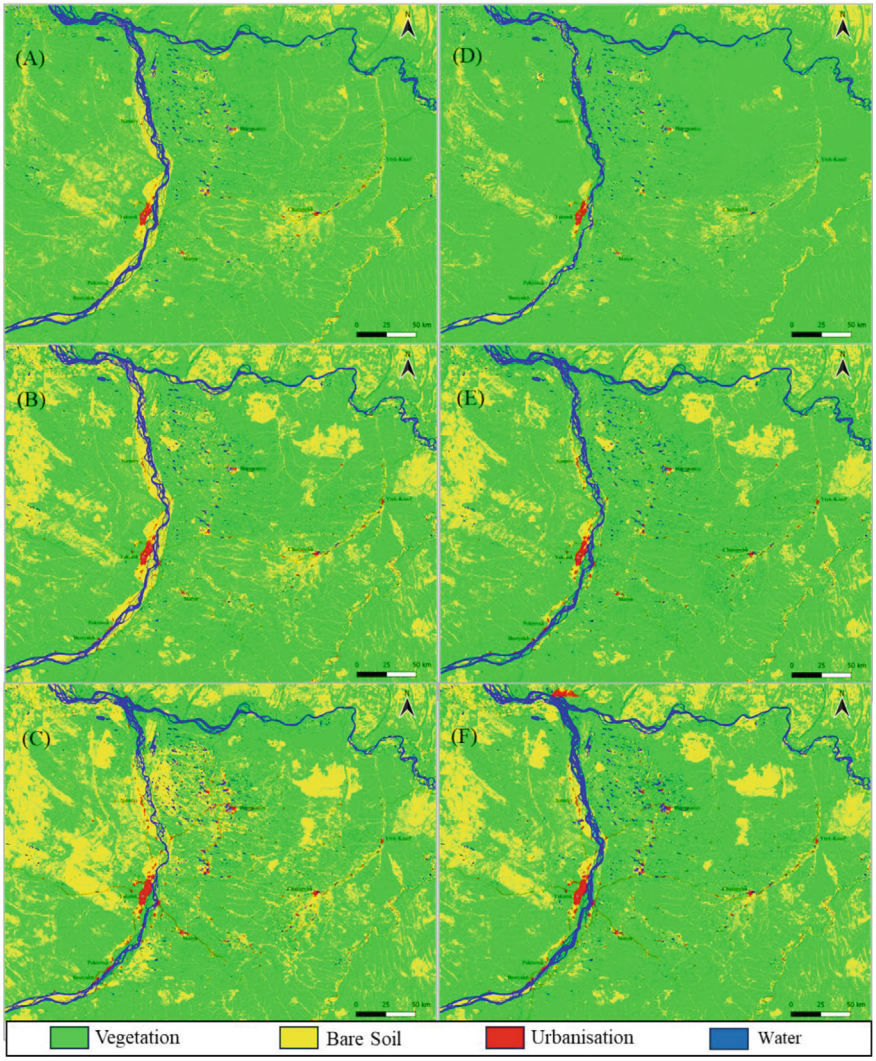


Fig. 23.6 Transformation and geo-simulation of the urban structures of central Yakutia 2015–2020 based on sentinel 2-MSI (**a**) (**b**) (**d**) by ISODATA (**a**) (**b**) and Mahalanobis distance (**d**) (**e**). Geo-simulation of the urban structures in 2030 by cellular-automat Markov chain (**c**) (**f**). (USGS earth explorer https://earthexplorer.usgs.gov/). Sébastien Gadal, Mounir Oukhattar, Moisei Zakharov, Jūratė Kamičaitytė, Walid Ouerghemmi, CNRS ESPACE UMR 7300, 2021

unsupervised classification of the Landsat-8 OLI images of the year 2020. In contrast, the results of these two classification methods show no significant visual difference from Sentinel-2 data. This could be explained by the low performance of the Mahalanobis algorithm compared to the ISODATA algorithm applied on a combination of MNF, NDVI, NDBI, PCA, RGB and NIRGB. Visually, this combination gave

comparable results for both, the 15 m resampled Landsat-8 OLI data and the 10 m resolution Sentinel-2 MSI data. Over the period from 2010 to 2030, the image analysis of the LULC results shows differentiated changes by land use unit type. The main changes and territorial transitions are observed in the bare soil, vegetation, and urbanisation classes.

We can go to see on the results by Sentinel-2, a significant increase in the urbanisation process between 2015 and 2030. The main changes were observed in urban structures (spatial organisation, and densification of the urban fabric). This increase in urbanised areas is accompanied by a growth in bare soil and a decrease in vegetation. This transition could be explained by a strong influence of the human factor (urbanisation) on the occurrence of forest fires in this area (Janiec and Gadal 2020). The number of forest fires in Central Yakutia is 300 cases over the period between 2000 and 2020 or 295,000 hectares with a peak of 1,7 million hectares of burnt area in 2002 (Petrov et al. 2022). Similarly, the denudation of bare soil is related to the process of anthropisation and intense agricultural activities.

The multi-temporal LULC classes change statistical analysis of the Yakutsk subarctic metropolis between 2010 and 2030 (Table 23.2 and Fig. 23.7) illustrates the above-mentioned cartographic results in Figs. 23.5 and 23.6. The analysis of these statistical results highlights a territorial dynamic shown by a process of urbanisation. These spatial and territorial dynamics will increase in the coming years according to the model geo-simulation. All spatial statistics of two classification methods tested on a multi-sensor approach (Landsat-5 TM/8 OLI and Sentinel-2 MSI) show significant development of urban areas.

Referring to the statistics of the unsupervised classification of Landsat-5 TM/8 OLI images (Table 23.2), the urbanised areas evolved from 0,1% (75,5 km^2) in 2010 to 0,4% (215,5 km^2) in 2020 with a positive rate of change of 185,3%. According to the projection in 2030, the urban coverage of the subarctic metropolis would expect 1,8% (946,2 km^2) with a rate of change of 339,1% between 2020 and 2030. This process of the rapid urbanisation of the metropolis could be linked to local demographic dynamics (population migration), natural population growth and the socio-economic development of the region.

On the other hand, the statistics provided in Table 23.2 show both regressive and progressive changes in the LULC natural units of the subarctic metropolis of Yakutsk. While we can see a clear increase in bare soils from 7,5% (3944,8 km^2) in 2010 to 8,9% (4653,5 km^2) in 2020. Vegetation cover has decreased remarkably over the same period. It decreased from 86,3% (45,236,5 km^2) in 2010 to 85,2% (44,638,9 km^2) in 2020. Based on this regressive vegetation trend, the vegetation cover of the area could decrease to 80% (41,943,5 km^2) in 2030 with a negative rate of change of −3,8% according to CA-Markov-based projections.

Similarly, referring to the unsupervised classification statistics of Sentinel-2 MSI images (Table 23.3 and Fig. 23.8), a similar trend of LULC changes is observed. The urbanised areas evolved from 0,04% (18,4 km^2) in 2015 to 0,1% (30,6 km^2) in 2020 with a positive rate of change of 67,3%. The simulations based on CA-Markov show that urbanisation of the subarctic metropolis would reach 0,52% (271,6 km^2) with a rate of change of 780,3% between 2020 and 2030. At the same time, bare soils

Table 23.2 LULC changes of landsat-5 TM/8 OLI between 2010, 2015, 2020 and 2030

LULC types	LULC area								LULC change					
	2010		2015		2020		2030		2010–2015		2015–2020		2020–2030	
	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)
Unsupervised classification														
Bare soil	3944,8	7,5	1411,1	2,7	4653,5	8,9	5416,2	10,3	−2533,7	−64,2	3242,4	229,8	−237,3	−5,1
Vegetation	45,236,5	86,3	47,472,6	90,6	44,638,9	85,2	41,943,5	80	2236,1	4,9	−2833,8	−6,0	−1695,3	−3,8
Water bodies	3153,5	6,0	3381,7	6,5	2902,7	5,5	4104,7	7,8	228,2	7,2	−479,0	−14,2	1202,0	41,4
Urbanisation	75,5	0,1	145,2	0,3	215,5	0,4	946,2	1,8	69,7	92,3	70,2	48,4	730,7	339,1
Total	52,410,4	100	52,410,6	100	52,410,5	100	52,410,6	100						
Supervised classification														
Bare soil	12,590,8	24,0	7975,2	15,2	3545,0	6,8	15,706,8	30,0	−4615,6	−36,7	−4430,2	−55,5	12,161,8	343,1
Vegetation	36,562,9	69,8	40,996,4	78,2	46,002,4	87,8	31,241,5	59,6	4433,5	12,1	5006,0	9,6	−14,760,9	−32,1
Water bodies	2956,2	5,6	2952,0	5,6	2096,5	4,0	4244,5	8,1	−4,2	−0,1	−855,5	−1,6	2148,0	102,5
Urbanisation	300,2	0,6	486,6	0,9	766,8	1,5	1217,7	2,3	186,4	62,1	280,3	0,5	450,9	58,8
Total	52,410,1	100	52,410,2	100	52,410,8	100	52,410,6	100						

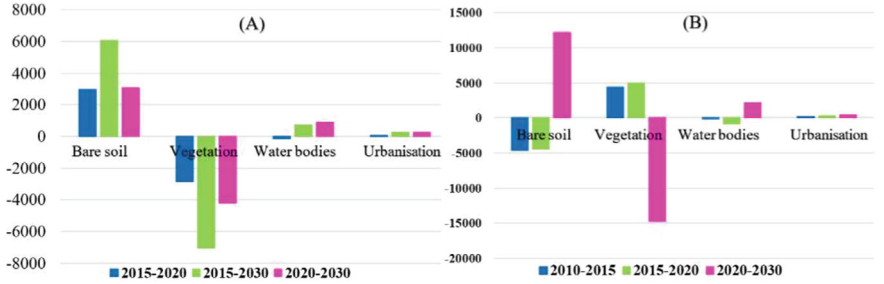


Fig. 23.7 Gain/loss (km^2) of the area by LULC class for the periods: 2010, 2015, 2020 and 2030 of Landsat−5 TM/8 OLI data

increased from 8,4% (4382,9 km^2) in 2015 to 14,6% (7366,3 km^2) in 2020 with a positive rate of change of 68,1%. This evolution would reach 19,9% (10,451,3 km^2) in 2030 with a rate of change of 41,9%.

In contrast, the vegetation class has decreased significantly to 86,6% (45,370,1 km^2) in 2015, 81,2% (42,538,1 km^2) in 2020 and 73,1% (38,322,7 km^2) in 2030. The rate of change is −6,2% between 2015 and 2020 and −9,9% between 2020 and 2030. The reduction in vegetation represented by agricultural and forest areas is correlated to forest fires, urban growth, and the drop in water levels between 2015 and 2020 from 5% (2638,8 km^2) to 4,7% (2475 km^2).

In this analysis of LULC change statistics, the discussion focused on the rates of change provided by unsupervised classification as it is the most accurate for the results from these two sensors (Landsat-5 TM/8 OLI and Sentinel-2 MSI).

23.5.2 Evaluation of the Accuracy of the LULC Classification

The accurate evaluation of the supervised and unsupervised classification images was performed using 300 stratified random points (Table 23.4). As a result of the evaluation of the stratified random points, the Sentinel-2 MSI-derived unsupervised classification LULC images have a higher kappa value (0,93) and overall accuracy (94%) than the Landsat-derived unsupervised classification LULC images which have a kappa value (0,78) and overall accuracy (84%). The Sentinel-2 derived supervised classification LULC images have a higher kappa value (0,85) and overall accuracy (89%) than the Landsat-derived supervised classification LULC images which have a kappa value (0,7) and overall accuracy (77%). Overall, the classified LULC maps have a good matching agreement with a kappa value of 70% and 78% (Landsat) and 85% and 93% (Sentinel-2) respectively for supervised and unsupervised classification. This is only a general assessment. These results may therefore vary depending on the use of different classification methods and statistics for accuracy assessment.

From this evaluation, the classification method based on the ISODATA algorithm applied on a combination of (NDVI, PCA, MNF, NDBI, RGB and NIRGB) gave

Table 23.3 LULC changes of sentinel-2 MSI between 2010, 2015, 2020 and 2030

LULC types	LULC area						LULC change						
	2015		2020		2030		2015–2020		2015–2030		2020–2030		
	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	
Unsupervised classification													
Bare soil	4382,9	8,4	7366,3	14,1	10,451,3	19,9	2983,3	68,1	6068,4	138,5	3085,1	41,9	
Vegetation	45,370,1	86,6	42,538,1	81,2	38,322,1	73,1	−2831,9	−6,2	−7048	−15,5	−4216,1	−9,9	
Water bodies	2638,8	5	2475	4,7	3365,5	6,4	−163,8	−6,2	726,7	27,5	890,5	36	
Urbanisation	18,4	0,04	30,9	0,06	271,6	0,5	12,4	67,3	253,1	1372,7	240,7	780,3	
Total	52,410,2	100	52,410,2	100	52,410,5	100							
Supervised classification													
Bare soil	5809,5	11,1	12,829,2	24,5	17,257,5	32,9	7019,8	120,8	11,448	197,1	4428,2	34,5	
Vegetation	44,206,7	84,4	37,000	70,6	31,502,9	60,1	−7206,7	−16,3	−12,703,8	−28,7	−5497,1	−14,9	
Water bodies	2371,4	4,52	2536,1	4,84	3566	6,8	164,7	6,95	1194,6	50,4	1029,9	40,6	
Urbanisation	22,87	0,04	45,05	0,09	84,54	0,16	22,18	96,98	61,67	269,7	39,5	87,7	
Total	52,410,4	100	52,410,4	100	52,410,9	100							

Table 23.4 Results of the evaluation of the accuracy of LULC maps

	Landsat-8 OLI LULC				Sentinel-2 MSI LULC			
	Supervised classification		Unsupervised classification		Supervised classification		Unsupervised classification	
	User's accuracy	Producer's accuracy	User's accuracy	Producer's accuracy	User's accuracy	Producer's accuracy	User's accuracy	Producer's accuracy
Bare soil	100%	44%	44%	37%	50%	30%	100%	78%
Vegetation	75%	100%	78%	75%	84%	83%	85%	100%
Water bodies	100%	100%	98%	99%	100%	100%	100%	100%
Urbanisation	46%	100%	70.37%	83%	83%	90%	92%	100%
Overall accuracy	77%		84%		89%		94%	
Kappa coefficient	0,70		0,78		0,85		0,93	

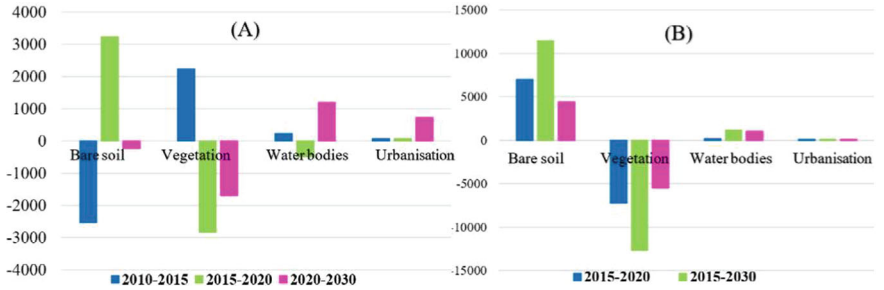


Fig. 23.8 Gain/loss (km^2) of the area by LULC class for the periods: 2010, 2015, 2020 and 2030 of Sentinel-2 data

the best accuracies of LULC classification for both sensors (Landsat-8 OLI and Sentinel-2 MSI). This demonstrates the importance of using an image classification approach combining multispectral transformation techniques (PCA, and MNF), spectral indices (NDVI, NDBI) and colour compositions rather than classification based on a Landsat-8 OLI or Sentinel-2 MSI multispectral raw images. Indeed, the NDVI is used to detect burnt areas, water surfaces, bare soil, and vegetation density and the NDBI is an indice that highlights urban areas where reflectance is higher in the Short-Wave InfraRed spectrum (SWIR) than in the Near InfraRed spectrum (NIR). In addition, to reduce redundancy in the data, the MNF and PCA make it possible to highlight urban morphology (road network, urban fabric, spatial distribution of urban areas) and the geomorphological forms of subsurface structures. The higher specific detection of each of these indices and transformations allows the ISODATA algorithm to easily separate the pixel values of each LULC unit.

23.5.3 Regional Geo-Simulation by NOAA DMSP-OLS and VIIRS-DNB Night-Time Images

The built-up urban areas of the metropolis are recognised and extracted from VIIRS-DNB and DMSP-OLS data for modelling and simulating the urban transformations in 2030 by CA-Markov machine learning processing at the regional scale.

NOAA-DMSP-OLS night-time images. The DMSP/OLS data were used for geo-simulation of urban forms and structural change in the subarctic metropolis of Yakutsk. Figure 23.9 shows built-up dynamics mapped with DMSP/OLS data in1995, 2001 and 2013 and in 2030 by geo-simulation. The image analysis shows an increase in the intensity of night light in the subarctic metropolis of Yakutsk corresponding to urban densification. The highest numerical count values represented by the red colour correspond to the areas of concentration of urbanisation and populations. Between 1995 and 2013 there is a significant spatial increase in urban forms and structures (light intensity of DMSP/OLS data). This expansion will become more

significant in the next seventeen years (2030). The result of the geo-simulation in 2030 confirms the urban and population densification observed between 1995 and 2013. The urban expansion of the subarctic metropolis of Yakutsk would result in 2030 in the expansion of existing urban centres and the appearance of new small urban centres. The territorial urban evolution is corroborated with the evolution of population growth which has evolved from 192 000 in 1990 to 347 182 inhabitants in 2021. Similarly, the geo-simulation result based on DMSP/OLS data supports the projected evolution of urban areas 75,5 km^2 in 2010 to 946,2 km^2 in 2030 derived from the LULC geo-simulation.

VIIRS-DNB night-time images. Figure 23.10 presents the cartographic result of the dynamics of urban structures from 2015 to 2030 derived from VIIRS DNB night light data at the scale of the Yakutsk metropolis. This cartographic result further confirms the process of increasing urbanisation evolution highlighted by the multi-temporal mapping of DMSP/OLS data and spatial modelling of population evolution (Figs. 23.3 and 23.9). The analysis of the results in Fig. 23.10 indicates nuances in light intensity between years in the centre of the Yakutsk municipality. At this level, the night light intensity VIIRS DNB is represented by two colours (yellow and orange) on the map Fig. 23.10a of 2015 and three levels of assorted colours (yellow, orange, and red) on the maps Fig. 23.10b, c and d of the years 2017, 2020 and 2030. The appearance of the red colour (maximum values of DN) demonstrates the increase in urban density in the centre of the urban municipality of Yakutsk and Zhatay. The

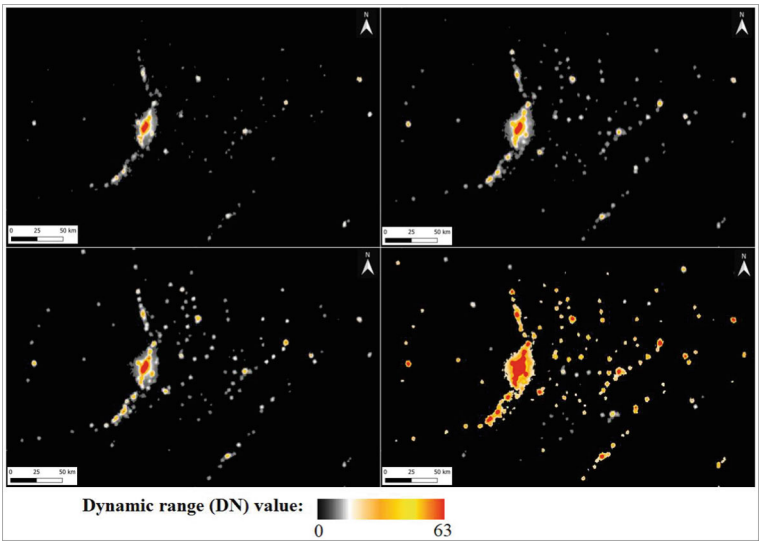


Fig. 23.9 Transformation and geo-simulation of the urban structures of central Yakutia 1995–2030 based on DMSP-OLS VNIR satellite night-time images at the scale of Yakutsk metropolis from 1995 (**a**), 2001 (**b**), 2013 (**c**) and projected in 2030 (**d**). (NOAA: https://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html). Sébastien Gadal, Mounir Oukhattar, CNRS ESPACE UMR 7300, 2022

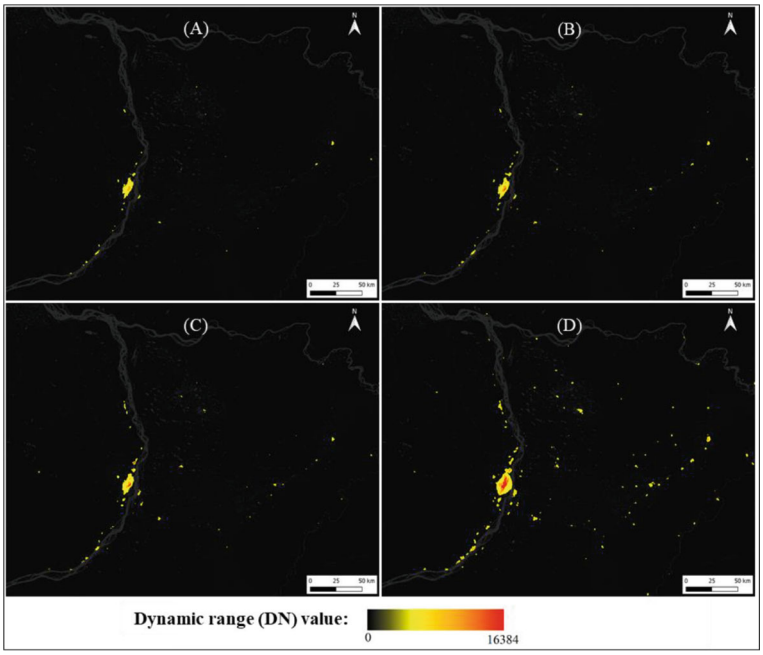


Fig. 23.10 Transformation and geo-simulation of the urban structures of central Yakutia 1995–2030 based on VIIRS-DNB satellite night-time images at the scale of Yakutsk metropolis from 2015 (**a**), 2017 (**b**), 2020 (**c**) and projected 2030 (**d**). (NOAA: ftp://ftp-npp.class.ngdc.noaa.gov/). Sébastien Gadal, Mounir Oukhattar, CNRS ESPACE UMR 7300, 2022

CA-Markov chain simulations in 2030 underpin a process of more important urban densification in the coming years which confirms the dynamics observed between 2015 and 2020.

The spatial organisation of urban structures and the spatial distribution of population density (Fig. 23.3) show a higher concentration in the centre of Yakutsk. The population density in the centre of the municipality ranges from 2500 to 13,000 inhabitants, whereas it varies from about 3 to 2000 inhabitants in the rest of the metropolis. In general, the spatial pattern of the urban development process of the Yakutsk metropolis follows the morphology of the Lena River with a spatial distribution more concentrated in the eastern part than in the western part of Yakutsk city.

23.6 Conclusion

The spatial and structural modelling of evolutions and changes of the subarctic metropolis of Yakutsk over the next 10 years is fundamental regarding the socio-environmental issues due to global warming and the rapid processes of territorialisation with the increase of population and suburbanisation. In this study, an approach to identify the best LULC classification algorithm was applied on Landsat-5 TM/8 OLI and Sentinel-2 MSI multispectral data. In addition, to refine the results from the multi-temporal approach, DMSP/OLS and VIIRS DNB night-time data were used to map and simulate the evolution of urban structures in the metropolis in 2030 at the regional scale. The study revealed that the trajectory changes of the Yakutsk subarctic metropolis are following the morphologic dynamics observed since the end of the 1990s. This form of territorialisation dynamic is intricately linked to a rapid increase in the population, which has risen from 192,000 inhabitants in 1990 to 347,182 inhabitants in 2021. The cartographic and statistical analysis and the CA-Markov chain simulations in 2030 show a good correspondence with the evolution of the spatial distribution of the population between 2001 and 2020. Furthermore, the LULC change analysis showed a continuous increase in urbanisation of 22,9 km^2 in 2015, 45,1 km^2 in 2020 and 84,5 km^2 in 2030. The increase of the road infrastructures and the buildings of the bridge crossing the Lena River will accelerate the trajectory of the morphologic change observed. However, the impact of global warming on permafrost melting is not considered yet. But the impacts are limited because of the technics of building and the limited impacts on soil dynamics. The impacts on the landscape's changes can be significant (Zakharov et al. 2021). According to the satellite sensors, the level of accuracies of the LULC modelling and CA-Markov chain simulations is up from 77% by Landsat-5 TM/8 OLI to 94% with Sentinel-2 MSI. The implementation of oriented object knowledge in the simulation model decreases the level of accuracy performances of the CA-Markov chain simulations: the reasons can be related to the probabilistic model itself, and the type of knowledge and surveys.

Acknowledgements This research was supported by the French National Research Agency (ANR) through the Polar Urban Centers (PUR) project (ANR-14-CE22- 0015), the CNES TOSCA AIM-CEE (Contribution of Multi-Sensor Satellite Imaging to respond to Environmental and Societal issues of Urban Socio-Systems), the CNES TOSCA TRISHNA URBAIN, and the FMSH-RSF research program Human Security in the Russian Arctic Zone.

References

Almeida De CM, Monteiro AMV, Camara G, Soares, Filho BS, Cerqueira GC (2005) GIS and remote sensing as tools for the simulation of urban land use change. Int J Remote Sens 26(4):759–774

Anderson JR (1976) A land use and land cover classification system for use with remote sensor data, vol 964. US Government Printing Office, Washington DC

Bhatti SS, Tripathi NK (2014) Built-up area extraction using Landsat 8 OLI imagery. Giscience & Remote Sens 51(4):445–467

Bhatti SS, Tripathi NK, Nitivattananon V, Rana IA, Mozumder C (2015) A multi-scale modeling approach for simulating urbanization in a metropolitan region. Habitat Int 50(12):354–365

Buchhorn M, Lesiv M, Tsendbazar NE, Herold M, Bertels L, Smets B (2020) Copernicus global land cover layers-collection 2. Remote Sensing 12(108)

Eskandari S, Reza JM, Oliva P, Ghorbanzadeh O, Blaschke T (2020) Mapping land cover and tree canopy cover in Zagros forests of Iran: application of sentinel-2, google earth, and field data. Remote Sens 12(12):1912

Fedorova EN (1998) Naselenie Jakutii: proshloe i nastojashhee (geodemograficheskoe issledovanie) [The population of Yakutia: past and present (geodemographic study)]. Novosibirsk: Nauka Publ 207

Fedorova SA, Bermisheva MA, Villems R, Maksimova NR, Khusnutdinova EK (2003) Analysis of mitochondrial DNA haplotypes in Yakut population]. Mol Biol 37(4):643–653

Fulton W, Pendall R, Nguyen M, Harrison A (2001) Who sprawls most? How growth patterns differ across the US. http://www.brookings.edu/~/media/research/files/reports/2001/7/metropolitanpolicyfulton/fultoncasestudies.pdf

Gadal S, Zakharov M, Kamičaitytė J (2022) Territorialisation, urbanisation, and economic development in the Russian arctic: energy issues. Valery I. Salygin. Energy of the Russian Arctic. Ideals and Realities, Springer Nature Singapore, pp 441–458

Gidey E, Dikinya O, Sebego R (2017) Cellular automata and Markov chain (CA_Markov) model-based predictions of future land use and land cover scenarios (2015–2033) in Raya, northern Ethiopia. Model Earth Syst Environ 3:1245–1262

Janiec P, Gadal S (2020) A comparison of two machine learning classification methods for remote sensing predictive modeling of the forest fire in the North-Eastern Siberia. Remote Sens 12(24):4157

El Jazouli A, Barakat A, Khellouk R, Rais J, El Baghdadi M (2018) Remote sensing and GIS techniques for prediction of land use land cover change effects on soil erosion in the high basin of the Oum Er Rbia river (Morocco). Remote Sens Appl: Soc Environ 13:361–374

Jensen JR (2005) Introductory digital image processing: a remote sensing perspective, 3rd edn. Pearson Prentice Hall, Upper Saddle River

Kantakumar LN, Neelamsetti P (2015) Multi-temporal land use classification using hybrid approach. Egypt J Remote Sens Space Sci 18(2):289–295

Kenworthy JR, Laube FB (1996) Automobile dependence in cities: an international comparison of urban transport and land use patterns with implications for sustainability. Environ Impact Assess Rev 16(4–6):279–308

Klimsiak T (2016) Right Markov processes and systems of semilinear equations with measure data. Potential Anal 44(2):373–399

Lo CP, Choi J (2004) A hybrid approach to urban land use/cover mapping using Landsat 7 enhanced thematic mapper plus (ETMþ) images. Int J Remote Sens 25(14):2687–2700

Longley PA, Mesev V (2000) On the measurement and generalisation of urban form. Environ Plan A 32(3):473–488

Péné-Annette A, Gadal S, Kamicaityte-Virbasiene J (2017) Pioneering cities of mining: comparison of the eastern Venezuela and eastern Siberia. Antonio Angelo Martins da Fonseca, Antonio Puentes, Brais Estévez Vilariño. Digit Cities Spat Justice 135–145

Petrov MI, Fedorov AN, Konstantinov PY, Argunov RN (2022) Variability of permafrost and landscape conditions following forest fires in the Central Yakutian Taiga zone. Land 11(4):496

Powell R, Roberts DA, Dennison PE, Hess L (2007) (2007) Sub-pixel mapping of urban land cover using multiple endmember spectral mixture analysis: Manaus, Brazil. Remote Sens Environ 106(2):253–267

Randazzo G, Cascio M, Fontana M, Gregorio F, Lanza S, Muzirafuti A (2021) Mapping of sicilian pocket beaches land use/land cover with sentinel-2 imagery: a case study of Messina province. Land 10(7):678

Serra P, Pons X, Sauri D (2008) Land-cover and land-use change in a Mediterranean landscape: a spatial analysis of driving forces integrating biophysical and human factors. Appl Geogr 28(3):189–209

Sukneva SA (2021) Migration processes in the Sakha republic (Yakutia). Espace populations sociétés

Vinokurova TZ, Shurgina AI, Zheleznova GA (1994) Demograficheskaja situacija v Respublike Saha (Jakutija): problemy i perspektivy [The demographic situation in the Republic of Sakha (Yakutia): problems and prospects], Jakutsk: JaNC SO RAN 72

Wilson JS, Clay M, Martin E, Stuckey D, Vedder-Risch K (2003) Evaluating environmental influences of zoning in urban ecosystems with remote sensing. Remote Sens Environ 86(3):303–321

Zakharov M, Gadal S, Danilov Y, Kamičaitytė J (2021) Mapping Siberian arctic mountain permafrost landscapes by machine learning multi-sensors remote sensing: example of Adycha river valley. In: 7th international conference on geographical information systems theory, applications and management (GISTAM 2021), INSTICC, online streaming, Czech Republic. pp 125–133. ffhal-03207301

Zanganeh Shahraki S, Sauri D, Serra P, Modugno S, Seifolddini F, Pourahmad A (2011) Urban sprawl pattern and land-use change detection in Yazd, Iran. Habitat Int 35(4):521–528

Zeng H, Sui DZ, Li S (2005) Linking urban field theory with Gis and remote sensing to detect signatures of rapid urbanization on the landscape: toward a new approach for characterizing urban sprawl. Urban Geogr 26(5):410–434

Zhao P (2010) (2010) Sustainable urban expansion and transportation in a growing megacity: consequences of urban sprawl for mobility on the urban fringe of Beijing. Habitat Int 34(2):236–243

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 24
The Invention of the Old City. A Didactic Experiment: Three Projects for Lübeck

Michele Caja and Pierfrancesco Sacerdoti

Abstract The rebirth of the urban image of German cities built up over the centuries—cancelled by the war, later demolitions and modern reconstructions—raises crucial issues in the discussion about strategies to adopt in historical contexts. The small-sized structure of the urban plots, which was often replaced by larger buildings, is the common element present in some German city centers. Different strategies adopt two different kind of interventions: "pilot buildings", which reconstruct the original buildings as *copies;* new buildings which reinterpret the original houses in a contemporary way. According to the principles of *critical reconstruction*, introduced in the European debate starting from the 1970s, the recent transformations of some urban blocks inside the medieval Gründungsviertel (Founders District) in Lübeck has become a positive example for a didactic experiment in the master's degree at the Politecnico di Milano (2020–2021, with Prof. Annegret Burg). After an in-depth analysis of the historical morphological structure of the urban form of one of the oldest Hanseatic cities of northern Germany, the research work led to design proposals for the blocks around the Marktplatz and the so-called *Buddenbrookhaus*, aimed at replacing out-of-scale or poor-quality buildings from the post-war reconstruction period with new morphological structures, based on the original form, still legible today thanks to historical maps.

Keywords Lübeck · Critical reconstruction · Building typology · Urban morphology

This paper is divided into two parts: Chapters 1 and 2 (M. Caja) and Chapter 3 (P. Sacerdoti).

M. Caja (✉) · P. Sacerdoti
Politecnico Di Milano, Milano, Italy
e-mail: michele.caja@polimi.it

P. Sacerdoti
e-mail: pierfrancesco.sacerdoti@polimi.it

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_24

24.1 Introduction

The small-sized structure of the urban plots, which was often replaced by larger buildings, built between the 1960 and 1980s, is the common element of recent urban reconstructions in some historical German cities. Starting from the first one, Hildesheim, other important centers were reconstructed in the following years: among them, the centers of Dresden and Frankfurt am Main, but also some historical urban blocks in the Friedrichswerder in Berlin, Potsdam and Lübeck. Reproposing the historical image, which was radically cancelled by several historical events—like wars and urban transformations in the 1950 and 1960s–, opens new questions inside the current debate on authenticity of historical context and its relation to new interventions.

The adoption of different strategies makes use at the same time of "pilot buildings"—rebuilt as *copies*—and new buildings which reinterpret the original houses.

24.1.1 Cultural Background

The relationship with pre-existing urban contexts was introduced in Italy in the 1950s by Rogers (1955) as a design process strictly related to historical buildings. Such a relationship is also present here, even if often reproposed in its *immateriality*, for the almost complete disappearance of the original constructive substance. That is why the rebirth of their *historicity* needs an intense force of imagination which becomes a real process of invention according to the original state, as intended in general by Eric Hobsbawm in relation to tradition (Hobsbawm and Ranger 1983): Traditions are not fixed and constant over time, but must be kept alive and in some cases constantly reinvented.

After World War II, German cities often decided to eliminate the original urban layout of plots, streets and squares, even if some of it was still present in the foundations of houses. The decision to remove it completely was taken to solve the then most urgent problems—such as traffic, parking spaces and new technical buildings for administration, offices and schools—in accordance with the new requirements dictated by the rebuilding city. In these reconstructions, references to the pre-existing structure were completely absent. They were also the mirror of cultural and ideological ideas against the ways of the past, which were considered useless compared to the concrete needs of the present. Only certain parts could be preserved as evidence of an earlier world.

Only later did a change of perspective emerge. The question of a new *heart of the city*, discussed at the CIAM Congress in the early 1950s (Rogers et al. 1952), was put in relation to the notion of *collective memory*, which Aldo Rossi took up from Halbwachs (1949) to show continuity with history within the *architecture of the city*. This gave rise to new analytical studies—especially in Italy (Caja et al. 2010) and Great Britain (Whitehand 2001)—on historical contexts, but also to the first

reconstruction proposals for German and Belgian cities, according to the militancy of the Krier brothers and Maurice Culot.

The case studies considered here have in common the same principle based on the historical arrangement of the pre-existing structure of urban blocks. It is in fact since the *kritische Rekonstruktion* movement, which arose at the end of the 1970s, that architects and town planners began to take the historical urban layout as a reference for their projects on an urban scale. This gave rise to a new type of architect (Borasi 2015) actively engaged in the reconstruction of European cities, from which they drew traditional figures relating to their urban spaces and residential typologies. Within the school of La Cambre and the Archives d'Architecture Modern (A. A. M.), led by Robert Delevoy, a resistance movement arose against the proposals that envisaged the destruction of the *Marolles* neighbourhood in the historic centre of Brussels, which led to the Brussels Declaration (Barey 1980), a veritable manifesto of a counter-culture to the tabula rasa principles inherited from Modernism.

24.1.2 Methodology

The methodology used here to analyse different case studies of recent reconstructions and to present the partial results of an Architectural and Urban Design Study held with Prof. Annegret Burg at Politecnico di Milano in 2021, is based on a morpho-typological approach. To better understand the meaning of these reconstructions, it was essential to take the structure of urban plots (*Parzellierung*)—as documented in historical maps and cartography—as the basis for our proposals. Only in a few cases was this structure evidenced by concrete material traces, as most of them were erased by hasty post-war interventions. Due to these transformations, the individual plots of land, whose ownership was generally private, and the layout of individual houses were mostly erased.

Today's return to a *Parzellierungsplan* aims to correct these interventions by redefining new common urban rules and architectural guidelines. As in the case of Berlin's Pariser Platz, the reconstruction of the original *Parzellierung* takes place to link urban morphology and architectural design (Malfroy 2001). The building typology is generally defined by the single block house, aligned with the street and leaning against neighbouring houses, which characterizes the historical image of streets and squares. Within this typology, there are variations in the relationship between the size and shape of the individual plot, the orientation with respect to the street, and the internal layout. In some cases, the subdivision of a single block into several plots allows the creation of a collective inner courtyard, to which the individual houses are connected.

From this concrete need to safeguard the existing historical structure, a new awareness of their value and identity, as well as of their exemplarity on an operational level, has emerged. The quality of these places is rediscovered not only as evidence of a past worthy of preservation for the authority that authentic historicity confers on it—generally limited within the notions of monument and document—but also as

an example for concrete learning, through the appropriation of its urban principles and architectural solutions. From the morphological point of view some aspects can be identified: the often-irregular shape of streets and squares; the parcelled structure of blocks; gardens and internal courtyards. Other aspects are typological and architectural: the façade, as representative element between the public and private spheres; the entrance as a moment of identity of the individual address; the roof as a conclusion; the choice of materials according to the tradition of the historical context (Caja 2019).

24.2 Urban Corrections

Retracing the long *history of reconstruction* (Nerdinger et al. 2010), the case studies here analyzed are paradigmatic not only for the questions they pose, but above all for the design solutions they propose. These are never to be understood as mere copies, but require a high level of creative reinterpretation. Far from stylistic reconstructions, these examples can be considered true design exercises in which contemporary architecture must question and confront itself with the vanished historical image. On an architectural level, it makes use of the *image* of houses and urban spaces that once existed and were later destroyed, documented today by historical drawings, paintings, prints and photographs. This documentation serves as a concrete basis for point replacements of oversized buildings constructed in the preceding decades.

24.2.1 German City Centres

An early example of this is the small town of Hildesheim in Lower Saxony, where the reconstruction of the medieval ensemble was made possible after the removal of a modern building from the 1950s (Häger 2011). This intervention represented a pilot project for other cities, where similar punctual replacement strategies were adopted. In Dresden, an oversized building complex from the 1980s had to be removed to enable the reconstruction of the historical blocks of the old square Am Neumarkt. In Berlin, the Socialist-era Foreign Ministry was destroyed after the demolition of the wall and in its place two residential blocks modelled on the original historical layout were built. Frankfurt am Main's Technische Rathaus, which was a huge 1970s complex built in the forms of British Brutalism, was also destroyed in 2010 for the reconstruction of the old Dom-Römer Areal, which connects the main square to the old cathedral. A similar process of replacement is taking place today in Potsdam, where socialist building complexes have been removed for the construction of new urban blocks around the Castle, also rebuilt a few years ago.

The use of a mixed model makes it possible to reproduce both the old buildings *where they were and as they were*, as well as creative reinterpretations of the old houses. This model was first applied in the Baroque blocks around the Neumarkt in

Dresden and the reconstructed Frauenkirche. Even Frankfurt's Dom Römer Areal is today a collection of individual townhouses, some of which are exact copies of the originals, while most of the others are designs by various local and non-local architects (Figs. 24.1 and 24.2).

Also in Berlin, some new old blocks have been reconstructed on a master plan designed by Klaus Theo Brenner, re-proposing their compact morphology. Such a *mixité* is also applied in Potsdam, next to Berlin, where the blocks around the Alter Markt refer to a common master plan, which is composed of different types of intervention: from the re-proposition of the original houses with their façades dating back to the eighteenth century—themselves copied from Italian Renaissance examples (copies of copies)—to new townhouses that follow common volumetric and compositional guidelines (Figs. 24.3 and 24.4).

Fig. 24.1 Dresden, Neumarkt (left): Plan, 1828 (Von Lesch); 8 Quartiere, 2002, plan. Above: Von Heinrich Lesch, Dresden, Stadtplan 1828 (extract). Down: Neumarkt, 8 Quartiere: Rekonstruktionsplan. From: Caja, M, (ed.): Neue Projekte in historischen Deutschen Städten. Quaderno di Aión 23 (2019): 18 and 20

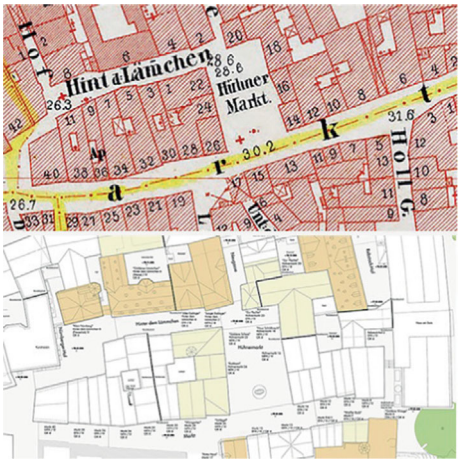


Fig. 24.2 Frankfurt am Main, Dom Römer Areal: plan, 1861 (Ravenstein); actual plan. Above: Frankfurt am Main, Ravenstein Plan, 1861 (Sheet 15, Extract). Down: Actual plan (extract). From: Caja, M, (ed.): Neue Projekte in historischen Deutschen Städten. Quaderno di Aión 23 (2019): 34 and 41

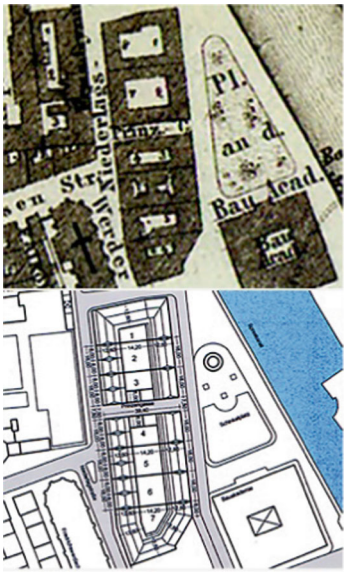


Fig. 24.3 Berlin, Friedrichswerder: plan, 1867 (Liebenow); plan, 2005 (Brenner). Above: W. Liebenow, Situationsplan von der Haupt- und Residenzstadt, 1867 (extract). Down: K. Th. Brenner, Rahmenplan für die Bebauung am Schinkelplatz, 2005 (extract). From: Caja, M, (ed.): Neue Projekte in historischen Deutschen Städten. Quaderno di Aión 23 (2019): 80 and 83

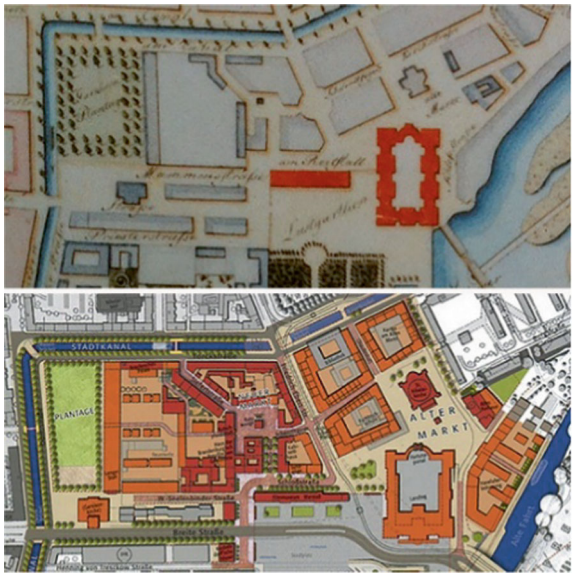


Fig. 24.4 Potsdam (right): plan, 1778 (Oesfeld); plan, 2012. Above: C.L. Oesfeld, Potsdam, Plan 1778 (extract). Down: Reorganisation concept, situation 2012. From: Caja, M, (ed.): Neue Projekte in historischen Deutschen Städten. Quaderno di Aión 23 (2019): 92 and 94

24.3 The Case of Lübeck

24.3.1 The Gründungsviertel

The same strategy has been adopted in the centre of Lübeck, where two vocational schools from the 1950s have been demolished to allow the critical reconstruction of some blocks in the Gründungsviertel, the historic Founders' quarter. Starting in 1990, after the demolition of the two schools and thanks to the support of the UNESCO World Programme Lübecker Altstadt, archaeological excavations and documentary analysis of the site began.

This neighbourhood is a typical example of Lübeck's current situation, in fact a collage of different ideas of city and architecture, where historic houses and monuments coexist alongside structures built between the post-war period and the present day, mostly producing an alienating effect. According to Hans Stimmann, in fact, it is not unity that defines the centre of Lübeck, but rather its fragmentation, often the result of transformations carried out without considering the memory of the historical heritage. A loss of memory that made possible, for example, the recent construction of an out-of-scale garage within the once densely parcelled city block where, among other old houses, stood the well-known *Buddenbrookhaus*, the family home in which many scenes of Thomas Mann's novel were set (Stimmann 2012) (Fig. 24.5).

Talking about the characters of the house in historical German cities means—according to Giorgio Grassi—referring to its forms and types. The type-morphological, formal, and constructive characters distinguish the historical German house as a minimal element of the urban layout (Grassi 1980). The urban image of Lübeck has developed according to a progressive process over time, with the use of a small number of building types. The *permanence*, according to the notion given by Rossi (1982), of its system is defined by the arrangement of streets, blocks, and their parcelled structure, from which basically two distinct types of juxtaposed block houses derive. These are based on their relationship to the street: the *Giebelhaus*, with

Fig. 24.5 Lübeck, Gründungsviertel: urban plan, 1872; the parcelled blocks on actual view. Above: Parcelisation plan and residential typologies. Down: The parceled blocks on actual view. From: Caja, M, (ed.): Neue Projekte in historischen Deutschen Städten. Quaderno di Aión 23 (2019): 116

Fig. 24.6 Gründungsviertel: townhouses in construction. Fotos: Michele Caja, 2020

its façade facing the street and its development in depth, and the *Traufenhaus*, oriented parallel to the street and overlooked by the eaves line (Dickinson 1951). These two types of houses, in their variations, have persisted over the centuries, despite the different stylistic and architectural variations of their façades: Romanesque, Renaissance, Baroque, neoclassical, historicist, eclectic, Jugendstil and contemporary, as in the new blocks under construction in the Gründungsviertel.

The layout of the neighbourhood—based on narrow, elongated blocks on the sloping terrain between the Marienkirche and the River Trave—follows the strategy of the cases mentioned above. Depending on the shape of the historical plots, the available plots have different sizes, thanks to which the richness and variety of the urban image of the past is recreated. The typological variants of the individual houses can accommodate different destinations for a total of 170 units, including flats, shops, and ground floor offices. The characteristics of the new quarter follow those of the medieval center of Lübeck: the density of the blocks, the compactness of the individual houses leaning against each other and the individuality of each façade. (Fig. 24.6).

24.3.2 Three Urban Projects

In continuity with the strategies introduced by this case study, a didactic experience was carried out at the Politecnico di Milano within the Architectural Design Studio (Master Thesis) held by Prof. Michele Caja together with Prof. Annegret Burg.[1] The aim was to elaborate a common plan for the centre of Lübeck based on the reconstructive principles of the case studies. Through replacement or completion operations, the plan seeks to restore the original shape of the historical blocks, based on a careful analysis of the original parcels.

[1] Laboratorio di Progettazione Architettonica 1 (Master's Course); Professors: Michele Caja, Annegret Burg, Maurizio Acito; Tutors: Arch. Martina Camesasca, Arch. Marzia Foglia, PHD Arch. Pierfrancesco Sacerdoti, Politecnico di Milano, 2020–2021.

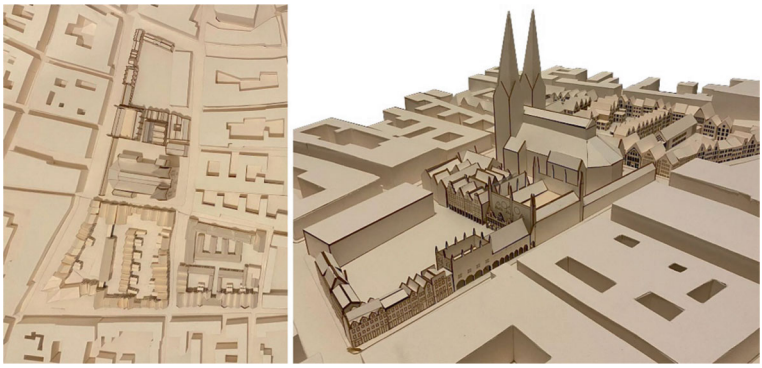


Fig. 24.7 Lübeck, Marienkirche: the three projects, view of the physical model. Politecnico di Milano: Laboratorio di Progettazione Architettonica 1, Master-Degree, 2020–2021. Professors: Annegret Burg, Michele Caja; Tutor: Pierfrancesco Sacerdoti

These blocks have been divided into four thematic areas, identified according to their location: the western entrance area to the old city, around the Holstentor and the old Salt Warehouses, and the blocks on the other side of the Trave river; the blocks around the Marktplatz, dominated by the presence of the old City Hall, and those to the north, including the *Buddenbrookhaus*—where Thomas Mann set many scenes of his famous book—which now houses a cultural centre; the blocks located along the eastern edge of the old city, also in close relation to the waterway and characterized by its minute urban fabric; the strip of land originally used for port activities and now being renovated for cultural, hotel and residential use.

The three projects that follow express the strategy adopted for the partial reconstruction of the centre of Lübeck, based on the pre-war situation and specifically on the 1910 Katasterplan, which is remarkable for its precision but shows a situation which was already altered by some urban projects and buildings built during the period of industrial and mercantile development, between the mid-nineteenth century and the beginning of the 20th (Fig. 24.7).

The general approach is that of critical reconstruction, adopted in various German cities. The main sources of inspiration were the Dom Römer project in Frankfurt and the Gründungsviertel in Lübeck, which follow the idea of a partial reinterpretation of the traditional row houses and urban fabric.

The functions are mixed in order to avoid the zoning criteria which were used after World War II and which partly caused the destruction of old city centres. Thus, there are shops or offices on the ground floor, in the spaces which are in closer contact with the streets and squares (public life of the city) and residential units on the upper floors. Some public functions such as schools, museums, exhibition spaces, centres for retired people are also included.

Project 1—Around the Marktplatz[2]

[2] With students Armin Grassi, Alessandra Monteriso, Silvia Puppin and Alessandro Vago.

The first project deals with the buildings and blocks which surround the Marktplatz—the Market square—which is one of the most significant public spaces of the old city. Today the only surviving historical building is the Rathaus—the Town hall–, on the northern and eastern sides, which stands out as one of the main monuments of the city, made up of various buildings layered over the centuries, from the Middle Ages to the Renaissance. The remaining sides were all rebuilt after World War II, although the late nineteenth century main post office building to the west had also escaped destruction: it was recently replaced by a department store. On the other sides there is a series of rather anonymous post-war buildings: for apartments and shops to the east and south, and for administrative offices—basically an extension of the Rathaus—to the north. Only recently one of the office buildings on the northern side, facing the former post office building and now opposite the department store, was replaced by a hotel which attempt to evoke the mediaeval urban fabric, for example with the use of gabled roofs, while the inner typology is largely independent from the context. A portico was created on the ground floor towards the south. The present situation does not appear adequate to the presence of the Rathaus and to the important role the square played in the past (Fig. 24.8).

The project proposes the demolition and reconstruction of all the post-war buildings surrounding the square, except for the hotel and the department store, due to their recent construction. The new buildings are thus located north, east, and south of the square and are based as much as possible on the layout of the historical urban parcels, while the facades and inner distribution are designed more freely, although taking the buildings of the pre-war period always into consideration.

A more complex situation is to be found on the northern side, where the project is conditioned by the presence of two important monuments: the Rathaus and the Marienkirche, the largest and most impressive of the gothic churches in Lübeck. Here two small blocks separated by narrow streets, partly following the historical situation, were designed. To the south four row houses evoke the building which stood here before the war, mostly narrow gable houses with shops on the ground floor. Since both the Rathaus and the hotel have porticos, it was decided to complete the system by creating a portico also in the buildings of the project. The larger block to the north, opposite the south side of the Marienkirche, was designed as a museum with a café and free exhibition space on the ground floor. The heart of the museum is the central courtyard, covered with a glass roof. Despite the unitary function of the block, the position of the inner load-bearing walls and the gables towards the adjoining streets are based on the characteristics of the historical building which stood here formerly.

The rows of thin blocks between the Marktplatz and the Breite Straße to the east, and between the Marktplatz and the Kohlmarkt to the south are simply replaced by new buildings based on historical photographs of the square and whose typologies are more coherent with the architectural tradition of the city. The roofs of the new buildings are pitched but their orientation varies: some belong to the older Giebelhaus typology, and others to the more recent Traufenhaus typology, thus evoking the layering which occurred in Lübeck over the centuries (Fig. 24.9).

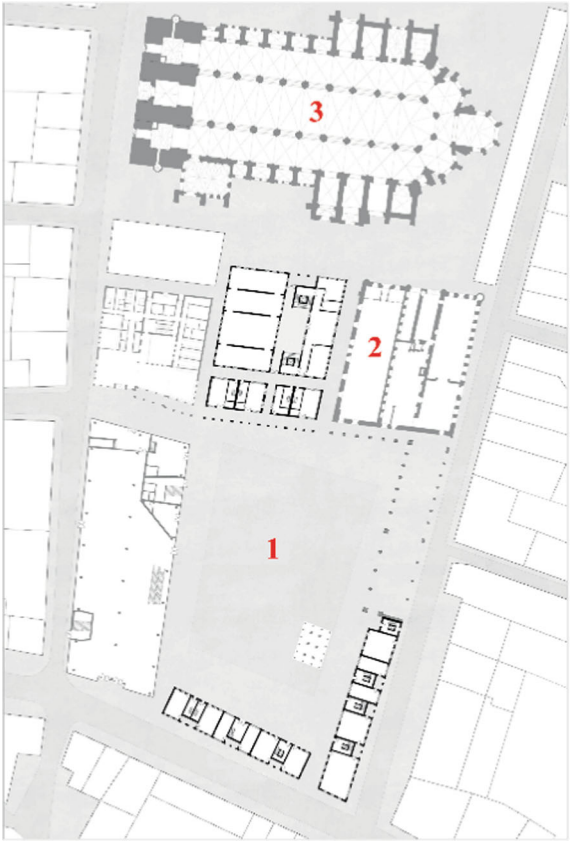


Fig. 24.8 Lübeck, project 1. Ground floor plan: Marktplatz (1), Townhall (2), Marienkirche (3). Politecnico di Milano: Laboratorio di Progettazione Architettonica 1, Master-Degree, 2020–2021. Professors: Annegret Burg, Michele Caja; Tutor: Pierfrancesco Sacerdoti

Project 2—The Block between Mengstraße, Fünfhausen, Beckergrube and Breite Straße[3]

The second block taken into consideration is located north of the Marienkirche and is characterised by the presence of the so-called Buddenbrookhaus, which was the home of Thomas Mann's grandparents and where he set many episodes of his first masterpiece. Today the only surviving part of the original house is the façade, restored after World War II with minor alterations, while the interior was gutted by fire following the 1942 bombing. Rebuilt and then adapted to house the Heinrich-undThomas-Mann-Zentrum, is it currently being enlarged by adding the adjoining house to the left, a post-war construction with a mediaeval façade saved from another building on a different site. On the Mengstraße most of the other historical buildings (or at least their facades) were spared by bombs, fires, and subsequent reconstruction projects, saving the pre-war context of the magnificent side façade of the Marienkirche, also thanks to the involvement of Thomas Mann (https://buddenbrookhaus.de/home).

[3] With students Claudia Guerini, Sofia Mariano and Sara Nati.

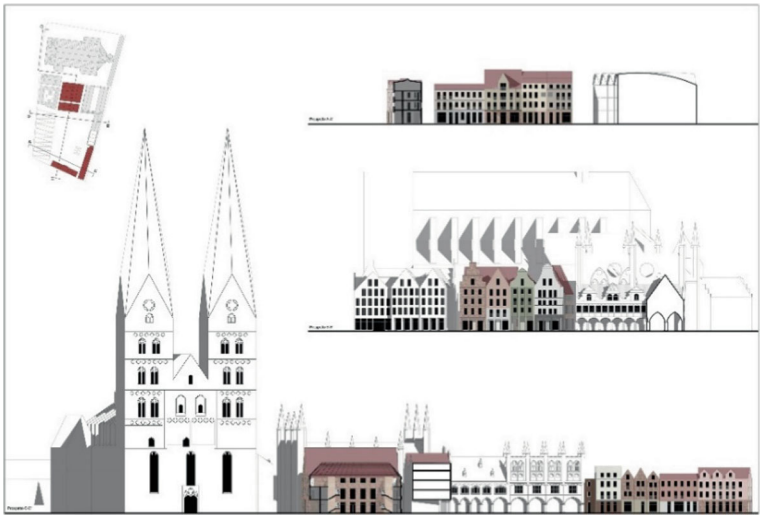


Fig. 24.9 Lübeck, project 1. Sections and Urban street fronts around the Marktplatz, with the Marienkirche (left) and the Rathaus (right). Politecnico di Milano: Laboratorio di Progettazione Architettonica 1, Master-Degree, 2020–2021. Professors: Annegret Burg, Michele Caja; Tutor: Pierfrancesco Sacerdoti

A few other historical merchants' houses have survived on Fünfhausen and Breite Straße just around the corner from Mengstraße, while the remainder were entirely rebuilt after World War II, with new buildings for apartments, offices, and shops. The new buildings follow the alignments set by post-war urban planning, which strove at widening the streets for increased automobile traffic. The cars needed to park however, and so many raised parking lots were built at the centre of the blocks, as in this case, producing poor urban quality on the inner side of the blocks to favour functionality (Stimmann).

In this part of town there is an incline, so Mengstraße is about 5 m higher that the parallel street Beckergrube: this had to be taken into consideration in the project. In the 1910 Katasterplan the centre of the block was occupied by a covered market, but this was built after the Mann family sold the house around 1890. Before, as stated by a passage in the novel, the property ran the entire depth of the block and actually reached Beckergrube, thus making it a pass-through lot (Mann 1971).

This discovery influenced the project strongly: the idea of a connection between the Buddenbrookhaus and the Theater Lübeck on the Beckergrube (not yet built at the time of the Manns) was endorsed by this discovery, thus a choice was made to prolong the house by building an extension within the block: a long building—somewhat like a barn or elongated single nave church—housing an auditorium below and a library above, partly inspired by the European Hansemuseum in Lübeck and partly by Herzog and De Meuron's Fondazione Feltrinelli building in Milan. The new building replaces the car park (Fig. 24.10).

Fig. 24.10 Lübeck, Project 2. Ground floor plan: Inner Street (centre), lined with new houses to the left and the extension of Heinrich-und-Thomas-Mann-Zentrum (1). Politecnico di Milano: Laboratorio di Progettazione Architettonica 1, Master-Degree, 2020–2021. Professors: Annegret Burg, Michele Caja; Tutor: Pierfrancesco Sacerdoti

The sequence of old houses and new buildings is completed by a new entrance building opposite the theatre on Beckergrube and by an inner street on the west side, which follows the slope. The opposite side of the inner street is lined with a newly designed linear block of row houses with gardens behind, whose simplified forms make it clear that these houses are entirely new and not the reconstruction of pre-war historical buildings.

Exactly the opposite happens along Fünfhausen, Beckergrube and Breite Straße, where the new buildings evoke the pre-war houses by reproducing their typology, architecture, and alignment. The designs of the facades provide modern interpretation of the historical ones, as in the Gründungsviertel project.

The only exception to the rule is the preservation of the department store on the corner of Beckergrube and Breite Straße, owing to its recent construction: a case like that of the project for the Marktplatz, also conditioned by a recent and questionable department store. This was a challenge: how to integrate in the reconstruction of the old fabric a building so radically different for its scale, typology, architecture, and alignment?

The solution attempts to integrate the building as much as possible in the new fabric of residential buildings, both on the Breite Straße, where the alignment is rather close to the historical one, and on Beckergrube, where two new recessed gable houses fill the gap between the store and the entrance building to the extended Heinrich-und-ThomasMann-Zentrum, aligned with the *Buddenbrookhaus*, whose brick facades with small openings indicate the different inner functions. However, one may say that

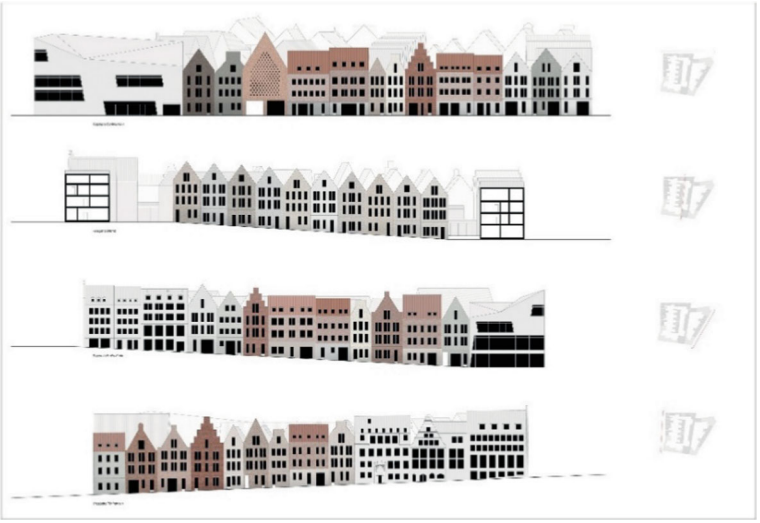


Fig. 24.11 Lübeck, Project 2. Urban street fronts (from the top): on Beckergrube, towards the new inner street, on Breite Straße, on Fünfhausen. Politecnico di Milano: Laboratorio di Progettazione Architettonica 1, Master-Degree, 2020–2021. Professors: Annegret Burg, Michele Caja; Tutor: Pierfrancesco Sacerdoti

the department store's pointed facades and roofline have an expressionist character which makes it compatible with the reconstructed mediaeval houses. The deep recess thus obtained towards Beckergrube becomes a sort of public square for the theatre, whose main entrance is located opposite.

By observing the general site plan, the principles which rule the project for this block emerge clearly: preservation of existing buildings when historical (houses on Mengstraße) or very recent (department store); construction of new houses following the typology and morphology of the pre-war city; creation of a new north–south "cultural axis": a pedestrian street, a modern version of the traditional *Gang*, connecting the theatre, the *Buddenbrookhaus* and the Marienkirche. This cultural axis is defined by the sloping inner street, the new residential buildings to the west, and the new cultural buildings to the east (Fig. 24.11).

Project 3—The Block between Meng-Und Blocksquerstrasse, Beckergrube and Fünfhausen[4]

The third and last project for this part of the city concerns the block to the west of the previous one, bounded by the following streets: Mengstraße, Blocksquerstraße, Beckergrube and Fünfhausen. In this block there are only two surviving historical buildings: a private house on the corner of Mengstraße and Blocksquerstraße, and a second one on Blocksquerstraße.

[4] With students Mattia Bottarelli, Federico Bruno, Mariana David Goncalves Frade and Alessia Fuoco.

It was decided to keep not only the two historical houses but also the post-war buildings facing the Mengstraße and the southern half of Fünfhausen: they are dignified brick buildings which have intrinsic architectural value, despite not following the footprint or typology of the pre-war urban fabric. This is one of the advantages of critical reconstruction: not the rigid replacement of all post-war buildings which do not follow the structure of the old city, but a subtle and flexible approach, which can combine the repetition of historical urban parcels and typologies, while saving the more recent buildings which keep in character with the tradition of the city, as in this case. Of course, the difficulty is greater, because it is necessary to find a balance between the surviving historical buildings, the post-war buildings worth preserving and the replacement of ill adapted post-war buildings with new structures.

The main issue here was how to organize the inner part of the block, since it acted as a sort of boundary between the post-war buildings to the south and the new buildings towards Beckergrube to the north: here it was decided to recreate the historical alignment, which had been altered after World War II by the general widening of the street (Fig. 24.12).

A T-plan inner passage was introduced, inspired by Lübeck's traditional Gänge (inner streets), with three entrances (on Blocksquerstraße, Beckergrube and Fünfhausen). Each entrance is treated differently: on Fünfhausen it helps soften the gap between the preserved post-war buildings and the new ones to the north, which follow the historical alignment and thus determine a narrowing of the street; on Blocksquerstraße the presence of one of the historical houses on the axis of the inner

Fig. 24.12 Lübeck, Project 3. Ground floor plan. Inner street, lined with old people's centre (1), kindergarten (2) and residential complex (3). Politecnico di Milano: Laboratorio di Progettazione Architettonica 1, Master-Degree, 2020–2021. Professors: Annegret Burg, Michele Caja; Tutor: Pierfrancesco Sacerdoti

street made it necessary to create a staggered solution, with a portico which leads to the courtyard—thus made public—between the two historical houses, qualified by the presence of a large preexisting tree; on Beckergrube the passage is accessible through a wide opening on the ground floor of one of the buildings, which is wider and has a roof parallel to the street: a Traufenhaus amidst the series of new Giebelhäuser.

The inner passage is lined with continuous two floor-buildings which evoke the traditional Buden (cabins) and which have different layouts and functions. The two L-shaped building to the north house respectively a kindergarten and a social centre for elder people; the inner gardens of both adjoin the private gardens of the row houses towards Beckergrube and Fünfhausen, thus making all gardens sunnier. The southern side of the passage is bounded by a comb-plan residential building with open courtyards and private gardens, which fills the gap between the passage and the taller post-war apartment buildings to the south.

The project is thus made up of autonomous and recognisable buildings, which are combined to create a harmonious whole, despite the inevitable contrasts and differences: the main objective is to mend the fabric of the block with the establishment of a new order. By observing the floor plans and scale model of the project, the various elements are recognisable and combine harmoniously at the same time: the historical houses to the west, the post-war buildings to the south, the comb building within, the T-shaped pedestrian passage, the two L-shaped building for the kindergarten and the old people's centre, the row houses to the north (Fig. 24.13).

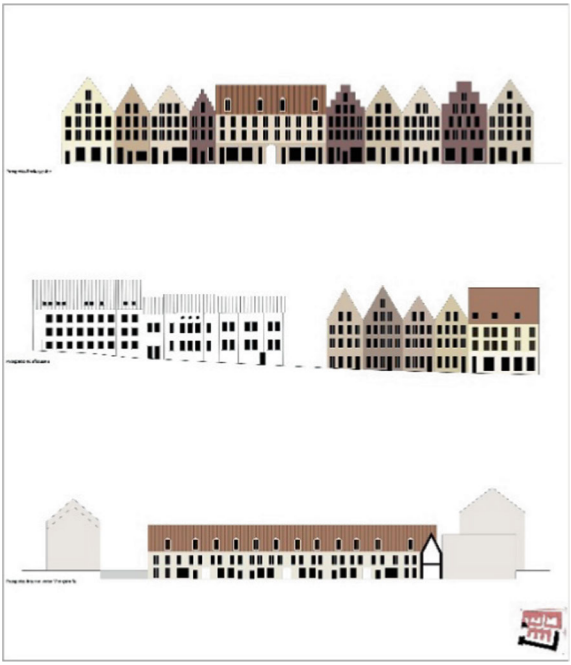


Fig. 24.13 Urban street fronts (from the top): on Beckergrube, Fünfhausen, the new inner street. Politecnico di Milano: Laboratorio di Progettazione Architettonica 1, Master-Degree, 2020–2021. Professors: Annegret Burg, Michele Caja; Tutor: Pierfrancesco Sacerdoti

24.4 Conclusions

Starting from these different projects, various common themes and principles emerge, used as bases for the reconstruction of the historical urban fabric:

- the alignment on the street;
- the re-proposal, as far as possible, of the urban parcels of mediaeval origin;
- the characterization of the individual typologies on the basis of certain architectural themes, which concern above all the configuration of the main façades on the street—simplified versions of the historical ones designed in the Renaissance, Baroque and Neoclassical periods—and those on the garden, often including lower internal wings;
- the introduction, within the compact residential fabric, of new collective facilities, such as schools, museums, cultural centres, hotels and commercial buildings;
- the presence, according to the typical Lübeck tradition, of passageways going through the block (*Gänge*), to establish a close relationship between courtyards and streets (Fig. 24.14)

Through this critical attitude between the pre-existing structure and new requests, the meaning of these proposals is defined. They are true contemporary reinterpretations of historical models, based on the needs linked to the memory and identity of

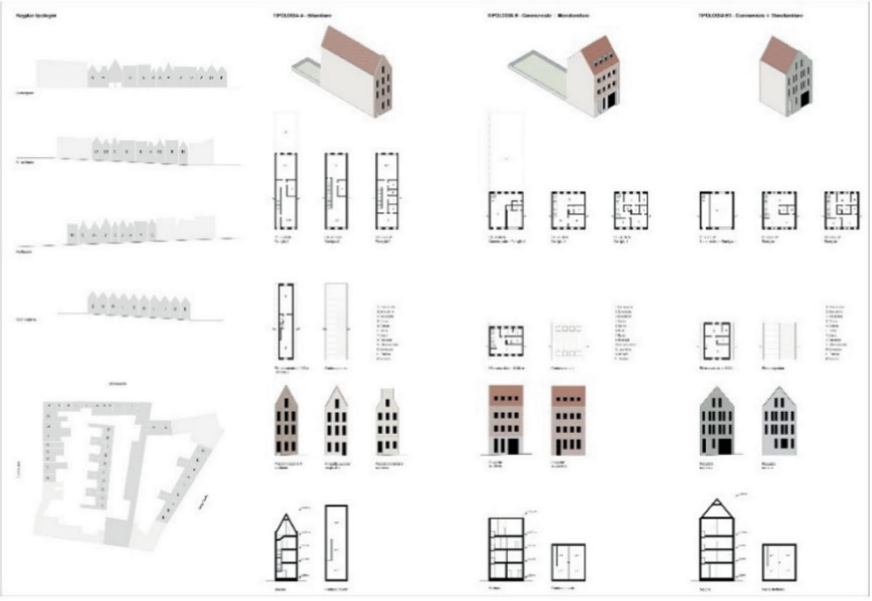


Fig. 24.14 Lübeck, Project 2. Typologies of houses. Politecnico di Milano: Laboratorio di Progettazione Architettonica 1, Master-Degree, 2020-2021. Professors: Annegret Burg, Michele Caja; Tutor: Pierfrancesco Sacerdoti

places in Lübeck that are the cornerstones of the urban and architectural culture of the European City (Gruber 1952).

What the limitations and shortcomings of the proposed reconstruction method are, can only be revealed in the near future, when it will become clear whether and how the city has truly been revitalised through these interventions and does not remain a mere copy of the historical image that has been lost over time.

References

Rogers EN (1955) Le preesistenze ambientali e i temi pratici contemporanei. Casabella-Continuità 204:3–6

Hobsbawm E, Ranger J (eds) (1983) The invention of tradition. Cambridge University Press, Cambridge

Rogers EN, Sert JL, Tyrwhitt J (eds) (1952) The heart of the city: towards the humanition of urban life. Pellegrini and Cudahy, New York

Halbwachs M (1949) La mémoire collective. Presses Universitaires de France, Paris

Caja M, Landsberger M, Malcovati S (eds) (2010) Tipologia Architettonica e morfologia urbana. Il dibattito italiano—antologia 1960–1980. Lampi di Stampa/Il Libraccio, Milano

Whitehand J (2001) British urban morphology: the Conzenian tradition. Urban Morphol 2:103–109

Borasi G (ed) (2015) The other architect: another way of building architecture. CCA, Spector Books, Montreal

Barey A (ed) (1980) Déclaration de Bruxelles. Propos sur la reconstruction de la ville européenne. A.A.M., Brussels

Malfroy S (2001) Urban morphology and project consulting: a Berlin experience. Urban Morphol 5(2):63–80

Caja M (ed) (2019) Neue Projekte in historischen Deutschen Städten. Quaderno di Aión 23

Nerdinger W, Eisen M, Strobl H (eds) (2010) Geschichte der Rekonstruktion. Konstruktion der Geschichte. Prestel, München

Häger H (2011) Der Marktplatz zu Hildesheim und das Knochenhaueramtshaus. Arch+ 204:70–75

Stimmann H (2022) Darf ein Parkhaus sich derart ans Buddenbrook-Haus drängen? In: Stimmans Stadtlektüren. Texte, Vorträge und Interviews 2012 bis 2022. Wasmuth & Zohlen, Berlin, pp 165–170

Grassi G (1980) Caratteri dell'abitazione nelle città tedesche. In: L'architettura come mestiere e altri scritti. Franco Angeli, Milano, pp 11–25

Rossi A (1982) The architecture of the city (L'architettura della città, 1966). MIT Press, Cambridge, Mass

Dickinson RE (1951) The west European city: a geographical interpretation. Routledge and Kegan Paul, London

https://buddenbrookhaus.de/home. Accessed July 2022. (Buddenbrookhaus/Heinrich-und-Thomas-Mann-Zentrum)

Stimmann H (n.d.) Darf ein Parkhaus sich derart ans Buddenbrook-Haus drängen. Op. cit

Mann T (1971) Buddenbrooks (Buddenbrooks: Verfall einer Familie, 1902). Penguin, Harmondsworth

Gruber K (1985) Forme et caractère de la ville allemande (Die Gestalt der Deutschen Stadt, 1952). A.A.M., Bruxelles (1985). On Lübeck: 114–121

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 25
Adaptation to Climate Change—A Challenge for Small Towns

Bartłomiej Olczak and Małgorzata Hanzl

Abstract A compact city is one of the leading solutions to counteract the negative impact of climate change. It is also considered a node in the Transit-Oriented Development network. However, while a higher urban density can, on the one hand, positively influence public infrastructure, transport and economics, on the other hand, as we learn from the analysis of Berghauser Pont et al., it can have negative environmental, social and health impacts. Therefore, the main objective of this research is to look for the trade-offs, including density and provision of open green areas that will serve climate change adaptation. While climate change adaptation has been explored through extensive literature, there is still much to research, especially when dealing with small towns as an element of the region. Therefore, this paper focuses on a small town—Zgierz (less than 60.000 inhabitants) post-industrial town in central Poland near Lodz. The study presents the quantitative analyses of the urban form of Zgierz town centre, prepared using GIS using open-source data. First, we estimated the current residential densities and calculated population densities by applying the morphological types' framework. Then we examined the provision and the actual distances to green areas. Moreover, the results were compared with local urban development documents. In conclusion, this paper presents the recommendations for balancing the density and amount of open green areas for the town centre of Zgierz and the scenarios for densifying urban lots in the heritage part of the town.

Keywords Small town · Climate change · Adaptation · Urban form

B. Olczak (✉)
Institute of Architecture and Town Planning, Lodz University of Technology, Lodz, Poland
e-mail: bartlomiej.olczak.1@dokt.p.lodz.pl

M. Hanzl
Institute of Architecture and Town Planning, Lodz University of Technology, Lodz, Poland
e-mail: malgorzata.hanzl@p.lodz.pl

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_25

25.1 Introduction

A compact city is one of the planning strategies to counteract the negative impact of urbanisation on the environment and biodiversity (Concepción et al. 2015) and to mitigate climate change (European Commission 2013, Gren et al. 2019; MA 2005). It is beneficial because it limits land consumption, enhances walkability, and potentially allows Transit-Oriented Development strategies (Calthorpe 2011). However, as we learn from the analysis of Berghauser-Pont et al. (2021), whereas a higher urban density can, on the one hand, positively influence public infrastructure, transport and economics, on the other hand, it can have negative environmental, social and health impacts. Therefore, the main objective of this research is to look for the trade-offs, including density values and the provision of open green areas that will serve climate change adaptation, particularly disaster management and environmental protection. Greenery reduces temperature, absorbs air pollution, contributes to water retention and provides many other services.

While climate change adaptation has been explored through extensive literature (Hunt and Watkiss 2011; Quay 2010) and policy documents (European Commission 2013; 2019; MA 2005), many threads still need further research. One such topic is the potential for adaptation regarding the relationship between the attractiveness of the core areas as places of residency and the amount of urban sprawl in a given town. This depends on the type of urban fabric—using the typology of Newman and Kenworthy (Newman and Kenworthy 2015) belonging to the following categories: walking city, tram suburbs, transit city, automobile city and exurban—and on the type of transportation infrastructure; in particular on the provision of public transportation services. Another factor vital for such considerations is the role of a given settlement in the region's overall settlement structure hierarchy. The above relationship is particularly noticeable for small towns near the regional centre. Therefore, in the current paper, we examine a case study of a small town—Zgierz, in central Poland near Lodz and focus on its potential for climate adaptation. Due to the collapse of the textile and chemical industries, it needs revitalisation of its core part.

Furthermore, progressing sprawl and de-urbanisation processes exacerbate the degradation of the town centre. Demographic forecasts indicate that the population of Zgierz will decrease. In 2030, it is predicted that only 53,578 people will inhabit the city (GUS 2017), i.e., 1,400 less than at present. Nevertheless, Zgierz could be transformed into one of the nodes in the regional settlement structure, implementing a Transit-Oriented Development strategy.

The current paper presents the quantitative analyses of the urban form of the town centre of Zgierz, prepared using GIS and open-source data. First, we estimated the current residential densities and calculated population densities by applying the morphological typology framework (Romice et al. 2020). Then the provision and the actual distances to green areas were examined. Moreover, plan development capacities were also addressed based on the Local Spatial Development Plan and the Study of Conditions and Directions of Spatial Development. Finally, the results were compared and assessed. In conclusion, this paper presents the recommendations for

balancing density and amount of open green areas for the town centre of Zgierz as an example of a small town—a node in the urbanisation network located close to the main city of regional relevance. Moreover, our study aims to evaluate the city government's interventions in climate change adaptation—explicitly—providing residents with new green spaces.

25.2 Background

Although the cities' population continues to grow, this does not translate into an increase in population density but rather an expansion of the urbanised area (Angel et al. 2011; Gren et al. 2019; Haase et al. 2013). At the same time, the growing use of cars creates an increasing demand for space. This applies to all the elements of the settlement structure and affects the demand for both roads and parking spaces. However, spatial resources, particularly in cities, are limited (UITP 2001). According to *the urban commons* approach (Newman and Kenworthy 1999), urban transformation should focus on transport space (roads, car parks) and public space. A compact city's goals should be linked to environmental quality, urban greenery and engagement with the city (Newman and Kenworthy 1999). While there is much talk about the role of technology (electric cars, solar panels, etc.) in tackling climate change, there are more straightforward solutions which deal with the physical configuration of the urban environment. The aim should be to ensure accessibility by reducing the distance between destinations rather than movement per se. This approach is called passive urbanism (Calthorpe 2011).

The focus of urban planners has so far been on the form of the physical environment and social and economic processes. Nature conservation was seen as an obstacle to urban development (Barthel et al. 2013). However, in the context of sustainable development, it is essential to integrate urban ecosystems with natural ones (Barthel et al. 2013). Concentrating urban development in the city centre can be achieved by increasing the intensity of development while preserving or complementing green spaces. Formal regulations are needed to define and enforce the links between density and the amount of open and green space (Hanzl et al. 2017).

Jacob's (1961) views on cities remain relevant because we still need diversity, civic space and human scale. The current perspective expands this approach further to include climate change and environmental protection. However, as Calthrope (2011) notes, it is possible to achieve similar results while departing from the socio-cultural perspective applied by Jacobs. By considering urban form, its components (buildings, plots, streets), attributes (accessibility, density, diversity) and impact on energy consumption in the development of climate policies, defining the proper density can contribute to better adaptation to climate change in cities (Batista 2018) and to increase the attractiveness of core areas.

25.2.1 Open Space and Density

Development density and open space ratio in a city are closely related. On the one hand, open spaces occupy valuable land that could be used for development and structural densification. On the other hand, open spaces have essential social and recreational functions (public spaces such as squares and parks) and environmental roles (green spaces), increasing the quality of life and attractiveness. At the same time, transport areas such as roads or car parks can negatively impact environmental quality, especially in a car-oriented society. The role of Green Infrastructure (GI) includes vegetation, especially trees, in improving climatic conditions in the city. Greenery reduces the urban heat island; it improves air quality and acoustic conditions (Roloff 2016) and is commonly perceived as necessary to ensure citizens' physical and mental health (Forsyth et al. 2017).

Furthermore, biologically active areas contribute to rainwater infrastructure, which prevents excessive surface run-off and improves resilience in urbanized areas. Therefore, preserving existing and creating new green spaces in the city helps counteract the adverse effects of climate change. At the same time, the type, amount and scale of green spaces should be adapted to the size and structure of the surrounding urban fabric. For example, in small towns, the provision of GI should be satisfied principally by small parks or street greenery; large parks are relatively the exception. Therefore, searching for a fair share of city green space is a significant challenge.

Density, the ratio of a certain amount to a unit area, has many applications. In urban planning, density is used to calculate the amount of housing, built-up area or population in an area (Hanzl et al. 2017). However, more consensus is needed on its application in urban planning and design (Alexander 1993; Churchman 1999). Comprehensive and verifiable analytical results are essential for effective and coherent planning and policy making (Faludi and Waterhout 2006). Thus, quantitative and qualitative analyses should form the basis of the decision-making process. However, the lack of a uniform methodology is an obstacle to analysis. The main problem is the definition of the boundaries of the analysed area, which might either include or exclude surrounding open spaces of streets and squares (Berghauser-Pont and Haupt 2010). Each country or city may use its density measure, as none is universally applied. Therefore, clearly defining the methodology used to calculate density is crucial for correctly interpreting the results.

An obstacle to conducting relevant analyses is often the lack of proper data sets. However, thanks to the development of Geoscience, the implementation of the INSPIRE directive in Europe, crowdsourcing data and other open-source data, the availability of the necessary information is improving (Hanzl et al. 2017).

Population density is one of the most widely used parameters in urban planning. For example, it is used in planning documents such as the Study of Conditions and Directions of Spatial Development (including the document approved for Zgierz—as of 2015). However, according to the Polish Law on spatial planning and development (Parliament 2003), the Study is only a strategic document. Unfortunately, despite numerous attempts to correct the legal planning system in Poland that take place since

its initial approval in 2003, there is still no link between demographic projections and Local Spatial Development Plans (Solarek 2019). This often leads to the urbanisation of open areas, including green fields.

Attempts to study population distribution in cities have been made since the hygienist movement in the nineteenth century (Brody et al. 2000). They were followed by several later theoretical approaches, such as Christaller's Central Place theory, and developed fully in the mid-twentieth century. An example is Clark's (1951) gravity mathematical model, which described the effects of city formation and population dynamics on population distribution. In Clark's model, population distribution is related to distance from the centre. New ways of estimating have been developed with the development of technology, including lasers, remote sensing, crowdsourcing and Geoscience. However, data availability is still a challenge, so traditional methods are still applicable. Building footprints and plot data are among the most popular measures to estimate population density. Calculations are based on building footprint, dwelling size and floor area ratio (FAR). With the increasing availability of cadastral data and GIS technology, it is possible to simplify and speed up the process. This method has been used for London by Smith and Crooks (2010), among others.

This study uses the Conzenian urban region, defined by area characteristics such as parcellation, building form and typology, and land use and function (Baker and Slater 2000). The morphological approach is applicable at multiple levels of detail, allowing consistency across planning documents. For instance, the morphological method has been applied to the document of the Study of Conditions and Directions of Spatial Development of Lodz (Lodz City Council 2002) using GIS databases (Hanzl 2003).

In ecology, there is the concept of environmental capacity, which defines the maximum amount of population that does not disturb the balance of the ecosystem. Similarly, in an urban ecosystem, the maximum density of development needs to be determined to protect the urban environment from damage associated with overpopulation (Oh et al. 2004).

While there is a great deal of focus on new technologies in the fight against climate change, urban planning is the most cost-effective solution we have long known (Calthorpe 2011). Urbanised areas in cities should be adapted to population dynamics to pursue sustainable development and counteract the adverse effects of climate change (Solarek 2019). Aiming to densify city centres to protect open areas on the urban fringe is an essential regional adaptation measure. At the same time, the lack of open and natural areas in the urban core contributes to the disproportionate impact of climate change. Therefore, we aim to focus on relating population density values with the green spaces' ratio through a proxy, i.e. FAR. The definition of proper relationship ensures a compact urban structure and, on the other hand, provides an adequate amount of biologically active areas and rainwater retention areas, thus preventing excessive surface run-off.

25.2.2 Suburbanisation in Poland

In Poland, suburbanisation emerged at the end of the twentieth century. In the socialist era, urban development was centrally controlled and thus independent of market mechanisms. This resulted in a lack of private demand for specific places of residence (Kajdanek 2011). After the political transformation, urban areas spread quickly due to the massive shortage and low housing standards (Kajdanek 2012). The problem of suburbanisation affects large and medium-sized cities and even small towns (Kajdanek 2012).

The lower land purchase costs and easy access to green recreational spaces make suburban housing more attractive than urban cores. The city, especially its centre, is no longer seen as an attractive place to live. Living outside is often considered cheaper and healthier; it also allows for fulfilling the dream of owning one's property. Combined with the low standard of the urban fabric in the inner city or rapidly ageing prefabricated blocks of flats, this leads residents to seek better quality and comfort of life outside the city (Kajdanek 2011).

In addition, cities often suffer from a land shortage for development despite the abundance of vacant, underdeveloped properties. This is due to the unclear titles of real estate properties and the uneven coverage by Local Spatial Development Plans. The hardships of developing vacant land in the city push investments outside the urban zone. They either remain within the city limits (internal suburbanisation) or move entirely outside its administrative borders (external suburbanisation) (Kajdanek 2011).

One of the key strategies to deal with the above challenges is improving living conditions and adjusting downtowns to changing climate through integrating Green Infrastructure (GI).

25.2.3 Case Study—Zgierz

The city of Zgierz was originally founded in the thirteenth century. In 1821, the government established a new settlement for weavers here, which affected the town's prosperity; within a few years, it became the largest textile centre in the region and the second in the country (after Warsaw) (Zgierz 2021). Soon, the crisis of the 1830s and the sanctions imposed by the tsarist authorities negatively impacted its prestige while favouring Lodz, whose cotton industry catered to local economy's needs.

The new Zgierz district was laid out east of the medieval settlement, around its core—a rectangular square (today's Kilińskiego Square). Perpendicularly intersecting streets ran through its centre. Most of the urban blocks were square or rectangular. Other geometric forms could be found only in the west and north peripheries. The plots varied in size and shape. The western part of the layout, the market square with adjacent buildings, served housing and services, and the eastern part was used for gardens (Rosin 1995). Similar layouts can be observed in many Polish cities of

the early nineteenth century (e.g., Lodz, Konstantynów, Radom); they were modelled on the French seventeenth century towns (Kalinowski 1966).

Nowadays, due to the decline of the textile and chemical industries as an outcome of political system transformation, the town faces the challenge of transforming its economic profile. This problem has persisted since the 1990s. As a result, many post-industrial sites in the city centre remain unused. The status of disrepair of the buildings negatively affects the city centre's attractiveness. Another massive problem is the lack of a coherent spatial structure of the centre. The value of land in the centre and the sense of identity are too low to effectively counteract the progressive suburban sprawl. There is also no effort to intensify the use of the centre and to fill in the gaps in development, which largely persist due to the real estate issues described above. One reason may be the growing demand for dedicated car space due to suburbanisation.

Zgierz city centre features low-rise—one-storey and two-storey buildings. The exceptions are blocks of flats, which, despite their height (usually five storeys), are located at considerable distances from each other, leaving space for green areas and transportation.

The first buildings erected in the New Town were single-storey, wooden or, more rarely, brick weavers' houses with hipped roofs (Popławska 1995). They were situated in the front part of the plot, with their roof ridge parallel to the road. The rectangular structure did not take the entire plot width; the remaining space was an entrance. Outbuildings and side buildings were usually added in later periods.

Along with industrialisation, the way the property was built changed. One-storey wooden or brick buildings remained at the front of the plot, and larger-than-original workshops were added in backyards. As a result, industrial buildings were mixed with residential buildings. In Zgierz, only a few urban tenement houses, common for contemporary Lodz and other towns in the region, were erected (Popławska 1995).

Contemporary buildings complement the historic structure; in most cases, however, they do not harmonise with the historical ones. Buildings are often placed randomly; the original subdivision of the plots is visible, but subsequent subdivisions and mergings have adversely affected its legibility.

The proportion of uncultivated land, including undeveloped plots, is high—there are overgrown parcels with wild vegetation. The frontage forming the walls of the urban enclosures is discontinuous. Numerous gaps in the frontage create openings to the interiors of the blocks. The majority of buildings in the area require renovation. There are also many vacant buildings.

25.3 Methodology

In order to investigate the adaptation potential to climate change and the possibilities to improve the image and quality of built fabric in the centre of Zgierz, we examine the intensity of development and the availability of green spaces, both in the current state and in redevelopment plans prepared by the town council, using a quantitative study which has been carried out using GIS tools. The study uses publicly available

data from the database of topographic objects (RSIS 2022) and the results of an urban inventory.

Based on the data collected, we have subdivided the area according to development types into morphological regions ranging in size from one to several plots. In addition, we have considered the type of land use, form of development and parcelling. The morphological regions identified included, for example, inner-city townhouses or modernist blocks of flats. We calculated the Building Coverage Ratio (BCR) and Floor Area Ratio (FAR) values within the designated areas with a specific development character. The formulae for the calculations are given below.

$$\text{Building Coverage Ratio (BCR)} = \frac{\text{Building Area (All Buildings)}}{\text{Lot Area}}$$

$$\text{Floor Area Ratio (FAR)} = \frac{\text{Gross Building Area(All Floors)}}{\text{Lot Area}}$$

On this basis, we have estimated the population density in the individual morphological regions. We divided FAR by the average usable area of a flat and then multiplied it by the average number of persons per household. For multi-family housing, the usable area of a flat for Zgierz has been assumed at 63.10 m^2 (GUS 2020). We assume the average number of persons per household in the Lodz Voivodeship is 2.59 (GUS 2020).

We then examine the accessibility of green areas. First, we set a 300 m buffer from the boundaries of public green areas in Zgierz city centre, assuming that this is the distance needed for all citizens (including children and elderly) to get to green space within 5 min' walk (WHO 2017). Next, we estimated the number of residents living in the buildings located in the designated zones. Our analyses address defined morphological types regarding the Green Area Ratio (GAR) (Ministry of Infrastructure 2002)—the parameter which defines land sealing (the share of permeable area to the area of a lot). We consider the distances between residential areas and public green spaces (parks, cemeteries) and leave out greenery on private plots without public access or uncultivated vegetation. While we recognise their role in counteracting the adverse effects of climate change by retaining water, providing biodiversity or mitigating urban heat island effects, their social function is mainly limited to visual effects and aesthetics. Therefore we tested the city government's contribution to climate change adaptation by providing green spaces for residents. The scale of the elaboration and lack of publicly accessible data on private and uncultivated greenery are why we cannot consider this category in our research.

In the next step, we compare the current state with the planning documents in force: the Local Spatial Development Plans and the Study of Conditions and Directions of Spatial Development.

Subsequently, in order to verify the possibilities of redevelopment of heritage sites, we analyse three different land use scenarios for the identified morphological types of development. The assumed scenarios include the following:

A—Climate change adaptation—the scenario assumes the smallest built-up area while preserving the most valuable cultural values. At the same time, the amount of permeable surface ensures that rainwater can infiltrate into the ground.

B—Filling in—business as usual—assumes leaving the existing development within the plot and allowing further development of the plots in a haphazard manner striving for structural density.

C1, C2, C3—Structural redevelopment—assumes that the front building is retained and that the structure is densified by introducing new development inside the plot. At the same time, the development of the plot is intended to improve living conditions and provide a more biologically active area than in the case of the existing state (scenario B). Scenario C3 assumes the location of the building when there is access to public space (e.g., a road) on both sides of the plot. Scenarios C1 and C2 consider the legal constraints arising from access to a public road on only one side of the plot.

Finally, we calculate water retention values for each scenario. The analysed plots are of a standard size resulting from historic subdivisions under conservation protection. We have calculated the proportion of impervious surface area and corresponding surface runoff based on the various forms of development on the plot. For the calculations, we assume that 20% of the plot will serve auxiliary uses (internal roads, car parks, litter bins, etc.) and an average rainfall value of 645 mm. We have also assumed that the target GAR value for proper water retention concerning climate change should be at least 35–50% (OEHHA 2006).

The spatial scope of the study covers the area of Zgierz city centre. These are areas of high cultural value, representing the city's historical identity. A significant part of this area is under conservation protection—the spatial layout of the New Town, characteristic weavers' houses from the early nineteenth century. In the eastern part, there are Modernist multi-family housing—blocks of flats. This part of town also accommodates the central railway station and public services. The axis of the entire layout is Długa Street, along which many public institutions and services are located.

25.4 Results

A high proportion of historic buildings are in the centre, including heritage weavers' houses and typical townhouses with commerce on the ground floor (Fig. 25.1). The heritage buildings are mixed with modern ones. Industrial development areas surround the site to the north and south. Some factory buildings north of the centre are vacant. From the west, the New Town neighbours a contemporary large-scale commercial complex. In the eastern and southern parts are clusters of multi-family housing blocks. The western part, including the old town, is dominated by single-family housing. A substantial share of structures are outbuildings (sheds, garages, etc.).

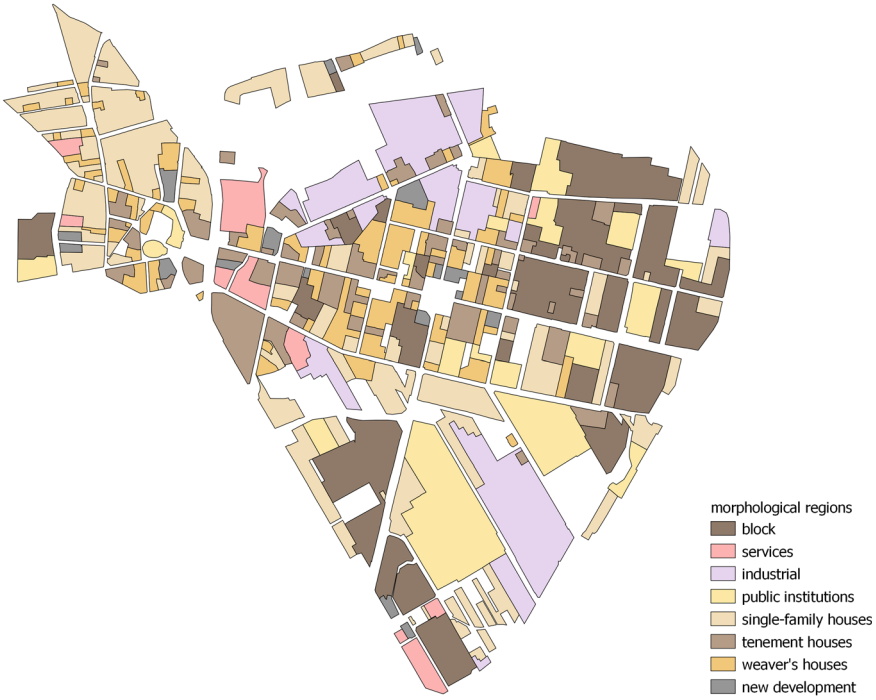


Fig. 25.1 Morphological regions in Zgierz. *Source* Own elaboration

25.4.1 Building Coverage Ratio, Floor Area Ratio and Population Density

The regions with the highest BCR values (41–100%) occupy the smallest area of the centre (Fig. 25.2). There are primarily historic buildings—weavers' houses, tenement houses, former factories, and, to a lesser extent, contemporary buildings located in the western part of the area. Moreover, typologies with the highest BCR values are absent in the eastern part. Instead, they concentrate along the main streets and squares of the city. The structures contributing to these values are the remnants of the climax phase of the burgage cycle (Whitehand 2007). The direct reason was the preservation of the historical plot divisions and the development built in later periods in the depth of the plots.

Regions with medium BCR values (29–41%) include the remaining historic typologies, particularly weavers' houses. This group also comprises large-scale commercial buildings in the centre and south and some single-family estates in the western, northern and eastern parts of the site.

The scarcely built regions with the smallest BCR values (1–29%) occupy most of the city centre. These typologies cover multi-family estates—blocks of flats, factory areas, and other single-family development. In principle, apart from the areas along

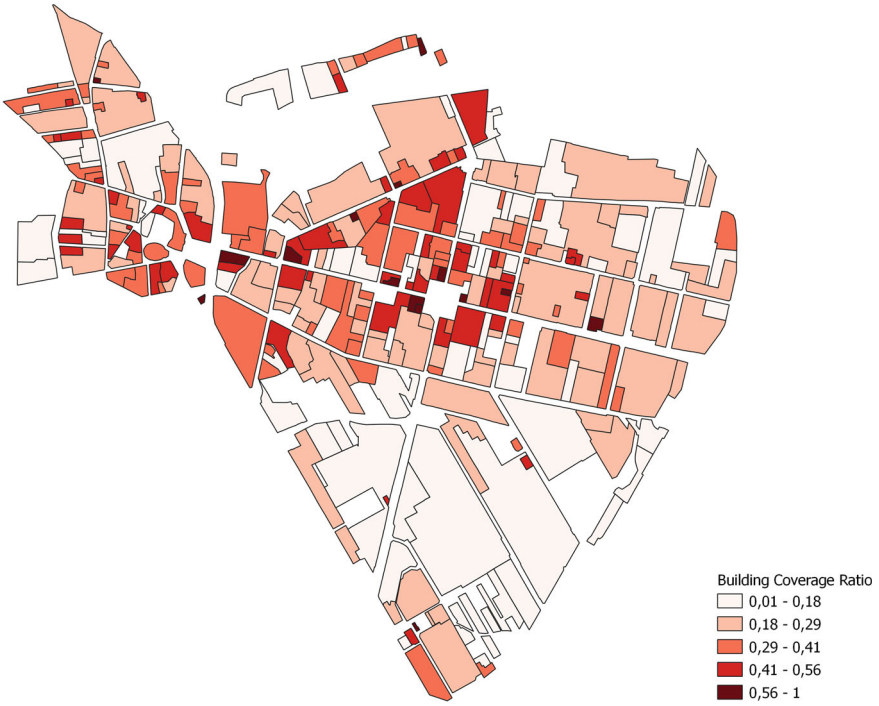


Fig. 25.2 BCR in morphological regions in Zgierz. *Source* Own elaboration

the main street—Długa Street and the two main squares—Kilińskiego Square and the old market square, all remaining sites feature the smallest BCR values. Therefore, we conclude that the centre of Zgierz is not compact and has large land reserves. This gives ample opportunities for structural densification. Alas, the relatively small BCR values in the Zgierz city centre do not equal a high share of the Green Area Ratio. The undeveloped area is often paved, primarily for car parks and transportation.

The regions with the highest FAR values (1.1–2.77) occupy the smallest area (Fig. 25.3), smaller than in the case of BCR values. The medium FAR (0.68–1.1) mainly pertains to multi-family development—blocks of flats. Again, the largest share of the central town features the lowest FAR (0.01–0.68).

The above is reflected by the population living in the centre of Zgierz. According to data for 2021, Zgierz is inhabited by 54,974 people (GUS 2021). Approximately 20 189 people live in the analysed area (circa 37% of all inhabitants of Zgierz) (Fig. 25.4). In this, as many as 66% of all inhabitants of the centre live in multi-family housing—blocks of flats. This confirms that the built-up area in the centre of Zgierz needs to be higher, which would translate into increased population density.

Fig. 25.3 FAR in morphological regions in Zgierz. *Source* Own elaboration

25.4.2 Greenery

The analysis (Fig. 25.5) shows that only the inhabitants of the northern part of Zgierz city centre can access public green areas. Approximately 7730 people live in the designated buffers, about 38% of the total population of the analysed area. This number would increase if we included green areas in the spaces between the blocks of flats. Except for the municipal park, green areas along the river and cemeteries, public greenery needs to be improved. While greenery is present in Zgierz public spaces such as streets or squares, it provides a small share of the surface area. Furthermore, in modernising streets or squares, existing greenery (if any) is replaced by new, rachitic plantings that have incomparably less impact on mitigating the adverse effects of urban climate change than mature trees. We conclude and recommend that municipal policy and management should prioritise green infrastructure. This can be done in several ways, such as adding more street trees, leaving more permeable surfaces, etc.

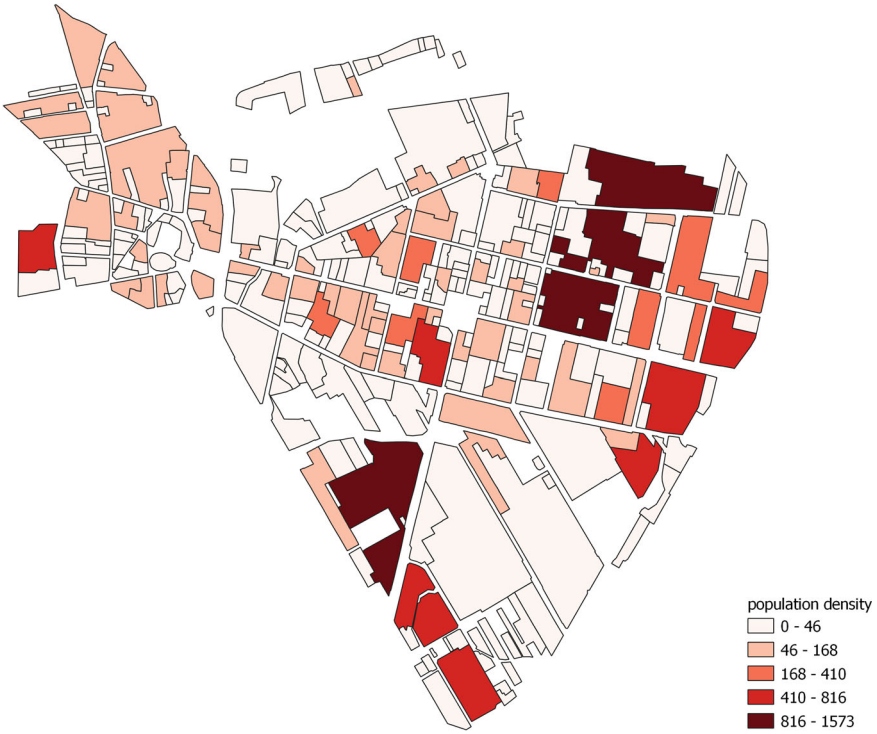


Fig. 25.4 Population density in morphological regions in Zgierz. *Source* Own elaboration

25.4.3 The Study of Conditions and Directions of Spatial Development of Zgierz

The Study of Conditions and Directions of Spatial Development is the local policy document which covers the whole community territory and which, in the Polish planning system, has to be adopted by every community. The Study of Conditions and Directions of Spatial Development of Zgierz (approved by the City Council of Zgierz with Resolution No. XI/120/15) (Zgierz City Council 2015) identifies the downtown area as a place of concentration of public life. At the same time, the spatial development state, spatial order, and aesthetics do not correspond with the function this area should fulfil (Zgierz City Council 2015). One of the critical challenges is to complement the urban structure with new development that considers historical values and caters to investors' expectations (Zgierz City Council 2015). The Study (Zgierz City Council 2015) draws attention to the need to revitalise post-industrial sites to strengthen the city's role in the metropolitan area of Lodz. Also, revitalisation measures are required along Długa Street, the axis of the historical layout and the area of the local identity. The street lacks the appropriate form of

Fig. 25.5 Greenery and zones within 300 m buffer from public green areas in the Zgierz downtown. *Source* Own elaboration

development harmonising with cultural heritage and suitable small architecture and greenery (Zgierz City Council 2015).

Moreover, the Study (Zgierz City Council 2015) identifies the need to rehabilitate urban green areas, particularly the Bzura River valley. It emphasises its environmental (ecological and ventilation corridor) and recreational role in the urban and regional systems. Current development and the concealment of the river in the canal do not allow its full potential (Zgierz City Council 2015). The Study (Zgierz City Council 2015) recommends the protection of Bzura valley from new development and removing existing structures. Besides, in order to bring life back to the centre of Zgierz, the Study (Zgierz City Council 2015) postulates limiting transit traffic, raising the level of spatial order and aesthetics, adopting Local Spatial Development Plans, preserving and exposing the cultural heritage.

While the Study calls for the protection of non-urbanised areas, among other things, because of the negative impact of suburbanisation on the environment, at the same time, the document conveys much more land for development than in the current state. This contradicts demographic forecasts, which indicate that the population of Zgierz will decrease. On the contrary, the Study assumed nearly 7,000 more

inhabitants than predicted in 2030. The need expressed in the Study to protect non-urbanised areas is therefore not reflected in the city's development plans. Moreover, although the sprawl problem in peripheral areas has been noted, no measures have been taken to stop this process, let alone counteract its adverse effects. Based on the forecasts, the main goal should be a more compact urban fabric by densifying the areas in the town centre. As planned in the Study, the allocation of new non-urbanised areas for building development may contribute to the further progress of the suburbanisation process and its consequences, such as increased transport pressure on the city centre and progressive degradation of the area.

Table 25.2 compares the results of the BCR and FAR values analyses for the current state and the parameters set out in the Study (Zgierz City Council 2015). We assigned the parameters defined in the planning documents to pre-defined morphological regions. The Study (Zgierz City Council 2015) covers the whole site and defines planning units (Fig. 25.6). In the analysed area, only four Local Spatial Development Plans are in force—3 in unit 1B New Town and 1 in unit Kurak East (Table 25.1 and Fig. 25.6). Therefore, we have adopted the values defined in the Study for the remaining areas (Fig. 25.6). Moreover, the Study (Zgierz City Council 2015) does not specify FAR values, so the projected value was only specified in the Local Spatial Development Plans for Unit 1B New Town. Besides, for the inner city (units 1A and 1B), the minimum biologically active area is not defined in the Study.

The indicators defined in the Study (Zgierz City Council 2015) and the Local Spatial Development Plans for units 1A and 1B reveal the aim to densify the structure of the Zgierz city centre. At the same time, parameter values are much lower for the other units surrounding those above. Compared to the existing values of BCR, we notice a high potential for the densification of the urban fabric. Particularly in the centre, there is a significant discrepancy between the existing and projected values. For the surrounding units, the current and planned values are similar. However, in some regions, the existing values are higher than the projected values.

Maximum current BCR values for Unit 1B are equal to or smaller than the lowest planned values. The only exception refers to the tenement houses, where the maximum current value is within the ranges specified in the Local Spatial Development Plans. Therefore, the above confirms that the analysed area has a significant potential for increasing the development intensity.

The Study (Zgierz City Council 2015) does not define the minimum green area ratio for Unit 1A, assuming it will be defined at the Local Spatial Development Plan level. However, this area's Local Spatial Development Plans have yet to be elaborated. For unit 1B, the design values impose minimal GAR values, which again is related to the aim to densify the centre structure. Whereas increasing the intensity of development in the inner city aligns with the idea of rehabilitation, this process should not occur without considering environmental issues or ensuring an adequate quality of life. The minimum GAR value is set at a similar level of 20–30% for the other units. However, these values might not prove sufficient considering the surface run-off.

Fig. 25.6 Local Spatial Development Plans in Zgierz and planning units according to the Study of Conditions and Directions of Spatial Development of Zgierz. *Source* Own elaboration

Table 25.1 Local Spatial development plans in Zgierz.

	City council of Zgierz resolution no	Local Spatial Development Plan
1	XL/420/2002 (Zgierz City Council 2002)	The area delimited by 1 Maja Street, Łąkowa Street, Łódzka Street
2	LII/471/10 (Zgierz City Council 2010)	The area delimited by Dąbrowskiego Street, Narutowicza Street, 3 Maja Street and Popiełuszki Street
3	XXVII/317/16 (Zgierz City Council 2016)	the area delimited by Rembowskiego Street, Narutowicza Street, 1 Maja Street and Długa Street
4	XLVI/604/18 (Zgierz City Council 2018)	The area delimited by 1 Maja Street, Dubois Street and Rembowskiego Street

Source Own elaboration

Table 25.2 Existing and projected of BCR, GAR and FAR.

Morphological regions	Existing		Projected		
1A old town					
	BCR (%)	FAR	BCR (%)	GAR (%)	FAR
Public institutions	32–35	0.35–0.78	80	–	–
Single-family houses	16–53	0.16–0.56	80	–	–
Tenement houses	23–48	0.46–0.95	80	–	–
Weaver's houses	12–64	0.12–1.27	80	–	–
New development	52	1.05	80	–	–
1B new town					
	BCR (%)	FAR	BCR (%)	GAR (%)	FAR
Block	21–41	0.69–1.19	50–90	5–35	1.5–3.6
Services	14–32	0.27–0.52	80	–	–
Industrial	9–55	0.24–1.06	45–80	5–25	1.0–3.5
Public institutions	10–41	0.19–0.71	80	10	2.4
Single-family houses	3–41	0.03–0.78	45–65	5–25	1.0–1.8
Tenement houses	16–69	0.17–2.77	35–90	0–40	0.8–3.6
Weaver's houses	11–100	0.12–1.0	35–90	0–40	0.8–3.6
New development	22–74	0.41–2.38	50–90	0–30	1,0–3.2
1C downtown east					
	BCR (%)	FAR	BCR (%)	GAR (%)	FAR
Block	16–50	0.49–2.0	50	25	–
Services	30	0.3	70	20	–
Industrial	38	0.38	50	25	–
Public institutions	10–27	0.13–0.48	70	20	–
Single-family houses	7–38	0.07–0.81	50	30	–
Tenement houses	17–59	0.25–1.47	50	25	–
Weaver's houses	18	0.21	50	25	–
2 Tuwima-Aleksandrowska					
	BCR (%)	FAR	BCR (%)	GAR (%)	FAR
Block	16	0.79	50	25	–
Services	45	0.45	50	30	–
Public institutions	14	0.14	70	15	–
Single-family houses	15–24	0.25–0.34	50	30	–
Weaver's houses	16–35	0.16–0.54	50	30	–
New development	42–45	1.14–1.34	50	30	–
4 Przybyłów					
	BCR (%)	FAR	BCR (%)	GAR (%)	FAR
Block	49	1,76	60	20	–

(continued)

Table 25.2 (continued)

Morphological regions	Existing		Projected		
1A old town					
	BCR (%)	FAR	BCR (%)	GAR (%)	FAR
Services	17	0.19	50	30	–
Single-family houses	9–50	0.11–0.76	50	30	–
Tenement houses	29–62	0.5–1.17	50	30	–
Weaver's houses	13–56	0.17–1.03	50	30	–
New development	3–63	0.4–1.53	50	30	–
5 Kurak East					
	BCR (%)	FAR	BCR (%)	GAR (%)	FAR
Block	9–19	0.67–1.1	50	25	–
Services	1–33	0.1–0.33	60	15	–
Industrial	10–31	0.1–0.3	60	20–30	–
Public institutions	11–14	0.14–0.24	60	15	–
Single-family houses	1–64	0.0–0.91	50	30–40	–
Tenement houses	48–49	0.83–1.17	60	15	–
Weaver's houses	32–35	0.33–0.63	50	30	–
New development	2–43	0.2–1.01	60	15	–

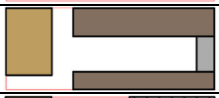
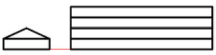
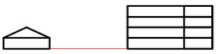
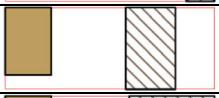
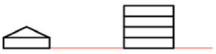
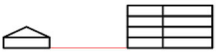
Source Own elaboration

25.4.4 Land Use Scenarios

The tables below show the development scenarios for the heritage structures—weaver's houses (Table 25.3) and tenement houses (Table 25.4). The analysed scenarios reveal the difficulties of densifying the historic building fabric while satisfying the need for green infrastructure. Furthermore, preserving heritage buildings (usually fronts) limits the possibility of increasing the intensity. In both cases, introducing new development inside the plot (scenarios C1-3) lowers the GAR values and increases the surface runoff. This is evident in the case of weavers' houses, common in the centre of Zgierz, where the characteristic form of buildings—usually a wooden, single-storey structure with a usable attic and a gable or hipped roof—is impossible to transform without losing its historical value. An alternative solution is to relocate historic buildings and create an open-air museum, introducing new intensive development in the centre with proper GAR values. However, such a solution would negatively affect the preservation of cultural values.

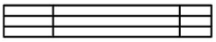
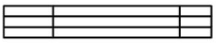
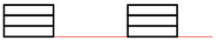
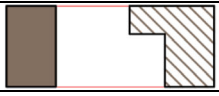
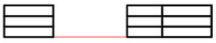
In the case of inner-city tenement houses, adding additional floors is possible. Since buildings' height in the centre of Zgierz is limited to 2–3 storeys, this could be a solution that serves both structural densification and adaptation to climate change.

Table 25.3 Land use scenario for weaver's houses morphological region.

Scenario	Weaver's houses			
	Plot	Cross-section	Impervious surface	Run off [mm]
A			40%	193,5
B			77%	322,5
C1			61%	258,0
C2			62%	258,0
C3			68%	258,0

Source Own elaboration

Table 25.4 Land use scenario for tenement houses morphological region.

Scenario	Tenement houses			
	Plot	Cross-section	Impervious surface	Run off [mm]
A			44%	193,5
B1			96%	322,5
B2			83%	322,5
C1			67%	258,0
C2			73%	258,0

Source Own elaboration

25.5 Discussion

As in the case of the Study of Conditions and Directions of Spatial Development of Lodz, residential capacities were calculated using the morphological approach (Hanzl et al. 2017) based on the definition of morphological regions (Whitehand 2007). The results of the studies – for Zgierz and for Lodz – are convergent; in both cases, a high potential for city centre catch-up has been discovered. Although the scale of the two cities is different, the reasons for the depopulation of inner cities are similar – the industrial crisis, the lack of a coherent regional strategy or the exodus of residents to the periphery in search of better living conditions in this, the availability of green spaces. Therefore, the assessment of residential capacity should consider the availability of open, green spaces that improve the quality of life.

In the context of climate change, action cannot be limited to decarbonisation alone but should, in parallel, consider the adaptation of cities to climate change (Gren et al. 2019). While at the macro scale, positive results for climate change adaptation can be achieved by increasing density, at the micro scale, conditions worsen. The adverse effects of overdensity are linked to the lack of biologically active space (Berghauser-Pont et al. 2021). Our study confirms the observations of Berghauser Pont et al. (Berghauser-Pont et al. 2021) in this regard. The search for a compromise between intensive development and open areas is one of the biggest challenges, especially if the historic urban fabric has to be considered; as in the case of the analysed area, only in one of the three scenarios, a GAR value allows for adequate water retention. Therefore, the only solution that would not increase surface runoff would be to increase the vertical density. Nevertheless, this solution would not be possible without the loss of historical value in the case of the weavers' houses.

Therefore, the solution to the problem we recommend are:

1. Protected open spaces in the planning documents. Planning a system of publicly accessible and linked green spaces is essential. Only space secured in this way will allow the compromise values of BCR, FAR, and GAR to be developed.
2. Revitalise brownfield sites and adapt them for new functions, including housing and public spaces with a high proportion of green space.
3. Increase the density of development by:
    a. developing undeveloped plots of land (after taking into account green spaces),
    b. replacing haphazard, non-historic buildings in the interiors of the plots with new structures of higher intensity,
    c. increase vertical density by adding storeys to historic buildings subject to preserving historical values.

An example of the above mentioned recommendations is the revitalisation project of a section of the New Town of Zgierz (Fig. 25.7) (Olczak 2016). The main aim of such a project was to make the New Town more human scale. Public spaces have been introduced into the interiors of the quarters to enliven the areas. By adding public spaces into the interiors of the quarters, it has been possible to reclaim undeveloped spaces and introduce new development. The project proposes new greenery in public

spaces. In addition, in the northern part of the study, it is possible to reclaim one of the banks of the river Bzura, where the post-factory areas are located, for green space. The post-factory buildings have been transformed and adapted for new functions. All valuable buildings have been preserved.

Fig. 25.7 Project of revitalisation of a part of the New Town in Zgierz. Olczak (2016) *Source* Own elaboration used earlier in, unpublished

25.6 Conclusions

A compact city is one of the leading solutions to counteract the negative impact of climate change. However, a higher urban density can, on the one hand, positively influence public infrastructure, transport and economics, but on the other hand, it can have negative environmental, social and health impacts. On the regional scale, developing local, compact nodes in the form of small towns with a dense core around the centrally located transportation node is commonly recognised as a solution, but this approach also represents some dangers. When re-using heritage fabric, densification might significantly alter the existing character of the heritage fabric. In the current study, we examine the possibilities of re-use of the historical core of a small post-industrial town. We have verified its redevelopment capacities, considering the need for increased open space. Our recommendations include protected and publicly accessible open spaces that accommodate greenery, brownfield revitalisation, and densification that might be introduced by filling undeveloped lots or replacing haphazard structures with new development and overbuilding existing structures. Our study shows that undertakings of this kind need to balance the relationships between the redevelopment, local identity and greening of the historical districts. The results of the current study are of more general value; they can be transferred to historical cores in other small townships.

Acknowledgements The authors are grateful for peer-reviews received as part of the editorial process. This book chapter has been completed while the first author was the Doctoral Candidate in the Interdisciplinary Doctoral School at the Lodz University of Technology, Poland.

References

Alexander E (1993) Density measures: a review and analysis. J Archit Plann Res 10(3):181–202
Angel S, Parent J, Civco DL, Blei AM (2011) Making room for a planet of cities. Lincoln Institute of Land Policy, Cambridge
Baker NJ, Slater TR (2000) Morphological regions in English medieval towns. In: Whitehand JWR, Larkham PJ (eds) Urban landscapes: international perspectives. Routledge, London
Barthel S, Colding J, Ernstson H, Erixon H, Grahn S, Kärsten C, Marcus L, Torsvall J (2013) Principles of social-ecological urbanism—case study: Albano Campus. Trita-ARK Forsknings publikationer, Stockholm, Sweden
Batista L (2018) Urban form and climate change. ISOCARP Rev 14:96–113
Berghauser-Pont M, Haupt P (2010) Space matrix: space. NAI Publishers, Netherlands, Density and Urban Form
Berghauser-Pont M, Haupt P, Berg P, Alstäde V, Heyman A (2021) Systematic review and comparison of densification effects and planning motivations. Build Cities 2(1):378–401. https://doi.org/10.5334/bc.125
Brody H, Rip MR, Vinten-Johansen P, Paneth N, Rachman S (2000) Map-making and myth-making in broad street: the London cholera epidemic, 1854. Lancet 356(9223):64–68
Calthorpe P (2011) Urbanism in the age of climate change. Island Press Washington, DC
Churchman A (1999) Disentangling the concept of density. J Plan Lit 13(4):389–411
Clark C (1951) Urban population densities. J R Stat Soc 114:490–496

Concepción ED, Moretti M, Altermatt F, Nobis MP, Obrist MK (2015) Impacts of urbanisation on biodiversity: the role of species mobility, degree of specialization and spatial scale. Oikos 124:1571–1582. https://doi.org/10.1111/oik.02166

European Commission (2013) The green paper—A¬ 2030 framework for climate and energy policies, 27.03.2013 COM(2013) 169 final. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0169:FIN:en:PDF. Accessed 5 Sept 2022

European Commission (2019) The European green deal—communication from the commission to the European Parliament, the European council, the council the European economic and social committee and the committee of the regions. Report. 11.12.2019 COM640 final, European Commission. Brussels. https://ec.europa.eu/info/sites/default/files/european-green-deal-communication_en.pdf. Accessed 5 Sept 2022

Faludi A, Waterhout B (2006) Introducing evidence-based planning. disP Plann Rev 42(165):4–13

Forsyth A, Salomon E, Smead L (2017) Creating healthy neighborhoods. In: Evidence-based planning and design strategies (Kindle Ed.). Taylor and Francis

Gren Å, Colding J, Berghauser-Pont M et al (2019) How smart is smart growth? examining the environmental validation behind city compaction. Ambio 48:580–589. https://doi.org/10.1007/s13280-018-1087-y

GUS (2017) Prognoza ludności gmin na lata 2017–2030 (opracowanie eksperymentalne). https://stat.gov.pl/obszary-tematyczne/ludnosc/prognoza-ludnosci/prognoza-ludnosci-gmin-na-lata-2017-2030-opracowanie-eksperymentalne,10,1.html

GUS (2020) Local data bank. https://bdl.stat.gov.pl/bdl/start

GUS (2021) Local data bank. https://bdl.stat.gov.pl/bdl/start

Haase D, Kabisch N, Haase A (2013) Endless urban growth? on the mismatch of population, household and urban land area growth and its effects on the urban debate. PLoS ONE 8:e66531. https://doi.org/10.1371/journal.pone.0066531

Hanzl M (2003) Virtual city models as a tool for urban tissue evaluation. In: Proceedings of 23rd urban data management symposium. Prague

Hanzl M, Bezerra L, Tomczak A, Warsza R (2017) Quantifying sustainable growth through a morphological approach comparison to population density measurements. In: Proceedings of computational science and its applications—ICCSA 2017. 17th international conference. Springer, Trieste Italy

Hunt A, Watkiss P (2011) Climate change impacts and adaptation in cities: a review of the literature. Clim Change 104(1):13–49. https://doi.org/10.1007/s10584-010-9975-6

Jacobs J (1961) The death and life of great American cities. Random House, New York

Kajdanek K (2011) Pomiędzy miastem a wsią. Suburbanizacja na przykładzie osiedli podmiejskich Wrocławia. NOMOS, Kraków

Kajdanek K (2012) Suburbanizacja po polsku. NOMOS, Kraków

Kalinowski W (1966) Zarys historii budowy miast w Polsce do połowy XIX wieku, Uniwersytet Mikołaja Kopernika, Toruń

Lodz City Council (2002) Study of Conditions and Directions of Spatial Development of Lodz (No. LXXVII/1793/02)

MA (2005) Millennium ecosystem assessment. Ecosystems and human well-being: synthesis. Island Press, Washington, DC

Ministry of Infrastructure (2002) Regulation on technical conditions to be met by buildings and their location (No. Dz.U. 2022 poz. 1225)

Newman P, Kenworthy J (1999) Sustainability and cities: overcoming automobile dependence. University of Chicago Press, Chicago

Newman P, Kenworthy J (2015) The end of automobile dependence: how cities are moving beyond car-based planning. Island Press, Washington, D.C.

OEHHA (2006) The effect of urbanization on the water cycle. https://oehha.ca.gov/media/downloads/ecotoxicology/fact-sheet/watercyclefacts_0.pdf. Accessed 24 March 2023

Oh K, Jeong Y, Lee D, Lee W (2004) determining sustainable development density using the urban carrying capacity assessment system. CASA Working Papers Series, p 78

Olczak B (2016) Rewitalizacja fragmentu Nowego Miasta w Zgierzu [Unpublished Bechelor's thesis] Lodz University of Technology

Polish Parliament (2003) Law on spatial planning and development (No. Dz.U. 2022 poz. 503)
Popławska I (1995) Architektura. In: Rosin R (ed) Zgierz Dzieje miasta do 1988 roku, Zarząd Miasta Zgierza, Oddział Polskiego Towarzystwa Historycznego w Łodzi, Towarzystwo Przyjaciół Zgierza, Łódź-Zgierz
Quay R (2010) Anticipatory governance. J Am Plann Assoc 76(4):496–511. https://doi.org/10.1080/01944363.2010.508428
Roloff A (2016) Urban tree management for the sustainable development of green cities. Wiey-Blackwell, Dresden
Romice O, Porta S, Feliciotti A (2020) Masterplanning for change. RIBA Publishing, Kindle Edition
Rosin R (1995) Zgierz Dzieje miasta do 1988 roku, Zarząd Miasta Zgierza, Oddział Polskiego Towarzystwa Historycznego w Łodzi, Towarzystwo Przyjaciół Zgierza, Łódź-Zgierz
RSIS (2022) Regional spatial information system of the Lodz Province. https://rsip.lodzkie.pl/
Smith AD, Crooks AT (2010) From buildings to cities: techniques for the multi-scale analysis of urban form and function. CASA Working Papers Series, p 155
Solarek K (2019) Urban design in town planning: current issues and dilemmas from the polish and European perspective. Warsaw University of Technology
UITP (2001) Focus a UITP position paper. Pricing and Urban Mobility. Union Internationale des Transports Publics
Whitehand JWR (2007) Conzenian urban morphology and landscapes. In: Proceedings of the 6th international space syntax symposium. Istanbul Technical University, Istanbul
WHO (2017) Urban green spaces: a brief for action. https://www.euro.who.int/__data/assets/pdf_file/0010/342289/Urban-Green-Spaces_EN_WHO_web3.pdf. Accessed 24 March 2023
Zgierz (2021) Kalendarium historyczne. http://www.miasto.zgierz.pl/pl/page/kalendarium-historyczne. Accessed 5 Sept 2022
Zgierz City Council (2002) Local Spatial Development Plan the area delimited by 1 Maja Street, Łąkowa Street, Łódzka Street (No. XL/420/2002)
Zgierz City Council (2010) Local Spatial Development Plan the area delimited by Dąbrowskiego Street, Narutowicza Street, 3 Maja Street and Popiełuszki Street (No. LII/471/10)
Zgierz City Council (2015) Study of Conditions and Directions of Spatial Development of Zgierz, (No. XI/120/15)
Zgierz City Council (2016) Local Spatial Development Plan the area delimited by Rembowskiego Street, Narutowicza Street, 1 Maja Street and Długa Street (No. XXVII/317/16)
Zgierz City Council (2018) Local Spatial Development Plan the area delimited by 1 Maja Street, Dubois Street and Rembowskiego Street (No. XLVI/604/18)

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 26
Public Open Spaces and Water: Urban Design in Response to Climate Change

Carlo Berizzi, Marta Mazurkiewicz, and Gaia Nerea Terlicher

Abstract The phenomenon is visible: nature today is at a critical point, and cities are vulnerable. One of the leading causes is the ever-increasing process of soil sealing that has involved cities from the twentieth century onwards. Climate change and soil sealing have weakened the cities that can no longer control natural events. Today, the increasingly prosperous and ever-growing cities must face an issue as crucial as it is urgent: the relationship between ecology and nature, between built and nature. If, on the one hand, water represents a threat to the city, on the other, one of the main resources to deal with climate change effect within urban voids. Starting from the assumption that ever-growing urbanization negatively affects all ecosystem services, and that water is a fundamental resource for ecological restoration and mitigation of the effects of climate change, four European case studies of urban regeneration through the rethinking of public spaces through nature-based solutions are highlighted. The case studies have a recognized architectural quality, belong to the European cultural context of open spaces, and are in metropolitan areas; they are selected following defined variables: reduce heat island effect, improve air/soil/water quality, increase biodiversity, and reuse of urban water.

Keywords Water · Public space · Climate change · Urban design · Nature-based solution

C. Berizzi (✉) · M. Mazurkiewicz · G. N. Terlicher
Department of Civil Engineering and Architecture, AUDe, University of Pavia, 27100 Pavia, Italy
e-mail: caro.berizzi@unipv.it

M. Mazurkiewicz
e-mail: marta.mazurkiewicz01@universitadipavia.it

G. N. Terlicher
e-mail: gaianerea.terlicher@unipv.it

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_26

26.1 Introduction

Climate change projections forecast more and more frequent heat waves, changes in the hydrological cycle, and increase in extreme events. The effects of this mutation are the increase in temperature, in high rainy seasons, dry seasons, and in flooding. This is a global problem that has different local implications. These phenomena are particularly prominent in cities, and each responds differently depending on its location, for example, on the coast, along a river, altitude, and density of development. Among all reasons for this change, there is the ever-increasing process of soil sealing that has involved cities from the twentieth century onwards (Adobati and Garda 2020). Green areas in cities have been removed by concrete, which also results in increased pollution, reduction of wildlife, and loss of biodiversity. "The concrete policy" that has shaped cities over the years intensifies the effects of changes in the urban climate making urban areas no longer able to control natural phenomena in which built-up areas are more vulnerable to the effects of climate change than rural areas. The excessive interference with nature and the approach to design focused on mere engineering solutions of modernity are putting cities under great pressure today pushing collective awareness to admit the necessity of different urban design approaches towards climate resilience.

Almost half of the world's population lives in high-density areas (European Commission 2020). As much as 48% of the population lives in areas classified by degree of urbanization as city categories. Other categories include towns and semi-dense areas and are inhabited by 28% of the population, and rural areas inhabited by 24% (a quarter), European Commission (2020). According to further projections made by the European Commission and the report presented, the world's city population is expected to increase to 55% in 2050. Despite this, urban areas occupy only 3% of the land on the Earth surface (UN 2019).

The vulnerability of cities to climate change is primarily due to their morphology, the high concentration of buildings, and its large population. These features make extreme weather conditions a serious threat to residents as well as the urban structure which are expressed in social, economic, and political problems.

A high building and soil sealing intensity ratio with a small proportion of the area devoted to green space increases the vulnerability of these areas to flooding and inundation that are the most common natural disaster affecting the largest number of people in the world (UNISDR 2015). Excess water from heavy rains has no way of getting into the soil (International Federation of Red Cross and Red Crescent Societies 2010): there is a lack of adequate urban drainage systems and confined areas for water infiltration in the ground.

Increasing in high temperatures entails typical urban phenomena such as heat island effect. Like a bubble that encloses the city, it drives urban temperatures beyond the limits of thermal comfort. Cities have their own distinct climate, urban microclimate, that differs from the rural due to the different air temperature in the ground layer of the atmosphere inside the city and outside the city (Fortuniak 2003). In large European cities, temperature differences between urban and rural areas reach

up to 10 °C. Urban heat islands arise from an increase in air temperature due to an increase in the proportion of heat-absorbing buildings and road surfaces. Materials such as asphalt and concrete absorb more sunlight than they reflect (Światowe Forum Miejskie WUF11 2022)[1] which subsequently causes them to give off energy, increasing the environmental temperature. In addition, the larger the area of the city is sealed, the lower the evaporation of soil and vegetation. Human activity by automobile traffic, heating and air-conditioning of buildings, and the production of goods also play a large part in this process. This is a dynamic phenomenon characterized by high annual as well as diurnal variability.

The main challenge of city planners and architects is to turn sealed soil areas into permeable ones. Introducing beneficial solutions like implementing greenery into urban spaces represents one strategy. Tall greenery is of great importance, as it moderates thermal conditions, improves local air circulation, increases humidity, and promotes air purification of pollutants (Klimada 2020).[2] Studies show that the smaller, scattered projects like green squares and parks have a higher yield than one large complex (Światowe Forum Miejskie WUF11 2022). In cases where buildings do not allow us to introduce green infrastructure due to lack of free space, planting trees along the streets, grassy pavements, partial vegetation on sidewalks, green walls, and green roofs become a solution. The Végétalisons la Villeprogramme for the city of Paris, developed to adapt the city to climate change, aims to meet the need for green spaces and introduce biodiversity as a way to limit urban heat island effect. The objective is to develop a new urban model for dense cities creating spaces with nature for Parisians, inviting the population to actively participate in the process of greening. The Parisian program works at the local level while several international organizations have been created to stimulate the building of appropriate toolkits for the adoption of appropriate urban strategies, such as: 100 Resilient Cities, Local Governments for Sustainable or Asian Cities Climate Change Resilience Network (Ilgen et al. 2019).

The climate change phenomenon questions not only the ecological issue but also those founding themes of the shape of the city, with the attempt to identify possible strategies to be adopted for adaptation to climate change and for a return to the human scale. Contemporary debate on the future of the city focuses on rethinking public space. Public space becomes the privileged place to adopt change, this thanks to its character of being an open and extremely flexible space in which "climate-proof city" and "city for people" constitute a single entity whose place of action is public space. This circumstance highlights the gradual abandonment of that sectoral and

[1] World Urban Forum 11 established in 2001 by the United Nations to respond to rapid urbanization and its impact on communities, cities, economies, policies, and climate change. Convened by UN-Habitat, the Forum is a high-level and open platform for addressing the challenges of sustainable urbanization.

[2] It is an official knowledge platform about climate change and adaptation to its impacts and its dissemination channels in the context of increasing the resilience of the economy, the environment, and society to climate change as well as counteracting and minimizing the effects of extreme risks, co-financed by the European Union.

hard approach of the last century in favor of a multi-sectoral and integrated, flexible, and adaptive one.

The main objective of contemporary projects is to introduce adaptive vision of the city working on public spaces designing with water and green. Strategies as nature-based solutions (NBS), Iwaszuk et al. (2019) can replace traditional hard solutions while regulating air temperature and storing and treating rainwater. Adapting urban spaces and introducing water cycle management allows controlling water by putting it into the soil, collecting it and using it to maintain green areas which benefits air quality and oxygen quantity, using it to fight heat island effect and cool the area, and improving ventilation. An added benefit of NBS in public spaces is that it improves the quality of the area and introduces an additional function to it that encourages residents to socialize and be active.

Analyzing the issue that climate change and its impact on cities have become, and the projects that have already emerged, three research questions were considered about public spaces:

- RQ1: What are the design strategies used to respond to climate change in cities?
- RQ2: Are the methods used a sufficient approach with increasingly frequent extreme weather conditions?
- RQ3: What impact does the NBS for water management have on the quality of public spaces?

26.2 Background

Water has always been of great importance in human life. It is not surprising that usually cities were in places rich in it. They have depended on water for their existence since the beginning of the first civilizations (Fumero 2020). Cities have often been developed along rivers, which were an essential part for agriculture. The location of the city in connection with the river was due to several reasons: drinking water, food, transportation route, energy, and defensive functions. The purpose of the function of rivers changed according to different historical periods, however, it was an integral part of building the settlement structure. The theme of water represented in ancient times a necessity for which man has always integrated his naturalness into the built environment with an approach of respect towards the resource. The urban settlements were in fact always built according to the natural cycle of water with particular regard towards ecological times.

The development of modern methods of urban water management began with the onset of the Industrial Revolution at the end of the eighteenth century (Sawyer 1994).

The modern ideas of speediness and efficiency made in the last century a strong transformation in the urban assets, which gave rise to the modern city by developing hard technological systems, for the management of resources, in particular water. These systems were based on the idea of unlimited natural resources and on the certainty that man could have full control of nature and its processes and made changes in the natural water cycle, which in the city can be called urban water

cycle. Furthermore, the development of road infrastructure placed the development of transportation modes above pedestrian traffic and nature such as covering existing canals with concrete.

Urban resilience projects have become key principles in the vision of the contemporary city (Wieteska-Rosiak 2018). The term "resilient city" strictly refers to an urban area that has the capacity to withstand and cope with a wide range of stresses, including preparing for, absorbing, recovering from and adapting to such disruptions. Resilience focuses specifically on coping with stress in complex adaptive systems (Ilgen et al. 2019). The strategies can be divided into two groups: global (international policies) and local (city-level actions).

The main document that has emerged as a strategic plan in global terms is the UN's announcement of the Sustainable Development Goals (SDGs). The Goal 11 focuses on making cities stable, safe, sustainable, and inclusive. This is an important aspect for the quality of people's living environment, including public spaces in their places of residence.

As for local actions, these are strategies undertaken by cities. Still, adaptation activities have a pilot dimension. It is a learning process that requires constant evaluation. Currently, the best-known local strategies are the Copenhagen Climate Change Adaptation Plan and the Rotterdam Waterplan 2. The strategy developed by Copenhagen is based on numerous reports and studies conducted on climate change (Copenhagen 2011). Despite calculations and forecasts based on proven knowledge, it is difficult to forecast what will happen in a few decades hence the city has adopted the solution of reviewing current changes on an ongoing basis and modifying the plan. The adaptation plan responds to many significant adaptation issues related to public spaces such as warming weather, the heat island effect, and extreme precipitation. Considering extreme precipitation, three strategies to be followed are presented:

1. larger sewer underground basins and pumping stations-replacement of sewers to get more capacity, separate rainwater from sewage;
2. manage rainwater locally instead of guiding it into the sewer-introduce green, low-tech solutions that absorb rainwater as well as help treat it. By managing water locally, we can minimize excess water in the sewer system;
3. ensure that flooding only takes place where it causes the least possible damage-the so-called "stormwater plan"—this method is not sufficient. It involves relieving pressure on the sewer system and diverting water to places where it won't cause damage, such as parking lots, playing fields, and parks.

New urban development involves increasing the adaptability of public spaces by investing in green infrastructure at street level and on rooftops with the goal of increasing space for water runoff. A new and innovative strategy is the use of additional water storage in highly urbanized areas so-called water squares. This is a concept developed by Rotterdam-based studios DE URBANISTEN and Studio Marco Vermeulen (Rotterdam Climate Initiative). Most of the time the water squares are dry and serve as public spaces in the form of playgrounds or sports fields. During extreme rainfall, they turn into an urban water storage pond.

All the concepts adopted in Rotterdam make it one of the safest cities in the delta and the example of the entire strategic plan is a model case of concrete adaptation to climate change in a highly urbanized area.

Copenhagen and Rotterdam are trying to move away from the concept of rainwater as "waste" and use its potential to combat climate change.

The awareness that the natural water cycle is of central importance for risk prevention and to respond to extreme events leads to new actions and strategies of adaptation to climate change. In these actions, the European Climate Adaptation Platform Climate-ADAPT[3] defines the Water Sensitive Urban Design (WSUD). It constitutes a holistic approach to integrate water cycle management in the built environment (Grant 2016). The principles of WSUD are based on design measures for the reintroduction of rainwater into the natural environment and for the development of vegetation and biodiversity in the urban context. It aims to promote the development of an environmental design that can activate urban regeneration processes in which water sensitivity, technical aspects, and architectural and environmental quality are combined. The importance of its strategies is given by the intention to reproduce the natural drainage, reduce sewerage system stress, improve water infiltration, encourage groundwater recharge, and improve urban water quality.

Despite the creation of many documents, we can see that still very few cities are choosing to make changes. Most projects are developed in large metropolitan areas with financial resources. From an objective point of view, large-scale cities face more environmental problems and any urbanized space should adapt towards sustainability, without overlooking small-scale cities. Northern European countries are pioneers in innovative solutions to counteract the effects of climate change. Denmark and the Netherlands are creating innovative projects that are appreciated worldwide and provide a basis for further development and a model to follow. However, there is a noticeable lack of implementation of adaptation strategies in other parts of Europe. Cities such as Milan, with a high potential for change, still do not have many implementations in this field.

26.3 Methodology

This paper examines solutions to the problems of strategic public places approaches to contrast climate change based on scientific evidence. Attention is placed on identifying problems, developing knowledge, and sharing information from strategic approaches from different geographic locations and different scales of the projects. The research process included two main phases: data collection and data analysis.

- Data collection

[3] It is a European platform that shares information on climate change adaptation in Europe. The platform is a partnership between the European Commission and the European Environment Agency (EEA).

A review of the literature related to urban climate change risks and resilience. Exploring approaches and strategic solutions for strategic approaches to the design of public spaces and the use of water resource management. The literature tends to take a more practical view in an empirical (not normative) context and focuses on discussing good practices for adapting urban spaces to climate change. The most relevant literature studies are all official and scientific reports on climate change, pre-strategies appropriate to the adaptation of public spaces, documents describing the projects in question and: "Cities in the world, a new perspective on urbanization" and "Biodiversity and Nature-based Solutions" published by European Commission, klimada website (https://klimada2.ios.gov.pl/), which is a database on climate change.

Four cases from different cities (Paris, Rotterdam, Denmark, and London) are presented considering how public spaces have increased resilience in countering climate change. Each element of importance in climate improvement is described. The analyses focused on water management and the use and implementation of water in public spaces. The case studies were chosen to diversify the locational situation, rooted in different local environments, and compare approaches from other countries. These are solutions applied in large cities with a high development ratio. The projects are mostly adaptations, conversions, and revitalisations of existing urban areas, representing a diverse typology of activities.

- Data analysis

The purpose of the analysis is to compare the case studies, to compare the variables: capacity of adaptation, usage of water, climate mitigation, quality, and design of public spaces, to examine the performance of the strategies used and their advantages. Seeking innovative solutions and their adaptation in the fight against climate change affecting urban spaces.

Projects mainly in the north of Europe were analyzed because it was noted that this is where innovative adaptations are created. In the south, countries are following the designs of their neighbors and their ways of dealing with extreme weather conditions, but their actual implementations are lacking.

The European cases were chosen because Europeans have so far mostly enjoyed the mildness of temperate climates, but nowadays they must cope with more and more extreme weather conditions, including flooding; moreover, Europe is historically characterized by the specific condition of public spaces in terms of shape and use connected with European culture. The analyzed projects were adapted to combat flooding and answer the question of alternative solutions for public spaces adapted to contemporary needs.

Experiences: case studies

Benthemplein Square, Rotterdam, Netherlands

Project: De Urbanisten

Year: 2013

The square project involves the redevelopment of an existing square at the junction of the densely built-up nineteenth century Agniesebuurtneighborhood (Public Space 2020), and the modern center of Rotterdam. The square is the result of the disposition of a group of buildings defining an irregular polygonal shape (Fig. 26.1). Most of the buildings on the square were built in the second half of the twentieth century. Many functions of different characters are in the square. The linear block designed by Dutch architect Hugh Maaskant with a length of around 200 m includes two schools (Zadkine College and Graphic High School), theatre (theatre school) and offices. The square also faces a nineteenth-century church with a facade of dark brick.

The reason why the Rotterdam City Council has intervened (Public Space 2020) is the increasingly frequent extreme conditions including heavy rains that flood many parts of the city every year. Hence, the city administration adopted the strategy of placing the water storage system not in underground tanks but exposed on the surface. This measure was intended not only to perform the main function of storing water during extreme weather conditions such as torrential downpours but also to contribute to improving the environment in the urban space, strengthen the identity of the district and provide residents with a new place to relax or spend time actively. Thus, the first water square was created, which combines all the above-mentioned features. The disposition of the new elements in the middle of the space gives a formal meaning

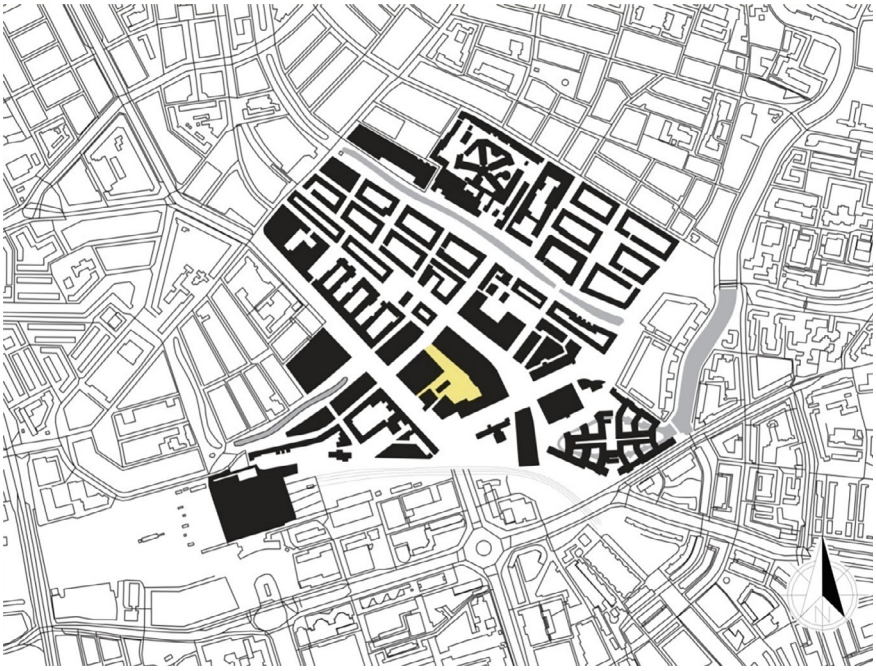


Fig. 26.1 Urban context of Benthemplein square. *Credits* Gaia Nerea Terlicher, AUDe Laboratory, University of Pavia

to the shapeless square. As De Urbanisten architects themselves emphasize "We invented the typology of the water square in 2005 for the International Architecture Biennale Rotterdam (IABR) "The Flood". Typological research by design on water squares was carried out by us in 2006–2007. The water square became official policy on an urban scale in the "Rotterdam Waterplan 2" (De Urbanisten) in 2007. A pilot study was carried out in 2008–2009." The Benthemplein plan has become a major urban policy for Rotterdam.

Given the location of the square and the placement of diverse functions around it, it was considered best if the square became a place with a dynamic character. The direct access of schools puts the place at a point where it should be adapted to young audiences with plenty of space for active spending and green spaces to take care of the relaxation parts as well.

All these factors made it possible to develop an innovative design for the water square (Figs. 26.2 and 26.3). Three rainwater harvesting tanks have been designed:

1. a not very deep non-drainage basin. When it is dry it serves as a place for people who ride wheels (rollerblades, roller skates, skateboard, etc.) and people watching them;
2. located on the north side of the square, in front of the main entrance to the church. Not a very deep basin, it collects rainwater during regular rains from the surrounding surfaces. Its shape is similar to a trapezoid, with surrounding steps used as seats and an island in the middle created to serve as a stage for dancing;

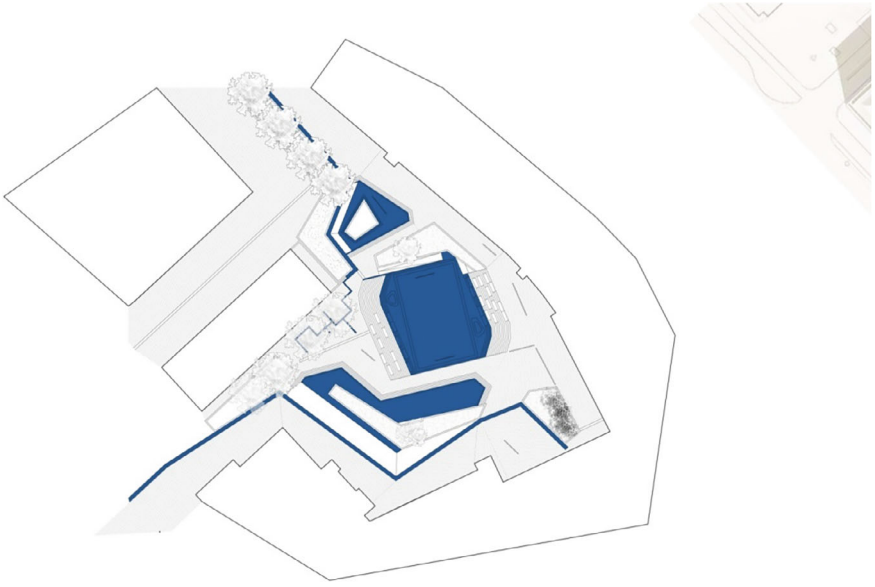


Fig. 26.2 Plan of Benthemplein square. *Credits* Gaia Nerea Terlicher, AUDe Laboratory, University of Pavia

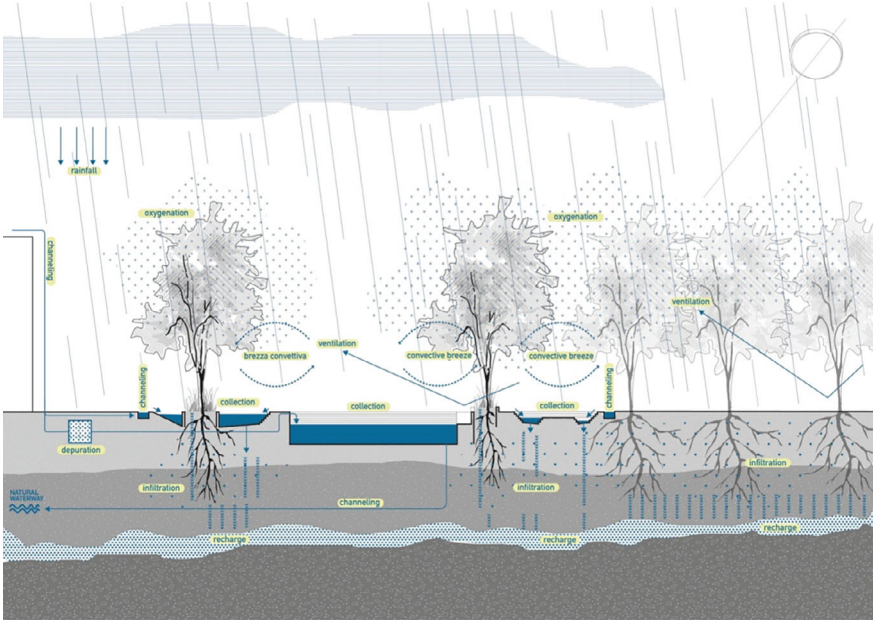


Fig. 26.3 Section of Benthemplein square. *Credits* Gaia Nerea Terlicher, AUDe Laboratory, University of Pavia

3. a deep basin, which allows for the collection of large amounts of water during heavy rains or long-term precipitation, is the centerpiece of Benthemplein Square. While there is no water, the basin serves as a sports field (for basketball, volleyball, or soccer) and also as a theatre with an audience. The viewing area consists of two rows of tiered seating in the form of cascading steps.

When it rains, water is collected from the plaza area and transported to the basins through a network of large stainless-steel gutters. In addition to these elements, a rain well and a water wall also supply water to the basins. The rain well was designed as a special beginning of one of the gutters and brings water into the basin from the roof from an adjacent building. The water wall introduces water from further away in the square to the largest basin. Both elements are visible from the observer's level and the wall of water is a kind of waterfall, the rhythm of which is dictated by the amount of rainwater.

After rainfall, the water contained in the two smaller no-drain basins flows into an underground infiltration basin. From there, it gradually seeps into the groundwater. This makes the ground more resistant to sudden floods and better able to cope with dry periods. It also has a positive effect on the maintenance of urban greenery. Water from the largest reservoir flows into the city's open water system within 36 h. All rainwater that has been buffered collected during drains no longer flows into the combined sewer system, which relieves the burden on the conventional sewer

system. Relatively dirty water does not overflow into open water which improves the overall quality of water in the city.

Each access to Benthemplein Square provides organized greenery. This emphasizes the importance of existing tall greenery and is a form of minimizing the urban heat island effect by cooling the surrounding area. Low greenery such as wildflowers have also been introduced to surround the trees, introducing biodiversity and enhancing the aesthetic value of the site, further creating a more intimate and relaxing place.

In the water square, every detail is thought out and carefully designed, nothing is the result of chance. Hence, the color scheme of the square emphasizes its function and gives character and dynamics. All areas that can be flooded (three basins) are painted blue. Elements that transport water are made of stainless steel. In addition, some of the colors correspond to those of the modernist building designed by Hugh Masskant.

The section shows how water and its action affect the square (Fig. 26.3). Rainwater is collected from rooftops in the area and transported by gutters to basins, where it is collected. From the three pools, it is infiltrated partially on the ground; while the biggest pool transports it to a natural waterway. This treatment makes the ground more absorbent and ready for subsequent sudden downpours and copes better in dry periods. Plantings of low and especially tall greenery also promote water infiltration, improve overall air quality, improve ventilation of the area, and create a convective breeze.

Place de la République, Paris, France

Project: TVK (Trévelo & Viger-Kohler Architectes Urbanistes)

Year: 2013

The City of Paris has taken up the challenge of the theme of fighting global warming. The objective of the intervention was the redevelopment of Place de la République. It is an important point for Paris because it is in the center at the confluence of the city's main alterations between the Paris 3, 10, and 11 districts (Fig. 26.4). The design concept is the result of a competition and placed the pedestrian as the main audience. Until now, the square was divided and could be said to have constituted one large intersection with a traffic circle in the middle, around the monument to La République. It is now the largest pedestrian plaza in Paris.

The design is based on an interdisciplinary open space with an emphasis on leveling the heat island (TVK 2013). The square measures 120 m × 280 m and today is a site that can be adapted for many functions such as a meeting place or a new attraction center. The removal of the traffic circle and the reorganization of the intersection has freed the site from the previously dominant vehicular traffic that concentrates on pedestrian and bicycle traffic. To maximize the area used by pedestrians, vehicular traffic is concentrated on the southern shaded edge and the two narrower sides, leaving the rest of the area to be used by users. After the reconstruction, the area available to pedestrians doubled from 35 to 70% (TVK 2013).

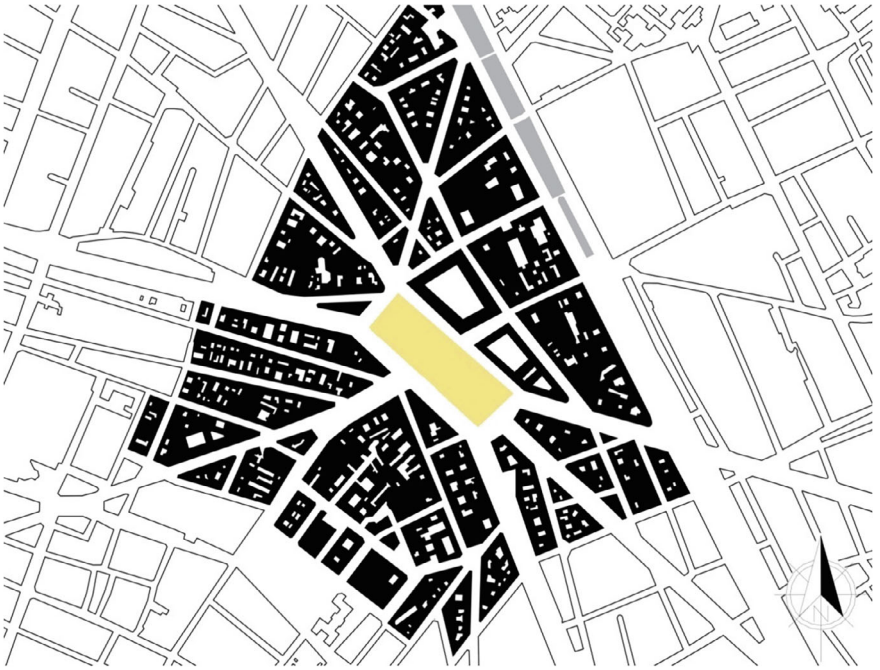


Fig. 26.4 Urban context of Place de la République. *Credits* Marta Mazurkiewicz, AUDe Laboratory, University of Pavia

The gentle 1% slope of the site reveals two terraces bounded on the north by a stepped descent. Between the terraces, the ground slopes toward one of the main transit points providing continuity of movement and ease of access. In addition, these points serve as cascading seating allowing users to relax or as a meeting place.

The only newly constructed building on the square is the freestanding pavilion "Fluctuat Nec Mergitur" measuring 162 m^2 (9 m × 18 m). The project, like the whole establishment, was created by TVK studio and is an integral part of the square. It is in the south-western part on the axis with the reflecting pool and the Marianne statue (Fig. 26.5). The pavilion is completely glazed in order not to obstruct the view, to blend in with the surroundings, and ensure the continuity of the panorama of the square.

To combat the urban heat island effect, the square maximized the amount of vegetation, especially tall vegetation. In this way, the shade of the trees cools the space and protects the pedestrian from the sun's harsh rays. The density of tree plantings on the north side also blocks cold winds during winter. On the west side, blue infrastructure has been introduced in the form of a 276 m^2 (23 m × 12 m) reflecting pool with showers, which is a form of social, recreational, aesthetic but above all climatic use. Sprinklers during hot weather spray water to cool the environment and when they are turned off, they do not affect the topography or use. In the central area, water is also located at the base of the La République monument in the form of

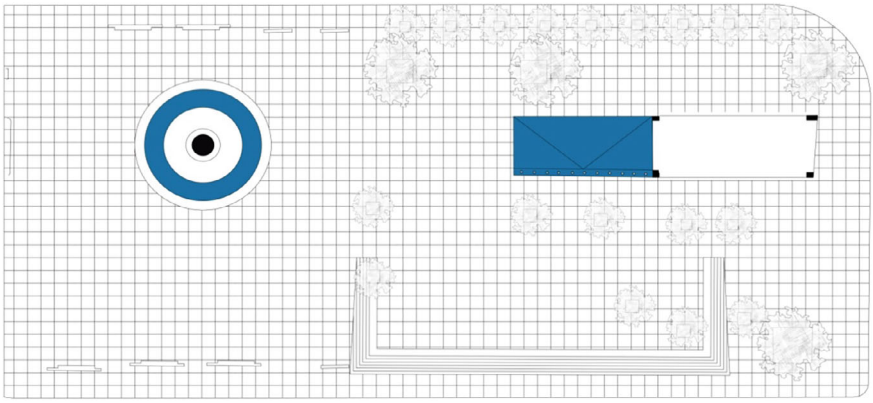


Fig. 26.5 Part of the plan of Place de la République. *Credits* Marta Mazurkiewicz, AUDe Laboratory, University of Pavia

a large circular basin. The entire layout of the square supports wind circulation and ventilation of the square. Summer breezes in contact with the water sheets of the La République statue and the reflecting pool cool the entire plaza area.

Boulevards with rows of trees and avenues, the statue of Marianne, terraces, and the newly constructed pavilion form a harmonious axis previously cut by the intersection of automobile roads. The effect of the axis is enhanced using a horizontal ground made of prefabricated concrete paving slabs in various shades of grey. Darker colors were used in the shaded parts of the square, while light colors were used in the open areas to allow the sun's rays to reflect. The monochromatic colors of the flooring allow La République Square to blend into the urban layout of the city.

The section shows the main role of tree plantings and soil connected to water cycle (Fig. 26.6). They support water infiltration, infiltration, and percolation into groundwater. They have a huge impact on improving air quality, shade, wind circulation, and ventilation in the area. Water infrastructure elements like a reflecting pool with jets spray a mist of water that cools the surroundings with the wind and offsets the urban heat island effect.

Granary Square, London, Great Britain

Project: Townshend Landscape Architects

Year: 2012

The project's relevance lies in the fountains, which constitute the main attraction. They serve the function of spraying a hovering water mist that cools the surrounding area on hot days. In this way, it combats the heat island effect occurring in the area. Thus, water fountains answer double needs: welfare and quality space.

Granary Square is in King's Cross (KX), London, a 57 hectare redevelopment area after abandoned railroad land (Townshend Landscape Architects), (Fig. 26.7). The entire premise focused on public spaces and pedestrian traffic (King's Cross).

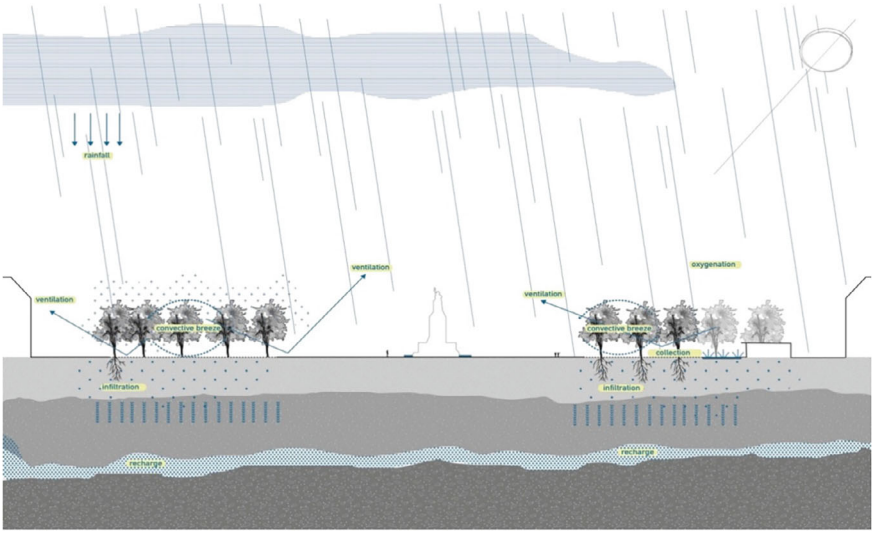


Fig. 26.6 Section of Place de la République. *Credits* Gaia Nerea Terlicher, AUDe Laboratory, University of Pavia

Granary Square is the central and largest area of public space in the revitalised KX. Its shape is determined by the existing and undertaken renovation of the historic Granary building from 1852 designed by architect Lewis Cubitt[4] (King's Cross). The building currently houses the University of the Arts London.

The square was designed as a water park with four areas of water jets (Fig. 26.8). The designers, together with the Fountain Workshop, paid attention to the historical aspect of the site and used the idea of the former canal basin, which was a mooring and unloading point for boats and later a storage yard, as inspiration for the fountains that are a reference to the past. Some historical elements such as cranes and railroad tracks were also left behind and incorporated into the new plaza. The location of the fountains refers to the historic canal basin and the position of each of the four sets of jets relates to the facade of the Granary building, reflecting its rhythm and scale. All four sets of fountains comprise a total of about 1,080 individual jets making the square one of the largest water features in Europe (Townshend Landscape Architects). They are located in a rectangular plan and on the two, shorter sides are placed benches allowing you to relax and enjoy the water element. The place is designed so that during the events held on the square it is possible to turn off the operation of the jets and they do not interfere too much with the topography of the square. Only the cobblestones around them were shaped so that the poured water leaves a thin layer that is a reflecting pool, but the slope is so small that it does not interfere with the functioning of the square. In addition, they have been designed to individually

[4] (1799–1883) was an English civil engineer and architect. Currently, the square next to Granary Square in the King's Cross area is named by the architect—Lewis Cubitt Square.

Fig. 26.7 Urban context Granary square. *Credits* Marta Mazurkiewicz, AUDe Laboratory, University of Pavia

program the jets so as to create movement throughout the square and create temporary spaces. During the summer the place is so popular that some of the events were moved to the neighboring square to avoid closure of the fountains.

The southern part of the plaza is topped by cascading steps leading down the canal. The steps have been planted with grass, which is one of the green points of the site. The other point is the increase in tree plantings on the west side. This introduces additional shade on hot days and greens the front of the canal.

The section shows the interdependence of greenery plantings and blue infrastructure in offsetting (Fig. 26.9) the urban heat island effect. Greenery introduces shade and improves air quality and ventilation in the square. Water enriches the area with the creation of convective breezes. Green areas also assist in the collection and infiltration of water and the introduction of water into the groundwater. A large area with fountains in the form of showers cools the square. During torrential downpours, water from the square cascades down towards the canal hence the area is protected from flooding.

Taasinge Square, Copenhagen, Denmark

Project: LYTT Urban & Landscape Architecture

Year: 2014

Taasinge Square is the first urban space adapted to climate change in Copenhagen. The place used to be flooded with about 1,000 m^2 of asphalt (LYTT) with little

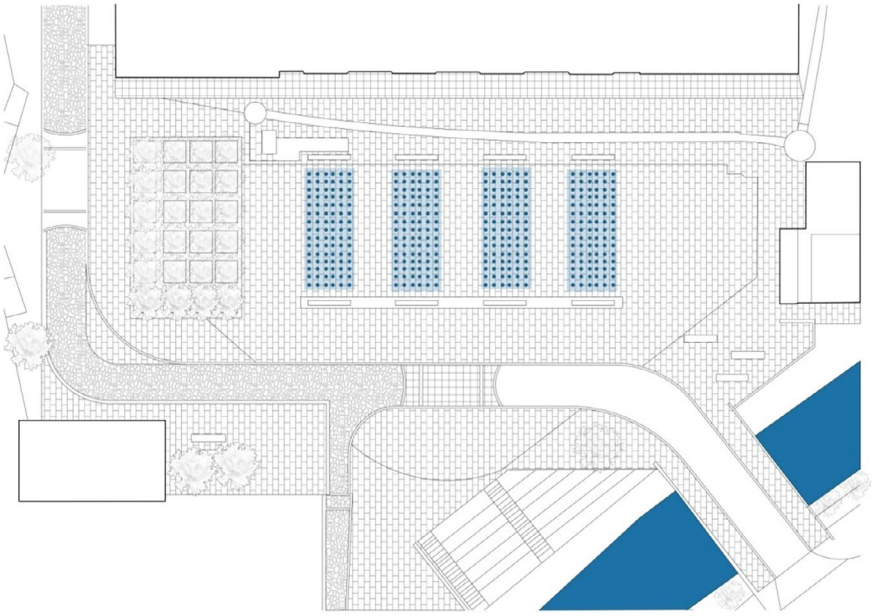


Fig. 26.8 Plan of Granary square. *Credits* Gaia Nerea Terlicher, AUDe Laboratory, University of Pavia

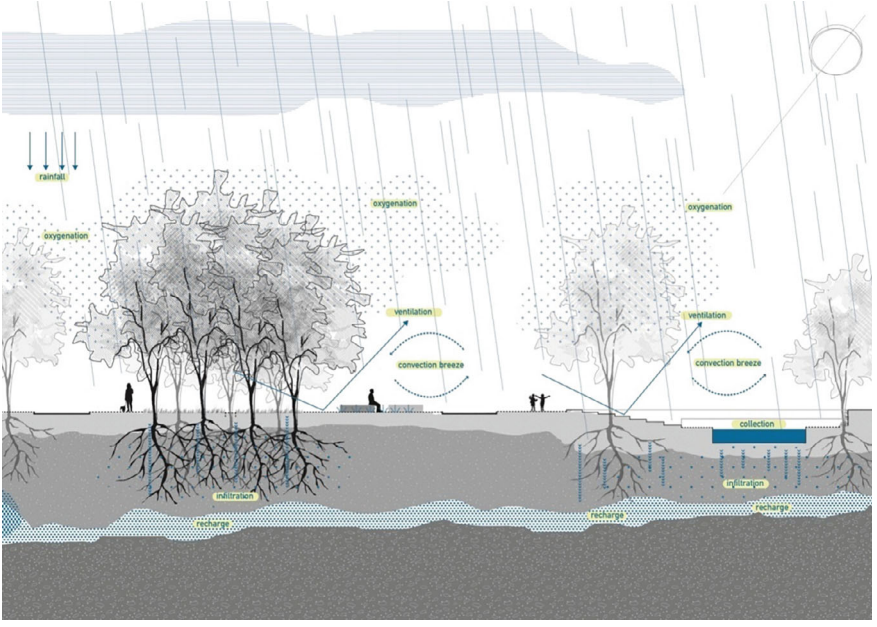


Fig. 26.9 Section of Granary square. *Credits* Gaia Nerea Terlicher, AUDe Laboratory, University of Pavia

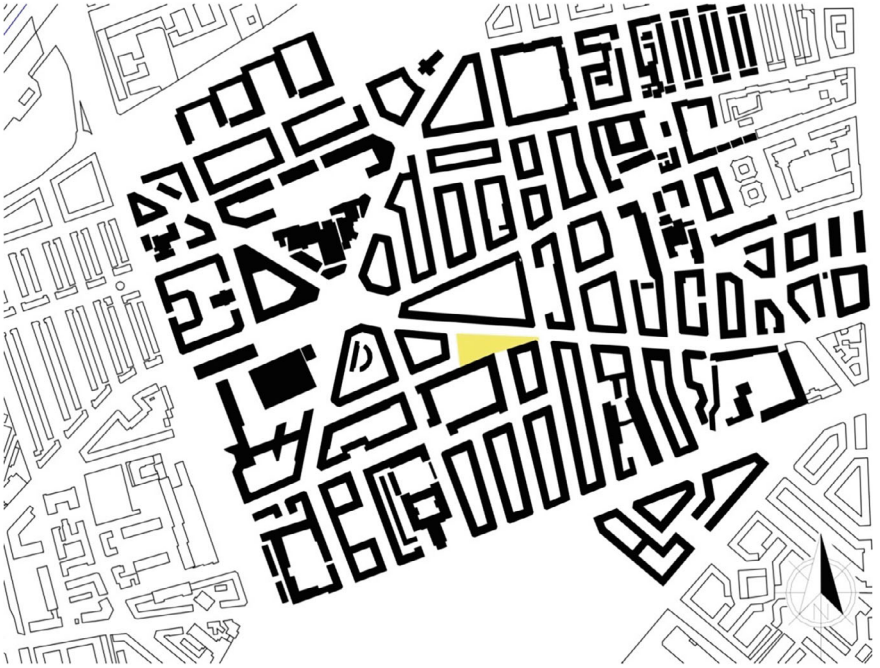


Fig. 26.10 Urban context of Taasinge square. *Credits* Gaia Nerea Terlicher, AUDe Laboratory, University of Pavia

greenery and after the reconstruction it is the green heart of the densely populated St. Kjeld district (Fig. 26.10). The concept of the entire project is to take a natural and peculiar approach to vegetation and water (Klimakvarter 2015). The topography of the area has been designed to offer a variety of uses for the square.

The adaptation of the public space of Taasinge Square is based on the retention and control of rainwater in the area around it (Fig. 26.11). The area rises above ground level in a westerly direction, while rainwater naturally flows in an easterly direction. This allows rainwater from the streets to be controlled in one direction, retained, and kept away from the drainage network. Taasinge square can seep rainwater from the surrounding area of about 4,300 m^2 (Klimakvarter 2015). The entire establishment can be divided into three parts:

1. "Solskrænten"—an area sloping toward the south, elevated above ground level that constitutes a green lawn. The place is used for relaxation as well as play. There are also stairs in the north-western part connecting the sidewalk at the intersection of Taasingegade and Ourøgade roads with the grassy slope;
2. "Torvet"—a central, sunny square with benches where it can be used as a playground or a place for relaxation all year round. Part is a space with greenery and part with granite slabs where there is innovative equipment in the form of water-collecting sculptures: "rain umbrellas" and "water drops." The umbrellas collect

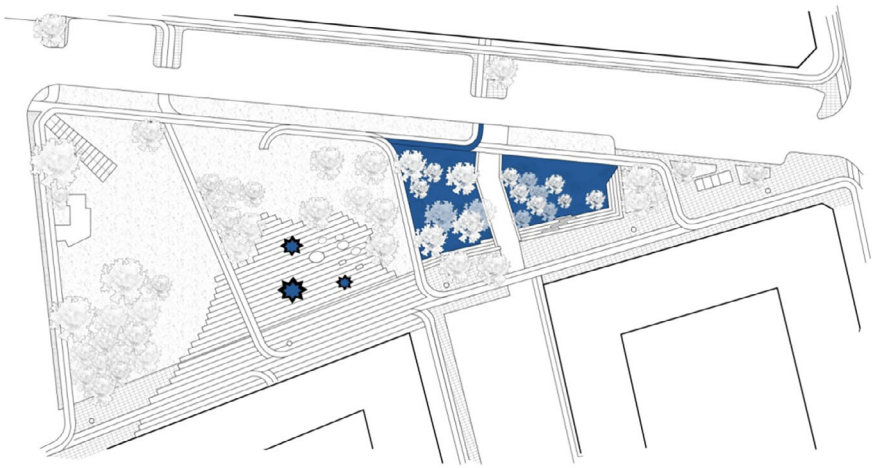


Fig. 26.11 Plan of Taasinge square. *Credits* Gaia Nerea Terlicher, AUDe Laboratory, University of Pavia

rainwater and guide it to infiltrate. Beneath the drop sculptures are three reservoirs that collect water from the roofs when it rains. Through roof drainpipes, the water is fed into underground reservoirs under the plaza and has undergone several treatment processes. Using the two hand pumps with which the square is equipped as part of the playground, the water is pumped to the surface, where it flows through small channels to the green areas, thus irrigating them. When the reservoirs are as full as possible the water naturally flows out of them and reaches the rainforest.

3. "Regnskoven"—the lowest point of the rainforest plaza with lush vegetation infiltrating the rainwater. This place promotes slow mobility because there is a bicycle path that runs over a bridge over a ditch that collects water.

Recycled materials were also used in the redevelopment of Taasinge Square. The granite slabs used in the square are surplus about 625 m^2 from Ørestad Boulevard, and 600 m^2 of cobblestones and 625 m^2 of granite stones were recycled into seating areas and sidewalks that ideally connect the square to the rest of the city (Klimakvarter 2015).

Under the square are two bunkers (air raid shelters) that serve as rehearsal rooms for musicians. The first is located under the western part of the square—Solskrænten and the second is in the center part of Torvet plaza. The entrances to them have been renovated and now also serve as niches for seating.

The square represents the Danish landscape with biotypes from the hill (west) to the pond (east). Seasonal diversity has been introduced, and vegetation has been selected so that urban biodiversity is visible in the long term. Moisture-tolerant vegetation was selected for the lowest part of the square because this is where most water collects. Along the streets, English oaks and flowering wild cherry trees were

planted. In addition, flowers, grasses, and herbs were planted. The vegetation was adapted to the soil conditions, the sunshine of the area, and its shading. In addition, salt-resistant greenery was used because the roads are sprinkled with it during winter periods. In the project, there are ditches around the roads, which capture water so that it does not flow into the sewer system as it may be contaminated, for example, by the salt hence it is infiltrated through a thin layer of filter soil in the designed ditches.

The section shows how we can manage and use water (Fig. 26.12). By working with the terrain and creating its slope, we can control water runoff. Ditches are created on the side of the street that collect the water flowing into it. Planted on this terrain, moisture-tolerant vegetation that infiltrates the water, introducing it slowly into the groundwater. Rainwater from roofs is depurated and accumulated in a reservoir. In the square, there are additional elements that collect water to gradually infiltrate it or use it as "raindrops" thanks to which we can use the water in the dry season. For the most part, the square is a green spot with numerous plantings that perfectly absorb water and prepare the ground in case of further excessive rainfall.

The case studies discussed can be divided into two different types:

(1) public space storing water, hereafter referred to as "PS_SW";
(2) public space that cools the environment, hereafter referred to as "PS_CE".

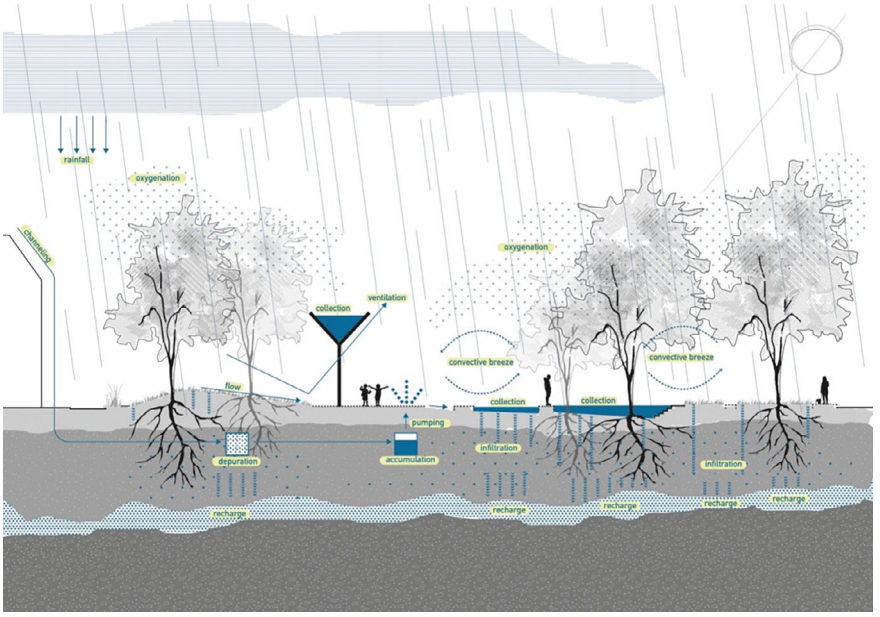


Fig. 26.12 Section of Taasinge square. *Credits* Gaia Nerea Terlicher, AUDe Laboratory, University of Pavia

The division into typologies is based on the specific function for which the square was designed. The PS_SW type includes:

- Benthemplein Square, Rotterdam, Netherlands;
- Taasinge Square, Copenhagen, Denmark.

Type PS_CE:

- Place de la République, Paris, France;
- Granary Square, London, Great Britain.

The scheme (Fig. 26.13) shows the differences between the factors that comprise the squares. Type SP_SW are the squares that have been designed with the main aim of retaining water in the square until the water supply network has sufficient capacity. The Taasinge and Benthemplein squares have inundation protection as an objective. They have system solutions in the form of sustainable drains introduced. This system makes the surrounding area more resilient, the collected water is retained safely in the square and does not overflow into the municipal sewer system. The Benthemplein square in particular has a strategy to collect excess rainwater and collect it outside, creating an urban pond, which is a new solution so far. Taasinge Square, through the topography of the terrain and the large amount of greenery, naturally retains water. Through the permeability of the soil, it infiltrates and purifies water. The role of water is of great importance here, but all the time these types of squares are pilot and experimental projects, subjected to monitoring to develop further strategies.

The main purpose of the PS_CE type is to cool the environment. The introduction of water is important in combating the urban heat island and introduces a recreational element. The Place de la République and the Granary Square are examples of a typical urban square but adapted to climate change through temperature-reducing elements. They are large-scale squares and the water on them provides fountains and water jets to cool the surroundings during hot days. In addition, they have tree plantings that provide shade and introduce good ventilation into the area.

Nonetheless, both types are designed to combat climate change. They are guided by multifunctionality and the introduction of as many environmental enhancers as possible. They respond to the need for adaptation by introducing biodiversity into the urban structure, improving air quality, ventilation, and shade, which prevents the site from overheating.

Public space	City	Year	Type	Objective	Actions			Environmental aspects			
					Sustainable drainage system	Permeability of soil	Tree boxes	Shadow	Ventilation	Air quality	Biodiversity
Benthenplein Square	Rotterdam	2013	PS_SW	I	●	●		●	●	●	●
Taasinge Square	Copenhagen	2014	PS_SW	I	●	●		●	●	●	●
Granary Square	London	2012	PS_CE	T			●	●	●	●	●
Place de la République	Paris	2013	PS_CE	T			●	●	●	●	●

I- inundation
T- temperature

Fig. 26.13 The scheme of the factors that comprise the squares. *Credits* Marta Mazurkiewicz, AUDe Laboratory, University of Pavia

26.4 Result and Discussion

A comparison of the projects has led to conclusions that proper water management will effectively combat climate change. The higher the density of development and population, the more intervention is needed. The examples discussed are located in different urban structures of varying nature: through the historic metropolitan structure and the neighborhood scale. Place de la République is located in the historical urban structure, it is a large-scale project nevertheless Benthemplein in its mostly modernist surroundings fulfills its role as a square bustling with life on a daily basis and in extreme conditions adapts to the strategy of collecting excess water protecting the area from flooding. All of the situations prompt us to think analytically and ask what needs to adapt the place to and what strategic solutions to use. Not all European cities require the same solutions such as collecting water in open, outdoor pools, but almost all are struggling with the increasingly common urban heat island effect. It is important to consider and conduct a thorough study of the area to make the right decisions on the methods to be used. All the cases discussed are examples of revitalisation of a given space. They were areas with high rates of impervious surfaces. Benthemplein Square was completely redesigned and turned into a real rainwater storage facility. As the first pilot water square, it takes what we usually hid underground. A system of horizontal infrastructure in the form of gutters that feed water into reservoirs that stay dry most of the year and provide a place for local community activation and activity. This approach is internationally acclaimed and a model example of rainwater management and development. Taasinge Square functions similarly. The topography of the project allows water to be collected in ditches and storage tanks. This relieves the burden on the city's sewer system, which no longer receives excess water it can't handle. In addition, the green square infiltrates rainwater perfectly and enriches the city's biodiversity. It filters dirty rainwater from surrounding roofs in specially designed systems located under the surface of the square, which helps purify rainwater before it is reused. The Place de la République, by removing the dominant automobile traffic, has enabled adaptation of the site and increased the chance of eliminating the urban heat island emerging thereby putting a large-scale plaza in the hands of users. A similar principle guided Granary Square, which left the square to host a variety of events but without forgetting to use many elements to combat climate change. All of the projects highly promote slow mobility but enable easy access. They are highly thoughtful adaptations from general design guidelines to details such as the choice of materials. This can be seen in the example of Place de la République, which, by choosing the right color scheme for the concrete slabs, regulates the reflection of the sun's rays on more exposed surfaces in sunny and shaded areas.

The analyzed projects are examples in which it can be said that the more interdisciplinary the projects are, the more diverse benefits are obtained. Good design must come from an understanding of the situation and its environmental contexts. Combining an interdisciplinary design that integrates flood adaptation with the design

of public spaces results in obtaining additional benefits such as microclimate reclamation. Moving away from conventional water management strategies such as underground retention ponds are used only during rainy situations while tree plantings, green roofs, rain gardens, water infrastructure, applied to public spaces bring benefits all year round. They can serve to improve the local environment, quality of life and, above all, reduce vulnerability.

26.5 Conclusion

The examples identified in the article provide an ideal basis for future projects. They answer the questions presented, which were the purpose of the analysis. The case studies demonstrate that design with water is fundamental in the fight against climate change. It can be used in many ways, to create different aquatic landscapes and implement new functions in public spaces and to create healthy spaces. Restoring the natural circulation of water and leveling impervious surfaces helps deal with extreme conditions to a great extent and increases the resilience of cities. The European experiences demonstrate that urban design based on water significantly improves the quality of the public spaces and turns nature inside the city at the same time. Envisioning this kind of approach to be developed in the future cities, urban voids will become green lungs for the city.

The projects encourage people to spend time there through diverse greenery, visibility of water, and quality of architectural solutions. The case studies show that even on a small scale we can create an ecological, sustainable, and human-friendly place.

However, it should be remembered that the problem of global warming and the effects that follow it are gaining in strength and frequency. Recent projects sensitive to the theme are still not enough to solve the problem. For this reason, research should not stop with the positive effects we have achieved so far, but constantly look for more effective methods.

References

Adobati F, Garda E (2020) Soil releasing as key to rethink water spacer in urban planning, city, territory and architecture

Berizzi C (2018) Piazze e spazi collettivi. Nuovi luoghi per la città contemporanea. il Poligrafo, Padova

Climate ADAPT (2016) Water sensitive urban design and building design. https://climate-adapt.eea.europa.eu/metadata/adaptation-options/water-sensitive-urban-and-building-design. Accessed 15 Aug 2022

Copenhagen (2011) Copenhagen climate adaptation plan

Culligan (2020) L'acqua nella storia dell'uomo, https://www.culligan.it/acqua-nella-storia-del luomo/. Accessed 01 Aug 2022

De Urbanisten, Watersquare Benthenplein, http://www.urbanisten.nl/wp/?portfolio=waterplein-benthemplein. Accessed 24 July 2022
European Commission (2020) Cities in the word, a new perspective on urbanisation, OECD Urban Studies
Fortuniak K (2003) Miejska wyspa ciepła. Podstawy energetyczne, studia eksperymentalne, modele numeryczne i statystyczne. Wydawnictwo Uniwersytetu Łódzkiego. Łódź
Fumero A (2020) Water Sensitive Urban Design (WSUD) as a climate adaptation strategy, Politecnicto di Turino (Italy) and KTH Royal Institute of Technology (Sweden), master thesis
Grant G (2016) The water sensitive city. Wiley Blackwell, USA
https://www.culligan.it/acqua-nella-storia-delluomo/. Accessed 01 Aug 2022
Ilgen S, Sengers F, Wardekker A (2019) City-to-city learning for urban resilience: the case of water squares in Rotterdam and Mexico City. MDPI Open Access J
International Federation of Red Cross and Red Crescent Societies (2010) Word disasters report, focus on urban risk
Iwaszuk E, Rudik G, Duin L, Mederake L, Davis M, Naumann S, Wagner I (2019) Błękitno-zielona infrastruktura dla łagodzenia zmian klimatu w miastach, Ecologic Institute i Fundacja Sendzimira
Klimada 2.0 (2020) Miejska wyspa ciepła. https://klimada2.ios.gov.pl/miejskie-wyspy-ciepla/ Accedes19 July 2022
Klimakvarter (2015) TåsingePlads, Copenhagen Klimakvarter, TasingePlads. https://klimakvarter.dk/en/projekt/tasinge-plads/. Accessed 04 Aug 2022
Kusińska E (2017) Creating Urban public spaces according to local communities needs. Politechnika Krakowska
Lévy B (2008) The European town square as an ideal place, or Camillo Sitte Revisited, Environment, land society-architectonics. Université de Geneve
LYTT Urban & Landscape Architecture, Tåsinge Plads. https://www.lytt.dk/en/projekter/tasinge-plads. Accessed 04 Aug 2022
Mairie de Paris (2018) Vegetalisons Paris. Dossier de Presse, Paris
Najwyższa Izba Kontroli (2022) Zachowanie i zwiększenie terenów zielonych w miastach, Lublin
Pluta K (2014) Public spaces in European cities: urban design. Politechnika Warszawska
Public Space (2020) Water Square in Benthenplein. https://www.publicspace.org/works/-/project/h034-water-square-in-benthemplein. Accessed 24 July 2022
Rotterdam Climate Initiative (2013) Rotterdam climate change adaptation strategy. Rotterdam
Sawyer CN (1944) Biological engineering in sawage treatment. Sawage Works Jurnal
Słodczyk J, Rzeka w lokalizacji i przestrzennym rozwoju miasta
Światowe Forum Miejskie WUF11 (2022) Miejska wyspa ciepła, czyli dlaczego w obszarach zurbanizowanych jest gorąco i co zrobić, żeby było chłodniej, https://www.gov.pl/web/wuf11/miejska-wyspa-ciepla-czyli-dlaczego-w-obszarach-zurbanizowanych-jest-goraco-i-co-zrobic-zeby-bylo-chlodniej. Accessed 19 July 2022
Townshend Landscape Architects, Granary Square, King's Cross, http://townshendla.com/projects/granary-square-kings-cross-62/. Accessed 26 July 2022
TVK Architects Planners (2013) Place de la République. Paris
TVK Architects Planners, Place de la République, http://www.tvk.fr/en/architecture/place-de-la-republique-paris. Accessed 24 July 2022
United Nations, Sustainable Development Goals, https://www.un.org/sustainabledevelopment/cities/. Accessed 30 July 2022
UNISDR (2015) The human cost of weather related disasters, CRED 1995–2015. Unites Nations, Geneva
Wieteska-Rosiak B (2018) Hybrydyzacja przestrzeni publicznej miasta w kontekście adaptacji do zmian klimatu, Uniwersytet Ekonomiczny w Katowicach
Zintegrowana Platforma Edukacyjna, Susza. https://zpe.gov.pl/a/przeczytaj/D9wtFH3hl. Accessed 19 July 2022

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 27
Developments in Urban Design Practice in Kadıköy Region of Istanbul: A Morphological Perspective

Ayşe Sema Kubat, Şebnem Çebi, and Mehmet Ronael

Abstract The Italian school of morphology remarks on the importance of the historical background of a settlement as a guide for the urban design process in addition to the French school that focuses on history as it gives the main character that shapes the current physical structure of a settlement area. Thus, it is aimed to investigate how an urban design can be guided concerning the history of a settlement, regarding the knowledge of these two schools of urban morphology. This paper considers how new ideas may be integrated into the urban form of a city that has been powerfully shaped by a long history. Since the typo-morphological interpretation of settlements; understanding physical form, formation, and transformation using types and typologies; can represent an essential reference point for urban planning and design, this study also aims to investigate past traces and to find clues that can be a reference for the future, and determine the design principles. Haydarpaşa in the Kadıköy district, a focal point welcoming visitor to Istanbul in the past but is an inactive space with potential based on the old Train Station and archaeological excavations of Chalcedon, is selected as the study area. In this scope, typo-morphological analyses in the neighboring Yeldeğirmeni settlement area guided the urban design process in Kadıköy to preserve the historical identity as a transportation hub and a commercial area; on the other hand, assuming a new role of being a recreational area that responds to the requirements of Yeldeğirmeni neighborhood.

Keywords Urban design · Urban morphology · Typomorphology · Istanbul · Chalcedon

A. S. Kubat · Ş. Çebi (✉) · M. Ronael
Istanbul Technical University, Harbiye St. 34367, Istanbul, Türkiye
e-mail: cebis17@itu.edu.tr

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_27

27.1 Introduction

Urban design is a process driven by the historical background of settlements and the current dynamics that affect the new design. Since urban morphology focuses on how today's settlements are formed in light of the historical background, it is essential to underline the leading role of urban morphology during the design process. According to the French School and Muratorian approach that creates the basis of urban morphology, history contains the required knowledge to shape a territory's future.

Muratori, as the pioneer of the Italian school of morphology, regarded the urban design process as a way of reconfiguration the historical background of the physical environment from different perspectives (Cataldi 2003). He is the first to underline the city as a living organism and the importance of providing a continuation of the design regarding the architectural understanding of previous buildings (Cataldi et al. 2002). Therefore, Muratori focuses on a new framework of morphology based on the leading role of previous practices in urban design (Kristjánsdóttir 2019).

Later on, the French School of Morphology was established on the foundations of the Italian school. However, these understandings have differences considering the evaluation of urban form through a social environment and its impact on each other (Kristjánsdóttir 2019). The roots of the school are based on social sciences that are concern with the relationship between humans and the built environment (Moudon 1998). The reason being that since the ongoing renewal and reconstruction movements of time are open to discussion from citizens' perspectives. The studies of Panerai, Castex, and Depaule were based on the idea that the town developed not as a whole but rather as a collection of urban fragments (Darin 1998: p. 66). Therefore, the efforts of French schools to analyze the urban pattern not only as a physical feature but from the perspectives of society, economy, and politics also broaden the outlook of morphology practices (Sadeghi and Li 2019).

27.1.1 Background

This paper is based on multi-scalar urban design practices regarding Italian and French thoughts of morphology, carried out within the Urban Design Studio of the Urban and Regional Planning Department of Istanbul Technical University conducted by Ayşe Sema Kubat. Haydarpaşa in Kadıköy district is the subject of an urban design project because of it being an idle cultural landmark that has always been a welcoming place for arriving visitors; and an archaeological site in the middle of Istanbul.

27.1.2 Methodology

The project's methodology is developed within the perspective of morphology schools that analyze the evolution of the physical structure of the urban environment consisting of multiple layers. In the first stage, the morphology of study areas is analyzed from a broader perspective to define planning decisions that will result in the new design being compatible with the surrounding environment. Next, the project focuses on urban design decisions related to transportation, land use, green infrastructure, and landscape design regarding upper-scale planning and benefits from the knowledge of the historical background of the physical setting. Also, the urban pattern and architectural characteristics of the neighboring environmentswhich contains the clues that may lead to the new urban design are examined.

The aims of the project may be summarized as follows;

- Creating unity between the current setting and future design of settlement with the consideration of the historical evolution of the urban area.
- Re-designing a cultural landmark that contains traces of different layers of history in a way that responds to current urban trends while respecting the urban memory.
- Integrating an idle space in a densely constructed urban area into green and blue infrastructure to provide people with green spaces and seashore access under the scope of sustainable development goals.
- Providing a vital common space that serves not only the surrounding environment but also the inhabitants of Istanbul that suffer from the lack of open and common areas.

In short, within the scope of the sustainable development goals and the increasing significance of urban resilience, it aims to achieve a functional and vital space design that meets the current needs of the urban residents and the city's possible requirements in the future. Also, this study guides the applications of design for urban areas with similar characteristics in different parts of the world in terms of revealing the relations between urban design and urban morphology.

27.2 Kadıköy as the Study Area

The site that is subject to urban design is currently called Haydarpaşa, which lies within the boundaries of the Kadıköy district in Istanbul (see Fig. 27.1). When the current situation of Kadıköy is examined from a broader perspective, it is possible to say that Kadıköy is the main center of the Anatolian side of Istanbul. It is a transport node accessible by different modes such as railways (The Marmaray and Istanbul metro line), vehicle roads, and marine lines which makes this area highly accessible resulting in a vibrant urban environment. Not only its accessibility but also its land use allocation, and their attached activities are among the factors that make Kadıköy an attractive focal point. Due to the agglomeration of commercial functions

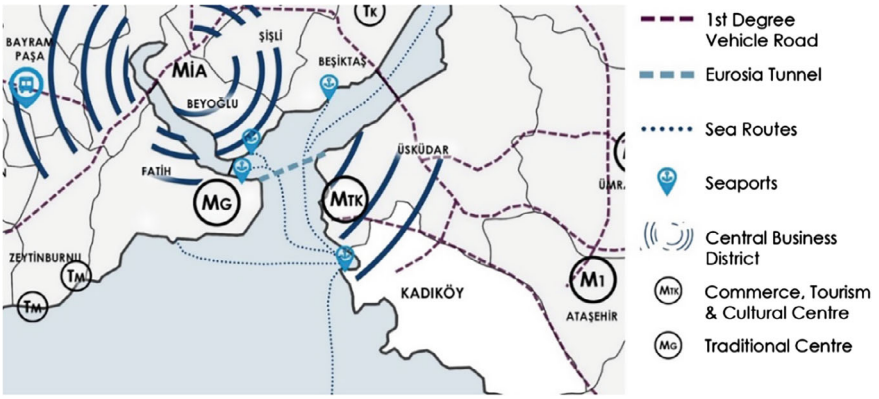


Fig. 27.1 Location of the study area (Authors)

alongside its cultural and historical heritage, it experiences dense 24 h pedestrian and vehicle traffic, which results in it becoming the proverbial 'city that never sleeps'. Even though the site is in the middle of a densely constructed settlement and a vital urban center, it is an idle space attached to Haydarpaşa Train Station, ready to be incorporated into the existing urban fabric.

Before going into details of the historical of Haydarpaşa/Kadıköy, it is important to mention how the area became the focus of a new urban design intervention. Haydarpaşa Station Building, one of Istanbul's most prominent landmarks, was partially damaged in a fire on 20th November 2010 (Milliyet 2010). Afterwards the plans for the restoration of both the Station Building and adjacent railway area started. In fact, the restoration process began right after the last train left the station in 2013 (Arkitera 2014).

While the restoration continued up to October 2018, the image of Haydarpaşa, a historical train station that had witnessed the arrival of thousands of people from all over, has transformed due to archaeological findings excavated under the station. Haydarpaşa Station gained a new identity as an archaeological site in the middle of the city and becoming one of the major symbols and cultural attraction points of Istanbul. Therefore, the new agenda for the redesign of Haydarpaşa focused on urban design proposals for the conservation of the archaeological findings while preserving the symbolic value of the station in urban memory and integrating the adjacent idle spaces into the surrounding area.

27.2.1 Historical Background of Kadıköy

Based on the understanding of the French and Italian schools of morphology that emphasizes the investigation of history as a crucial beginning step of the urban design process, it focuses on the roots of the urban pattern (see Fig. 27.2). Despite the

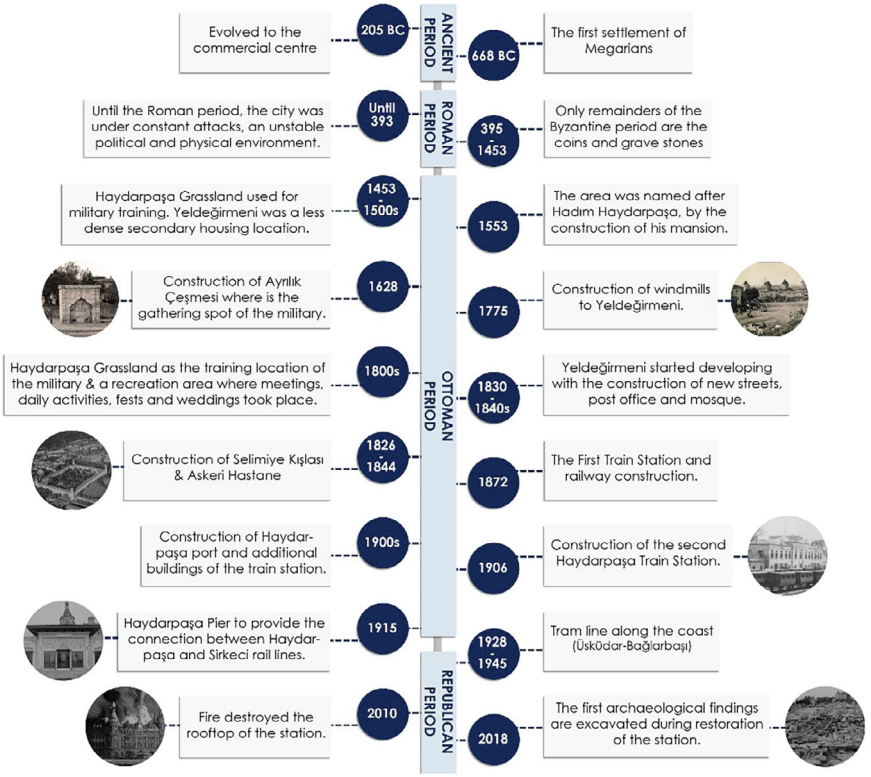


Fig. 27.2 Historical background of Haydarpaşa (Authors)

common assumption that the historical peninsula is the oldest settlement of Istanbul, Kadıköy, called Chalcedon in ancient times, was inhabited approximately 17 years before the historical peninsula known as Byzantion (Demir 2008). Haydarpaşa was the oldest nucleus of Chalcedon due to its proximity to the waterfront and mine beds and its fertile agricultural lands. According to Demir (2014), the reason why there was a settlement before that of Constantinople is because of its safety from barbarian threats, physical suitable for agriculture and animal husbandry, in addition to its proximity to the sea. The area was assumed to be one of the two ports of Chalcedon, and a commercial axis emerged that was attached to the port. Unfortunately, there is no solid evidence of all the physical features due to the destruction caused by wars during the Hellenistic and Roman Periods (Türkoğlu 2014).

With the conquest of the city by the Ottomans, the area became a recreational space surrounded by low-density settlements of secondary housing (Atılgan 2021). In addition, it became the gathering place of the army and served as a space for military exercises (Atılgan 2021). Apart from the mansions with extensive gardens, the first settlement of Haydarpaşa formed on Yeldeğirmeni Hill—where it is named

after the four windmills constructed there (Kütükçü 2014). Since then, the settlement developed around the main commercial street and respecting certain planning features of Selim III's Nizamname (İyier 2012).

At the end of the nineteenth century, the construction of a train station that would be the gateway to Anatolia started. Hence, the recreation area lost its use as a common area due to the location of the railways and associated facilities allocated on the Haydarpaşa grassland. Along with the developments around Haydarpaşa Station, the development of the Yeldeğirmeni neighborhood accelerated. The first education facilities and religious buildings in Yeldeğirmeni were constructed by the new residents of the neighborhood who are the employees of Station construction company and originated from Germany and Italy (Atılgan 2021).

In 1908, Haydarpaşa Station Building became one of the landmarks of Istanbul and a part of the silhouette of the Bosporus, and it still salutes the historical peninsula of Istanbul from Anatolia. During the twentieth century, in the Republican era of Türkiye, the station was the gateway of Istanbul that welcomed trains from Anatolia (Atılgan 2021). After 2013, it was closed for restoration and no longer in service. The Haydarpaşa Train Station site is in close proximity to the transportation network and urban facilities (En Son Haber 2013). Moreover, it has great potential for transformation into an attractive area responding to the requirements of both neighboring settlements and inhabitants of Kadıköy.

27.3 Planning the Site: A Wider Perspective of the Haydarpaşa Area

The first step of the study, based on state of the art urban planning practices, defines the site's visual, physical, and social relations with its surrounding environment: Yeldeğirmeni neighborhood, Kadıköy square and seaports, the commercial center, and historical landmarks (see Fig. 27.3). The creation of unity and integration between the site's present and future can only be established by a broader perspective that considers different dynamics and layers of the urban environment. Therefore, the transportation system, green network, and land use allocation in Kadıköy are rearranged by the planning decisions that followed detailed analyses that determined the problematic spots and potential within the area.

Kadıköy, as a district and a socio-economic center of Istanbul, has high potential to lead and inspire the design process, such as cultural heritage that can generate attraction for urban identity. The marketplace/commercial center is accessible by different types of transportation modes. It provides opportunities for a wide range of user groups and consumers, including a great diversity of economic activities. In the oldest parts of the settlement as Yeldeğirmeni and Moda, the rhythm and balance within the urban fabric and organization of street layout that creates a connection with the scenery increase the aesthetic of the urban area. Hence, for integrating the social dimension into the planning and design process according to the French School of

Fig. 27.3 Surrounding environment of the study area (Authors)

Morphology, it is crucial to mention the socio-demographic structure of the district. The demographic structure of the area can be considered as gentrified due to the settlement of a 'creative class' and an influx of young people in recent years. The change in society is reflected in the urban pattern in a way that renovated the old urban area in terms of the requirements of the 'creative class' and new user groups.

However, the cityscape may not be attractive in aesthetic terms due to buildings erected that are incompatible with the silhouette. On the other hand, the seashore is allocated for incompatible land uses, such as parking lots and bus stops, interrupting the continuity of pedestrian movement and the green network along the coast and breaking the link between people and blue infrastructure. The Haydarpaşa station area and several other voids in urban patterns create idleness and are the primary focuses of urban design. Since Kadıköy witnesses a dense human crowd, the interruption of pedestrian routes because of vehicle traffic and highways is a significant challenge that planning and design practice needs to consider. Due to the absence of open and green spaces in the densely constructed urban fabric, indoor and outdoor facilities are not sufficient to provide a good quality of living. Also, the creation of new social and cultural facilities to integrate different user groups is another aspect that needs to be considered. In addition, the increasing number of members of the 'creative class' demands flexible and multi-functional urban spaces that could serve the different requirements of a variety of professions (Olcay and Mengin 2019).

Based on the synthesis findings taking into account various aspects of the urban environment in detail, the upper-scale proposals of transportation and green networks are made to ensure the suitability and continuity of these subsystems for the entire Kadıköy (see Fig. 27.4). Later on, these proposals are integrated into the further stages of the study.

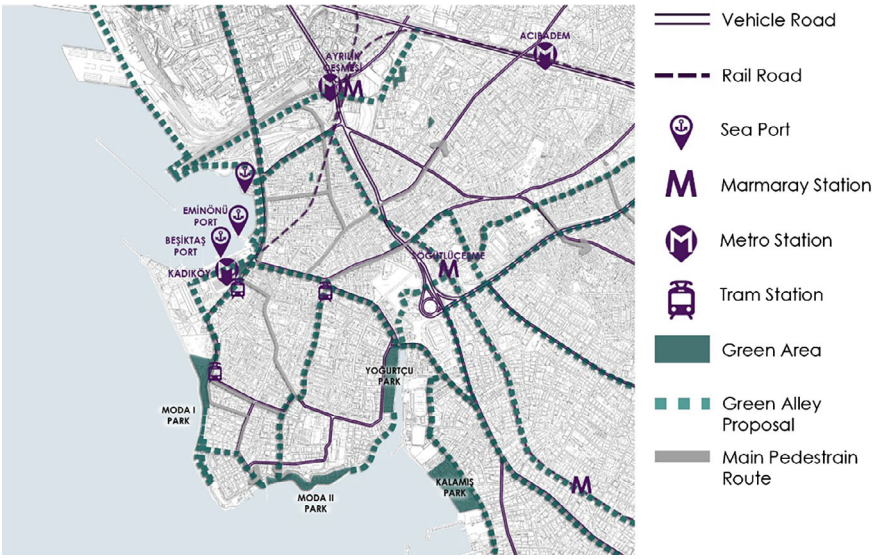


Fig. 27.4 Proposals in the upper scale (provided by the authors from the Base Maps (2015) of the Municipality of Istanbul)

27.3.1 Making Proposals for Transportation System

Kadıköy may be defined as a transportation node where different modes intersect and channel through the inner parts of the Anatolian side of Istanbul. The connection with the European side is provided by marine transportation as well as an underground tunnel for vehicle traffic (Eurasia Tunnel) and a railway line (Marmaray) connecting the historical peninsula to Kadıköy underneath the Marmara Sea.

The seaports are located along the urban square, which was formerly occupied by bus stops, so the identity of a square that is a public base for gatherings, activities, and leisure could not be preserved. Therefore, the bus stops are relocated to the site to generate a more welcoming urban square for all inhabitants and visitors (see Fig. 27.5). However, the metro exits are still integrated into the urban square to enable people to transfer to marine and vehicle transport. The railway and Marmaray line are extended into the proposed site to the new train station, rather than extending the rail line to the Haydarpaşa Station Building in order to protect and exhibit the archaeological findings of Chalcedon under the old station. On the other hand, in the transportation system, vehicle traffic is re-arranged by the decisions of road hierarchy, and main pedestrian roads are integrated with the green system to maintain safe and comfortable pedestrian movement.

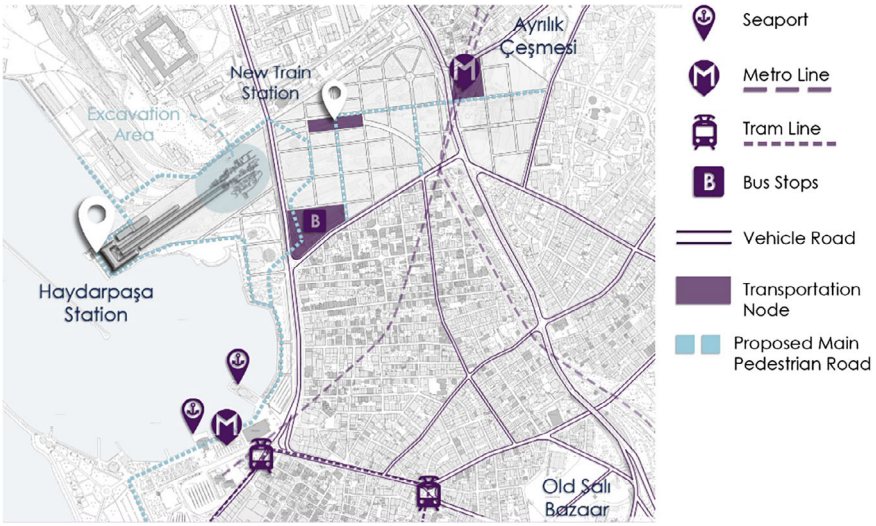


Fig. 27.5 Proposals for transportation network (provided by the authors from the Base Maps (2015) of the Municipality of Istanbul)

27.3.2 Creating Green Network

Existing green areas cannot form a green system/infrastructure due to the interruption of continuity of greenery not only in densely constructed settlement areas but also along the waterfront. Thus, new green areas within the site are proposed to increase outdoor comfort and enhance the quality of life as a solution to the construction density that does not allow for the creation of open areas where inhabitants can interact with nature.

On the other hand, where the physical layout does not allow for green areas, greenery is brought to street sections because of the importance of the continuity of the 'green' concept. New green routes are to be linked to the current systems to create an intersection of greenery and pedestrian movement. Also, in narrow streets that form part of the urban fabric, the green system will be executed as part of the design of the buildings or their façades. Finally, an urban square that welcomes arrivals from the Bosporus will be created with an aim to create a connection between two sides of Marmara Sea (see Fig. 27.6).

27.3.3 Determining Land Uses

Land use decisions are taken to provide the continuity of specific functions in the current urban setting and bring new ones to the area based on the shortcomings in the physical environment and problems of urban life. The Haydarpaşa Station area and

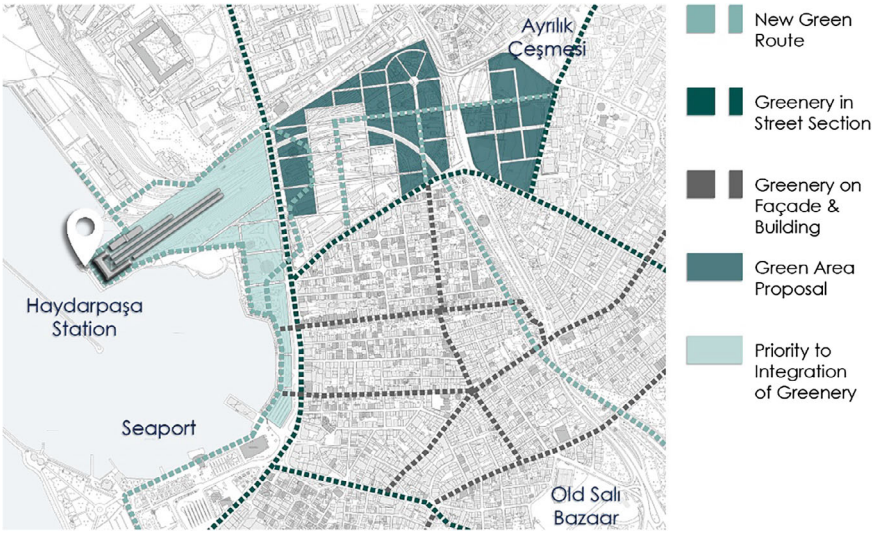


Fig. 27.6 Proposals for green network (provided by the authors from the Base Maps (2015) of the Municipality of Istanbul)

the findings of Chalcedon are planned as an interactive cultural and archaeological center creating a platform for people to perform or exhibit art, in addition to observing and enjoying the historical heritage and scenery of Bosporus. The seashore will be re-planned as an urban square that functions as a welcoming and aesthetic representation of Kadıköy that captures the attention of visitors providing space public activities. Multi-functional land use is proposed for the site as a reflection of the existing multi-functional land use in the settlement area that brings different activities and user groups together and creates a stimulating urban environment. New green areas are designed as part of the in the green system (see Fig. 27.7).

As a further step in the urban planning, the design process is conducted based on the upper-scale decisions in a way that enhances the urban aesthetic. This is done by not only reflecting the historical references of the urban pattern and architecture but also following the modern understanding of today's design world.

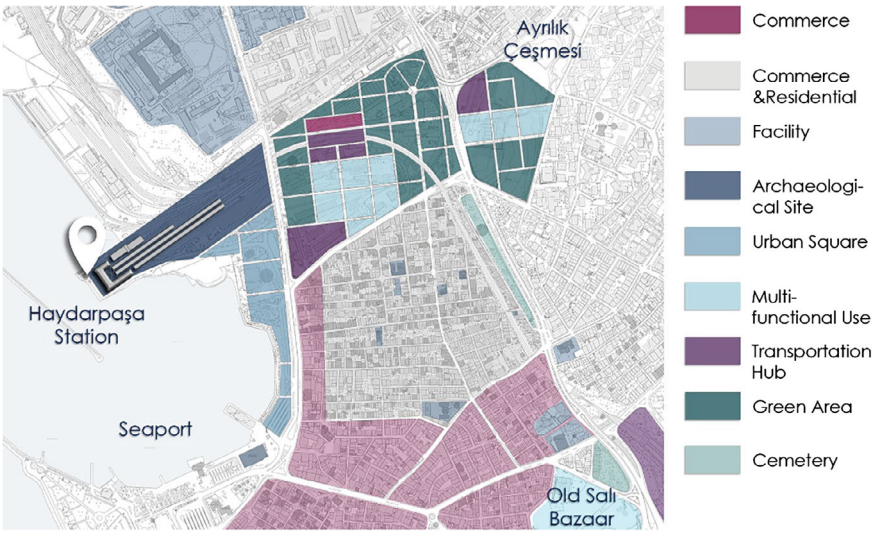


Fig. 27.7 Proposals on land use (provided by the authors from the Base Maps (2015) of the Municipality of Istanbul)

27.4 Designing the Site

27.4.1 Creating the Basis for Design: The Role of Geometry in Shaping Urban Form

Before making the planning proposals, the main layout of the new design that land uses and, transportation and green systems is created as a base for further design steps. The primary focus of establishing harmony and balance between what is current and newly planned within the scope of Muratorian school, the main layout is a reflection and extension of the neighboring area named Yeldeğirmeni. Due to being shaped over a long period, the grid layout, from its historical background and the neighborhood's physical characteristics, are powerful reference points in guiding and directing the urban design process. Even though it is one of the oldest neighborhoods (still inhabited) in Istanbul, it was urbanized under the stipulations of the Nizamname of Ottomans in the nineteenth century that aimed to increase the quality of life within the urban area (Şendur 2010). Therefore, the newly suggested grid layout is the most suitable way of respecting the past of Kadıköy and benefiting from the current urban pattern in shaping the future environment (see Fig. 27.8).

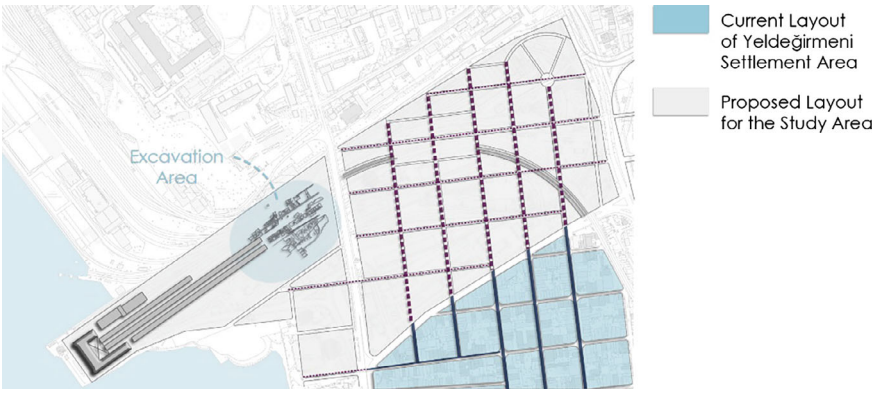


Fig. 27.8 Reflection and extension of the existing grid urban pattern (provided by the authors from the Base Maps (2015) of the Municipality of Istanbul)

27.4.2 Designing the Layout Based on the References: The Role of Landmarks in Shaping Urban Form

Haydarpaşa Station Building is a significant landmark that reflects the area's historical background but it is not the only symbolic structure that enhances the urban aesthetic and dates back to the Ottoman period. In addition to the Station Building, Selimiye Barracks, Faculty of Medicine (Mekteb-I Tıbbiye), and Old Military Hospital (Eski Gülhane Askeri Tıp Akademisi) are landmarks inherited from the late nineteenth century. All these buildings are magnificent structures seated on the hilly topography of Haydarpaşa and saluting Bosporus and the historical peninsula of Istanbul. Courtyards and extensive gardens surrounding the building are the common characteristics of these landmarks constructed in the nineteenth century as public facilities (Yavuz 2005). Accordingly, these buildings are easily prominent and easily recognized in the silhouette of Istanbul owing to their unique architecture.

These landmarks are symbols of both Haydarpaşa and Kadıköy and are in the proximity of the site. It is appropriate that a design proposal should give reference to these magnificent historical treasures. Thus, by taking the position of these landmarks into account, harmony between what is new and what reflects history can be created by urban design.

The streets are formed in a grid layout on sloping topography, allowing for vistas of the Bosporus scenery even from a long distance along the straight streets that face the shoreline. Square-shaped building lots enable the flexible movement of pedestrians and create a more stimulating environment that provides alternative routes for pedestrians (Jacobs 1961). On the contrary, rectangular-shaped building lots direct pedestrians to a specific route and lead them to the focal point of settlement. Streets assume the role of being a common area where inhabitants tend to spend time and socialize, especially on main commercial axes where cafés and restaurants exist.

Fig. 27.9 Yeldeğirmeni neighborhood (Photos are taken by the Authors)

When it is focused on the building scale, it is possible to distinguish the old buildings with their ornaments, window types, bay windows, balconies, and doors. Hence, in contrast to the older ones, newly constructed buildings are easily recognized due to their simpler architectural styles Facility buildings are located along the main roads which pedestrians use heavily. Also, they may be called the attraction points of the neighborhood that generate vitality, due to being used by different groups at different times of the day (see Fig. 27.9). Together with the urban pattern of the Yeldeğirmeni settlement area, landmarks (the station building, barracks, faculty, and hospital) can define the base for design in a way that attaches the past and present, idle and vital in order to create unity (see Fig. 27.10).

The basis of the design is founded on three different layouts as a reference for Yeldeğirmeni, the seating of the Haydarpaşa Station Building, and the orientations of the landmarks (see Fig. 27.11). Also, railways are the threshold in urban design by separating the site into two in terms of physical perception.

The neighboring area to the Station building will follow the location of the Haydarpaşa building to represent the importance and the effect of this magnificent landmark on the new design. On the northern side of the railways, the grid layout will be formed concerning Yeldeğirmeni in terms of directing the flow of people and creating a focal point in the new design. Then, on the southern part of the railways, the grid layout will be re-shaped by the axes of landmarks (The Barracks, Faculty, and Hospital), allowing for the flexible movement of people and the creation of alternative routes.

27.4.3 Adapting Land Use Decisions to the Urban Design

Then, the land use decisions of the upper scale are detailed by determining the activities that will take place within these specific functions concerning the requirements and demands of Kadıköy settlement area and also by considering the previous land uses of Haydarpaşa from the ancient time to the present.

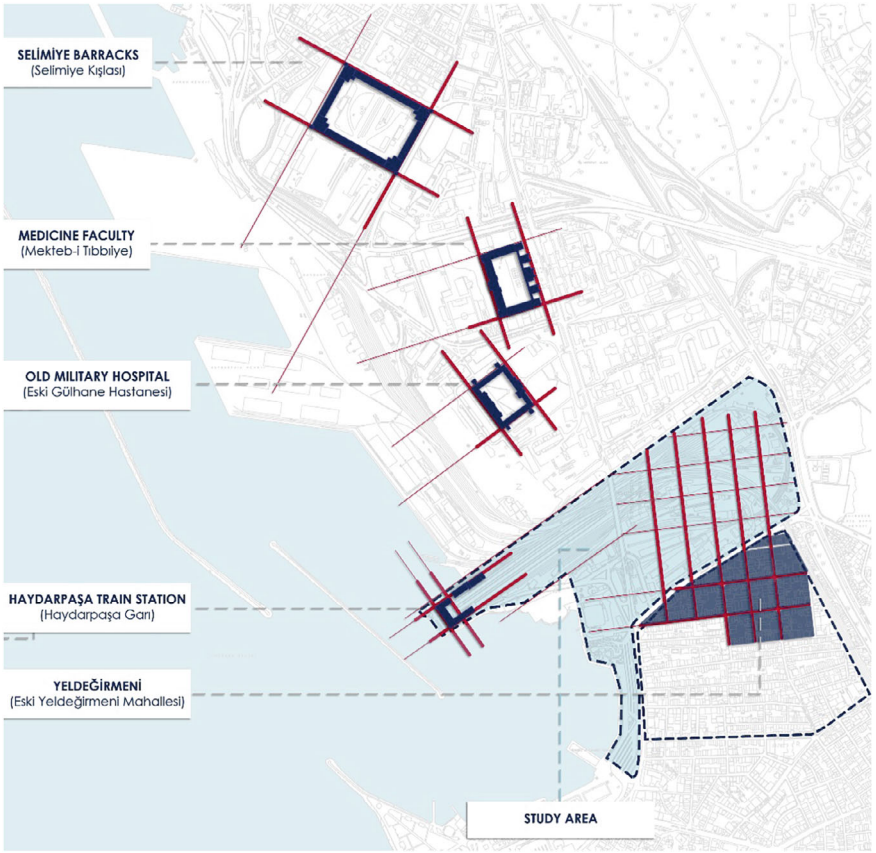


Fig. 27.10 Landmarks in Haydarpaşa, Kadıköy (provided by the authors from the Base Maps (2015) of the Municipality of Istanbul)

During the Ottoman period, Haydarpaşa Grassland was a famous recreational and attractive area for its inhabitants and users of the immediate environment. Despite hosting military training and gatherings, it was also a shared space for people to gather, rest, and organize fests and weddings (Atılgan 2021). With respect to the former land use and the consideration of the need for open and green areas in a densely constructed area, it is crucial to bring back the old recreational identity. Kadıköy lacks open spaces that enable its residents to interact with nature and relieve the stress of urban life. Therefore, recreational land use with playgrounds, open sports areas, parks, forested areas, a botanical garden, and a color garden is proposed to serve different user groups at different times of the day (see Fig. 27.12).

Chalcedon had a linear commercial area in the Roman Period where other land uses connected. According to the analyses in the neighboring settlement area, in Yeldeğirmeni, the main roads are allocated for commercial use. In both cases, the main roads are vital and densely used due to commercial activities. Therefore, the new

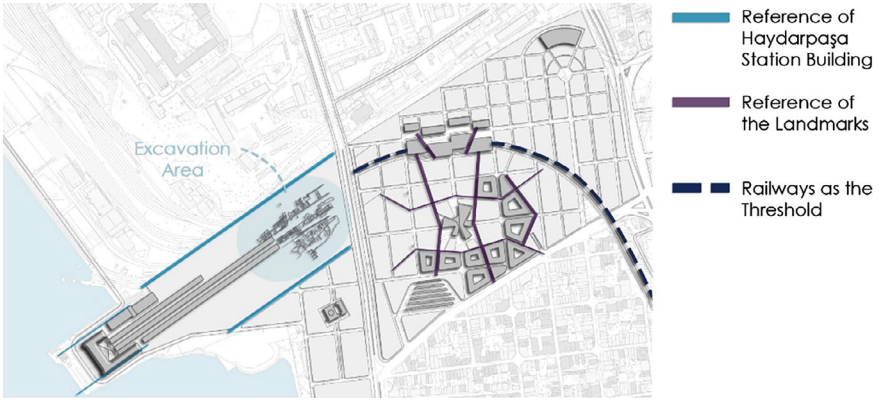


Fig. 27.11 Reflection of landmarks to the design (provided by the authors from the Base Maps (2015) of the Municipality of Istanbul)

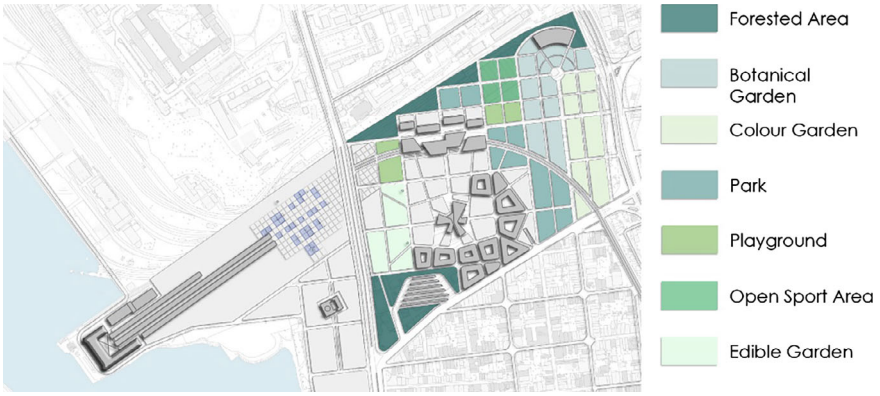


Fig. 27.12 Urban design process: green areas (provided by the authors from the Base Maps (2015) of the Municipality of Istanbul)

urban design will continue to locate commercial land use along the main pedestrian road and form an essential commercial area with cafés and restaurants that will serve people's basic requirements. As mentioned before, this project has adopted an approach of 'proposing a new train station and making arrangements on the archaeological site' to create an open archaeological museum that extends to the old Haydarpaşa Train Station. The 'old' Haydarpaşa Station Building was designed for multi-functional use, serving both arrivals and workers. It contains a restaurant, offices, resting rooms for visitors, and so on. Therefore, it is crucial to design the new train station considering the current requirements of passengers and to define several other functions that increase the station's attractiveness and comfort. These functions may be broadened by having art galleries, exhibitions, workshop spaces, cafés, and stores (Erkan 2016). At the same time, the old Haydarpaşa building and

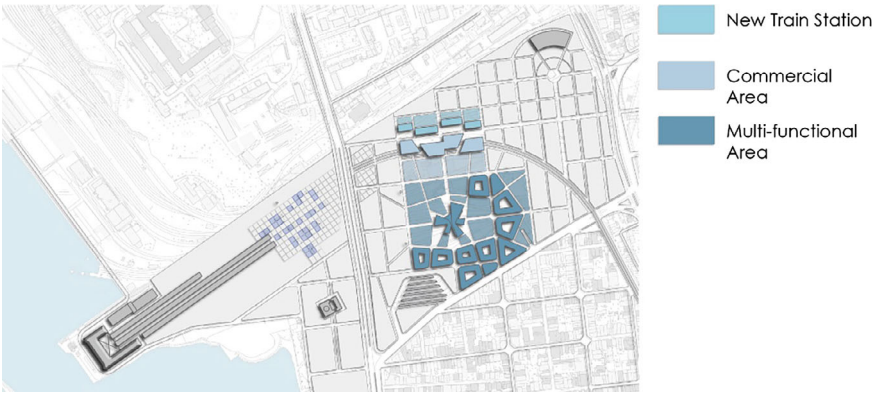


Fig. 27.13 Urban design process: commercial and multifunctional areas (provided by the authors from the Base Maps (2015) of the Municipality of Istanbul)

the stations attached to it can be used to exhibit the old train wagons, which have been used since 1908.

At the south of the new train station and commercial area, the multi-functional area that includes warehouses and co-working spaces is located as one of the focus points of the new design, which is a system of open and closed spaces that generate a more diversified activity area. Apart from the focal building that serves as a theatre and library, all other buildings created their own courtyards, inspired by the architecture of the landmarks such as Selimiye Barracks, Medicine Faculty, and Old Military Hospital which surround their private indoor spaces (see Fig. 27.13).

The archaeological site is designed based in reference to Haydarpaşa and the design layout reflects the seating and orientation of the Haydarpaşa Station Building as the importance of following the guidance of history is highlighted by the Italian school of morphology. A grid platform is designed over archaeological findings below the current ground level. Thus, visitors can walk over the ancient city of Chalcedon and observe the details under a glass platform. In addition, the archaeological site can also be seen from the pedestrian bridge which connects the archaeological site, the settlement area, and the new urban design features. The bridge starts from the central part of the urban square, goes through the site, and then reaches the archaeological site's southern part. Like the rest of the design, the bridge is curved following the orientation of the landmarks (The Barracks, Faculty, and Hospital). It enlarges at specific points to create vistas towards the Bosporus and the findings of ancient city of Chalcedon (see Fig. 27.14).

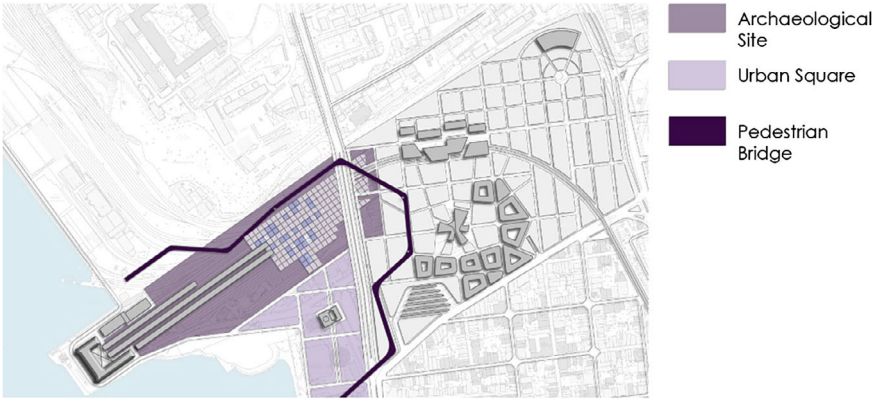


Fig. 27.14 Urban design process: archaeological site and square (provided by the authors from the Base Maps (2015) of the Municipality of Istanbul)

27.4.4 Improving Urban Aesthetic and Vitality with Landscape Design

Afterwards, the layout is detailed by a suggested system of open and closed spaces that can serve different activities during the day (see Fig. 27.15).

The final stage of the design is a process of improving the outdoor comfort and quality of the urban area with the help of landscape design. A linear green system is created along the main pedestrian roads to visually connect focal points. This will attract the users' attention to the area's focal objects. The color gardens aim to create an attraction point and increase the visual aesthetic of the botanic garden and the current settlement by using colorful trees. These tree species are the Japanese cherry blossom tree (prunus asano), Judas tree (cercis siliquastrum), Japanese maple (acer palmatum), and Cherry plum tree (prunus cerasifera), which changes their color during the seasons. Also, small-scaled squares are created in the green landscape in order to provide a resting space where people can observe/experience the surrounding area.

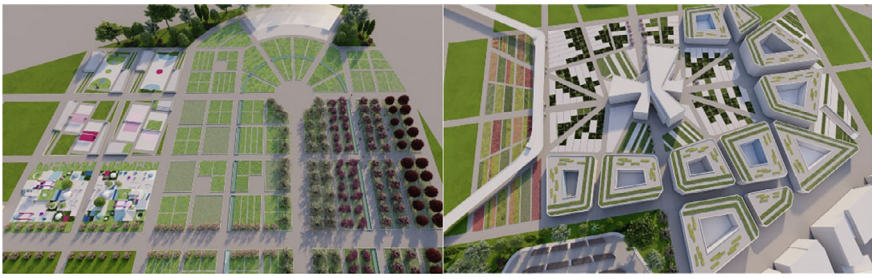


Fig. 27.15 Landscape design (provided by the authors)

27.5 Results and Discussion

Since Haydarpaşa Train Station is one of the landmarks of Istanbul and has a valuable place in the history of Kadıköy by welcoming visitors from Anatolia for decades, it is the focus of different design proposals for the future of the area. It is crucial to remark on the importance of the station in urban memory and the value of the archaeological site in urban history (see Fig. 27.16). The discussions about preserving historical assets and sustaining the area's essence can be categorized into two main points of view.

First, since it is adapted to the urban planning process, the necessity of exhibiting the archaeological heritage of the people of Chalcedon and protecting the Ottoman' railway. Therefore, a medium may be founded by urban design to present the past's different layers in one frame. A new train station located east of the findings enables the exhibition of the archaeological site and allows people to interact/experience the history. Also, it is possible to keep the attraction of the old station building with new functions, such as creating a railway museum.

Alternatively, keeping the station function of the Haydarpaşa Train Station and the railways without damaging the archaeological findings of the ancient era is another option. When the station is seen as a gateway to Istanbul that witnesses the arrival of thousands of people, the memory and spirit of Haydarpaşa can only be sustained through the new generations by maintaining the function itself. Although there are two counterarguments about the future of the Haydarpaşa Station, it is decided to preserve the archaeological findings in a way that enables the interaction of ancient heritage with the people. Therefore, what is proposed in urban planning and design is the best proposal for achieving the primary goal of providing harmony between old and new environments. This proposal allows for the transformation of one of

Fig. 27.16 Archaeological findings of Chalcedon (Provided by the authors from the satellite map, 2020)

the landmarks of Istanbul, namely, the Station Building, into a vital public space that could attract people from all over, adding to the cultural characteristics of the area. Haydarpaşa Station, with its new identity, will become a recreational area with different kinds of land uses. It will offer activities in addition to integrating its archaeological assets into these new land uses, respecting the urban memory of the area with a new train station that will welcome fresh arrivals to Istanbul.

27.6 Conclusion

In brief, the ongoing debates on the future of Haydarpaşa Train Station that is a historical landmark and an archaeological site in Kadıköy, Istanbul is the reason why this project is conducted. Since the preservation of historical urban patterns and the sustainability of urban identity are crucial, the urban planning and urban design processes are based on the understandings of Italian and French schools in terms of identifying historical traces in the urban pattern as the leading factor of the design process. Before starting the design, the site's transformation during history and its place in today's urban pattern is investigated to find clues on how to bridge the past and present of Haydarpaşa. The past and current dynamics of the urban area are examined concerning the urban pattern's multi-layered structure to determine potentials and problems that need to be considered during the design. The upper-scale proposals on transportation, green system, and land use are detailed during the urban design process in addition to adapting these proposals to the design layout inspired by the landmarks and the settlement area of Haydarpaşa.

Based on the design process in Haydarpaşa, it is possible to say that the success of design in creating a vital urban area depends on the response to the requirements of different user groups, whether they are inhabitants or visitors from the rest of Istanbul. The diversity of activities provided by design is another key factor in attracting more people from diverse backgrounds to transform an idle space in the middle of the city into a densely used public space. Additionally, the accessibility of the area in terms of different modes of transportation and the ease and continuity of pedestrian movement are the primary concerns of the design based on the vitality aspect.

On the other hand, the search for integrity between the past and the present of Haydarpaşa is concluded by using the old settlement area and historical landmarks as the major guides of the new design. The new pattern is attached to the older one by providing the continuity of the present urban area. However, still, it is distinguished by its architectural characteristics despite following the references to past uses of Haydarpaşa and landmarks of Kadıköy. In this way, sustaining the urban identity and memory is achieved by exhibiting different layers of history within the site. Finally, the ultimate achievement of the project may be summarized as putting forth the way a historical urban setting should be examined in current planning and design practice. In addition, providing a new perspective on how the past land uses of a historical landmark that holds a celebrated place in urban memory can be updated and transformed within the scope of the requirements of the current users.

References

Arkitera, https://www.arkitera.com/haber/haydarpasada-restorasyon-projesinin-detaylari-belli-oldu. Last accessed 18 Aug 2014

Atılgan A (2021) Geçmişten Günümüze haydarpaşa. K-İletişim Yayınları. İstanbul

Base Maps (2015) 1/1000 and 1/5000 scaled base maps of Greater Municipality of Istanbul

Cataldi G, Maffei GL, Vaccaro P (2002) Saverio Muratori and the Italian school of planning typology. Urban Morphol 6(1):3–14

Cataldi G (2003) From Muratori to Caniggia: the origins and development of the Italian school of design typology. Urban Morphol 7(1):19–34

Darin M (1998) The study of urban form in France. Urban Morphol 2(2):63–76

Demir M (2008) Antik Yunan Kaynakları Işığında Kalkhedon ve Khrysopolis (İÖ. 500–300). In: Üsküdar Sempozyumu VI. Üsküdar, pp 15–36

Demir M (2014) Körler Kenti Khalkedon ile Byzantion'un Kuruluş Hikayesi. Körler Kenti Khalkedon Ile Byzantion'un Kuruluş Hikayesi. Aktüel Arkeoloji 37(1):56–67

En Son Haber, https://www.ensonhaber.com/ic-haber/haydarpasa-son-seferini-yapti-2013-06-19. Last accessed 19 June 2013

Erkan YK (2016) Haydarpaşa Tren Garı: Bugün, dün ve yarın kentin bedeninde bir yara. METU J Fac Archit 30(1):99–116

İyier Ö (2012) Kadıköy Rasimpaşa Kentsel Sit Sınırları İçindeki Tarihi Yapılar Ve Cephe Öğelerine Yönelik Tipolojik Yöntem Önerisi. Uzmanlık Tezi. Kültür ve Turizm Bakanlığı

Jacobs J (1961) The death and life of great American cities. Random House, New York

Kristjánsdóttir S (2019) Roots of urban morphology. ICONARP Int J Archit Plann 7:15–36

Kütükçü T (2014) Geçmiş zamanların, mekânların ve hatırlamaların rafında: Kadıköy'ün kitabı. Ötüken, İstanbul

Milliyet, https://www.milliyet.com.tr/gundem/haydarpasa-garinda-yangin-tarihi-cati-tamamen-yandi-1319650. Last accessed 28 Sept 2010

Moudon AV (1998) The changing morphology of suburban neighborhoods. In: Typological process and design theory, pp 141–157

Olcay GP, Mengin H (2019) The characteristics of the working place of the creative class: the case of fashion designers in Istanbul Nisantasi. In: AESOP annual congress 2019. Venice

Sadeghi G, Li B (2019) Urban morphology: comparative study of different schools of thought. Curr Urban Stud 7(4):562–572

Şendur S (2010) Kadıköy-Yeldeğirmeni semti mimarisinin tipomorfoloji yöntemiyle incelenmesi. Master's thesis. Yıldız Teknik Üniversitesi

Türkoğlu İ (2014) Kuruluşundan Antik Çağ'ın Sonuna Kadar alkhedon Tarihi. Doctoral dissertation. İstanbul Üniversitesi

Yavuz S (2005) Haydarpaşa Garı ve çevresindeki yapıların tarihsel araştırması, askeri karakol ve muhacır misafirhanesi yapılarının yeniden değerlendirilmesi. Master's thesis. Yıldız Teknik Üniversitesi

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Part V
Practical Architectural and Urban Solutions

Chapter 28
Invigorate Urban Public Vitality Based on Spatial Characteristic Analysis: A Case Study of Lujiazui Central District

Ying Yang, Kun Liu, Shuling Liao, and Yong Liu

Abstract The planning and construction of Lujiazui Central District were essentially completed in the 1990s, and since then, this area has become an important financial central district in China. However, as the public center of the city, Lujiazui Financial District currently struggles to provide daily public activity space for citizens, highlighted by the presence of single-function, insufficient public buildings and the inaccessibility of open spaces. We conducted an analysis of the characteristics of Lujiazui Central District space and carried out a relevant case study to explore the strategies of adding a dimensional function to the mixing degree, creating public spaces in high-rise buildings, improving transport links, and using other methods to reconstruct the built environment. We also proposed related public policy suggestions, so as to stimulate the vitality of people in Lujiazui and create better services for public life.

Keywords Vitality of public space · Urban design · Urban public space · Lujiazui central district

28.1 Introduction

Shanghai's urban construction has entered a stage of refinement and development, and improving quality of life and building a dynamic urban public space are important construction aims. Urban vitality derives from people's activities (Wang 2019). Urban spaces are the setting of the daily lives of many people, and the construction of public spaces has an impact on the shaping of urban vitality. Micro-scale public spaces have a direct impact on urban vitality, while the meso and macro forms of a city also affect daily vitality to a certain extent. This paper uses Lujiazui Central District as an example. After more than 30 years of development and construction, this district

Y. Yang · K. Liu (✉) · S. Liao · Y. Liu
Department of Architecture, Shanghai Academy of Fine Arts, Shanghai University, Shanghai, China
e-mail: liukun_arch@shu.edu.cn

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_28

has become an important financial center in Shanghai and a window into China's economic exchanges with foreign countries. At present, the area is mainly used for offices that have relatively limited space. This lack of public building space makes it difficult to create public vitality in the city center. Open public space is seldom used due to its concentrated distribution and poor accessibility. Based on the research of the space status and characteristics of Lujiazui Central District, this paper analyses the reasons for the lack of daily public vitality in this district and explores methods to enhance the quality of daily public life in this urban central district by improving its spatial function connection and traffic connections.

28.2 Related Studies

Urban vitality usually refers to the ability of a place to induce active social and economic activities (Jacobs 1961), which is an important factor affecting the quality of urban life (Jin et al. 2017). Urban form influences the generation of urban vitality and enhancing public vitality from the perspective of form is the fundamental goal of urban design (Ye et al. 2018). There have been many studies on strategies to enhance the vitality of cities—exploring the relationship between public green space and urban vitality (Lopes and Camanho 2013), campus commercial space design from the perspective of urban vitality (Yang 2022), renewal strategy of old industrial zones (Zhao and Wang 2022), block environmental space micro-transformation design (Zhang 2021), traffic microcirculation modes (Wang 2022), etc.—mainly focusing on the design and transformation of micro spaces. There are also ways to analyze and shape urban vitality through the practice of urban design cases, such as the urban design of key areas in the core development zone of the southern New City in Nanjing (Zha 2011) and the design of a vibrant block in the downtown area of Tangshan (Hong et al. 2005).

This paper takes Lujiazui Central District as the research object and puts forward the strategies to shape the urban vitality of the area based on the meso and macro morphological research. After more than 30 years of construction, the existing spatial characteristics of Lujiazui Central District are as follows: single-function setting and single-space supply object (Sun 2006); low building density (Liu 2018); architecture of mainly high-rise buildings (Li and Liu 2018); and a traffic system dominated by motor vehicles. The accessibility, efficiency and comfort of the traffic system still needs to be improved (Tang 2018). The teaching experiment team of Tongji University aimed to address the spatial problems of this area and improve public vitality by changing the urban landscape (Cai et al. 2018, 2019, 2020).

28.3 Methodology

In this literature review, the relationship between urban vitality and urban form is addressed, and it is concluded that the current methods to improve urban vitality are mainly focused on micro-space reconstruction and actual urban design projects, while the study of Lujiazui Central District is mainly focused on the discussion of spatial characteristics and problems. By means of photo recording and interviews, this paper investigates the current status of public vitality in Lujiazui Central District. This study draws on materials and data from 2020; the relevant area and height are explored and illustrated.

This study covers the central district of Lujiazui, which includes Pudong South Road in the east, Dongchang Road in the south, and Huangpu River in the northwest (Fig. 28.1). Through an analysis of the spatial characteristics—single-function, low-density, high-rise buildings and motor vehicle priority—it is concluded that the space is single-function; the podium area has a low occupancy; distribution is concentrated; the public interface is insufficient; accessibility is low; and an efficient and connected traffic system is lacking. On the premise of not changing the current low building density and height of buildings, this paper discusses the transformation strategy of increasing the functional mixing degree, creating public space in high-rise buildings, and improving traffic connections. The structure of this paper is shown in Fig. 28.2. Meanwhile, we analyze the experimental studies of Lujiazui and explore methods to improve public vitality in this urban central district.

28.4 Results and Discussions

28.4.1 Spatial Characters and Problems

In early 1990s, through Lujiazui central urban design international consultancy, a design from the Shanghai consulting group, combined with a design from Rogers (Britain), was used to improve the construction of this district (Cao 2018), consisting of an urban morphology of mainly low-density, high-rise office buildings and the transportation of motor vehicle priority. As the Central District of the city, the spatial characteristics of Lujiazui Central District cause certain obstacles to the formation of daily urban vitality.

Spatial Characteristics of Lujiazui Central District

Lujiazui Central District mainly consists of private office buildings. This single function means that the activity of people in this area is relatively one-dimensional, as office spaces tend to exclude a range of other daily activities of ordinary citizens. On the other hand, the number of residential buildings in central Lujiazui is very small, and there is a lack of people who do not work full-time in offices. Therefore, it is difficult to form sustainable public vitality in the central district of the city.

Fig. 28.1 Lujiazui Central District research scope. Made by author

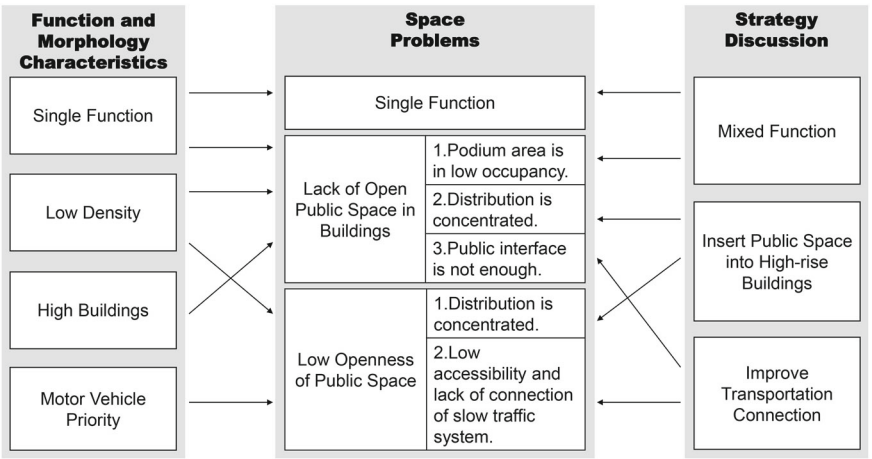


Fig. 28.2 Study structure. Made by author

The ground floor and the lower floors of buildings, which are closest to the city space, have a strong public openness. Compared with the financial and business districts of other cities (Manhattan Diamond Block, Manhattan Financial District, Tokyo Marunouchi, Singapore Raffles, as shown in Table 28.1), Lujiazui Central

District has a low building density (Liu 2018) (Fig. 28.3). This characteristic leads to a lack of public space on the ground floor of the region, which affects the accessibility of the architectural space. The spaces outside the buildings of Lujiazui Central District mainly comprise motor-oriented roads and centralized open public spaces (green spaces, squares, etc.). Large-scale roads are not easily crossed by pedestrians, further weakening the accessibility of open public spaces in the area.

A city consists of various spaces, and the integration of these elements in a city center is paramount. The building coverage ratio in central Lujiazui is very low,

Table 28.1 Comparative study of the spatial density of urban central district. From: Liu K (2018), A study on urban spatial form based on density, PhD thesis, Southeast University, China: 164

	Lujiazui central district (Shanghai)	Manhattan diamond block (New York)	Manhattan financial district (New York)	Marunouchi (Tokyo)	Raffles (Singapore)
Floor area ratio	2.6	7.5	5.1	3.0	3.0
Building coverage ratio (%)	20%	50%	38%	27%	32%
Average floor	13	15	13	11	9

Fig. 28.3 Lujiazui Central District block map. Made by author

but the floor area ratio remains high. Various features of the city are developed in a vertical direction. There are 51 super high-rise buildings with a height of over 100 m and 4 super high-rise buildings with a height of over 300 m. These are mainly commercial office buildings hosting companies of the financial industry (Height is shown in Fig. 28.4). Emphasizing vertical development reduces the area ratio of public space on the ground, causing greater divisions in the building spaces on upper floors.

The traffic system of Lujiazui Central District mainly serves motor vehicles and does not effectually cater for pedestrian spaces. In the original urban design scheme, Century Avenue was intended to serve as both a convenient road and attractive landscape, but in the later construction process, a road with a width of about 100 m was used as a motor vehicle passage. The traffic system, with a priority toward motor vehicles, reduces the pedestrian accessibility of central Lujiazui. The lack of a pedestrian system has attracted the attention of academic circles and government departments. Since 2006, the idea of two-story corridor system in Lujiazui Central District has been proposed, gradually implemented and constructed, and a pedestrian system has been improved (Liu and Chen 2012) (Fig. 28.5).

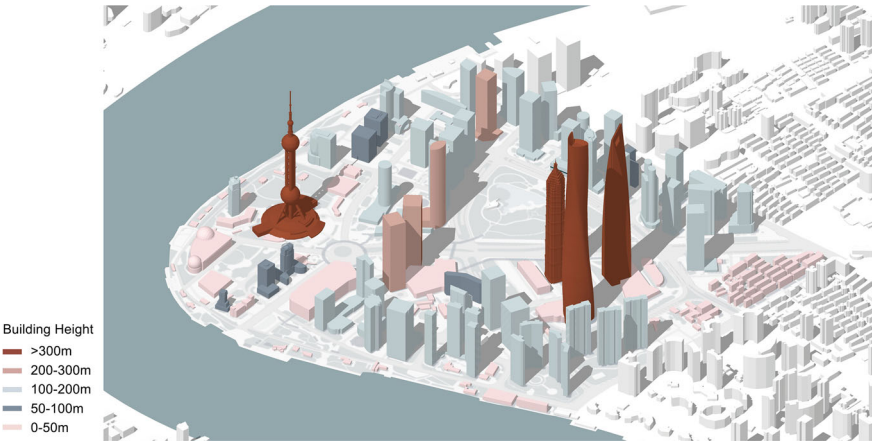


Fig. 28.4 Building height distribution map. Made by author

Fig. 28.5 Left: century avenue. Middle: Second floor corridor system. Right: Connecting part of corridor and the building. Photographed by author

Lujiazui Central District has single-function spatial characteristics, with a relatively low building density, high building height and priority for motor vehicles, which can be considered, to some extent, as a realistic version of the urban central district in the Ville Radieuse proposed by Le Corbusier (2010). This idealized urban model is based on the idea of an efficient transportation system. However, the cross skyscrapers of Ville Radieuse are enormous and have very complex functions. The operation of the city prioritizes efficiency and ignores public vitality. The urban form of Lujiazui Central District is similar to the Ville Radieuse concept, which also has the disadvantage of insufficient public vitality in daily life.

Single Function

In 1990, Pudong and Lujiazui began a large-scale development, and Lujiazui Central District was positioned as the main part of Shanghai CBD, mainly for business and office functions (Fig. 28.6). The single function of the space leads to the lack of diversity of people in the area. Office staff gather in the Central District during the day on weekdays and leave the area after work. Business office space is reserved for office staff, and so ordinary citizens seldom choose to carry out their daily leisure and entertainment activities in areas with concentrated offices strictly intended for businesses. The single-function spaces of Lujiazui Central District make it difficult to maintain crowds in the urban center. The vitality of a city derives from people's daily activities, but the lack of functional mixing makes it difficult to attract stable crowds that can practice a variety of diverse activities, so as to arouse a sustainable urban public vitality.

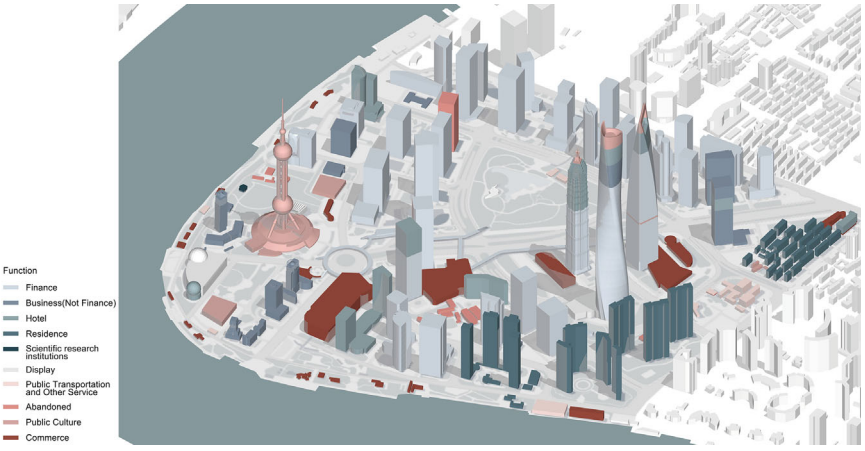


Fig. 28.6 Architectural space function distribution map. From: Lujiazui Urban Design 2020 graduation project group, Shanghai University, including Wenjin Xue, Dishu Ding, Jiaxin Ding, Yunfei Lu, Xuanying Wu, and Peng Chen

Lack of Open Public Space in Buildings

Lujiazui Central District buildings mainly function as private business offices for workers. Under the current traffic conditions, spaces with strong public attributes in office buildings are concentrated on the ground floor and lower floors (Fig. 28.7). Due to a low building coverage ratio in this area, super high-rise buildings are the most common, and the areas on the lower floors of these public buildings are relatively small. The spatial characteristics of the low-density and independent management and construction of each plot make the upper floors of this central area independent and disconnected from one another. The lack of public building space on the ground floor leads to a lack of public interaction in this area (Fig. 28.8), and the lack of a constant public presence in the streets means that space is an obstacle for the people, reducing public vitality to a certain extent.

Low Openness of Public Space

Lujiazui Central District has a riverside park, Central Green Space, Oriental Pearl Park, National Gold Plaza and other open public spaces, which attracts some tourists who visit these areas for leisure and entertainment on rest days. However, these spaces are very concentrated, with few open public spaces scattered around the office buildings. The low density and incoherence of the pedestrian system reduces the concentration of accessible public spaces, which means that the office workers have few choices of green spaces to visit during break times. In their lunch breaks, office staff are more likely to walk in the corridors, which are more accessible, and thus suitable for use in their breaks. In recent years, the construction of riverside green

Fig. 28.7 Publicity of architectural space. From: Lujiazui Urban Design 2020 graduation project group, Shanghai University, in-cluding Wenjin Xue, Dishu Ding, Jiaxin Ding, Yunfei Lu, Xuanying Wu, and Peng Chen

Fig. 28.8 There are few and intermittent open interfaces on the ground floor. Photo-graphed by author and drawn by author

Fig. 28.9 Left: Riverside green. Photographed by author. Right: Lujiazui Central District green space distribution map. Made by author

spaces in Lujiazui Central District has created public open spaces to accompany office areas, attracting a more people to such places. People are willing to go to open public spaces for their daily activities, and the improvement of public spaces plays an important role in enhancing the vitality of a city (Fig. 28.9).

28.4.2 Invigorate Urban Public Vitality Strategy and Case Study

The public vitality of a city derives from people's activities (Wang 2019), and the shaping of public vitality requires diverse crowds and appropriate spaces for public activities. Based on the spatial characteristics of Lujiazui Central District, Professor Cai's team from Tongji University proposed increasing the central buildings density and designed smaller buildings in the city to increase the open interface, thus creating

Fig. 28.10 Urban spatial form of Lujiazui after increasing building density. From: 2017 Shanghai Urban Space Art Season Exhibition, photographed by author

small scale streets in this area (Fig. 28.10). In this case, urban form is changed to reshape the public vitality.

We discuss from a different direction. This section discusses the circumstances of low density, predominantly super-tall building spaces, the functional mixing degree, the strategy of mixed functions, creating public spaces into high-rise buildings and improving slow traffic systems to modify existing space. It also puts forward the suggestion of optimizing public policy in order to enhance urban public vitality.

Mixed Function

At present, the space function of Lujiazui Central District is mainly used for business offices. Non-office functions should be created across this whole area to improve the mixing degree of functions to enrich the diversity of people and generate sustainable spatial vitality. Lujiazui has the highest vacancy rate in Shanghai's central business district (9.7%) according to a 2021 analysis of office and business buildings by the DCL Fund (2022). Other functions can be placed in the upper floors to enhance public vitality, such as increased living, education, exhibition spaces, etc. (Fig. 28.11).

Housing is the most important function of a city, as it provides security and satisfies the most basic needs of daily life. Cities usually have stable populations, which can maintain the vitality of urban spaces and drive the development of the daily public space. The city of Shanghai, which currently consists of only high-end housing and luxury hotels, is not suitable for young people and ordinary workers and choosing to live elsewhere means the added daily stress of commuting. Compact living spaces that can be built in vacant office spaces enable the city to maintain a stable number of people even outside of office hours. For example, you + International Youth Community is for young people who have just graduated. Private spaces for personal living are small, but the public space is large and is rich in public amenities. There are

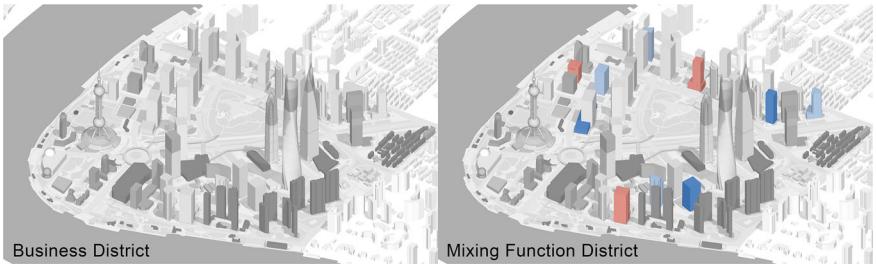


Fig. 28.11 Place non-office functional space in Lujiazui Central District. Made by author

also apartment spaces such as Cohost West Bund, with single rooms and loft-style co-living spaces, fully equipped with facilities for people with the economic means to live independently.

With an influence the whole country or even internationally, the educational function of open spaces can encourage young people to add to the vitality of a city. For example, Parsons School of Design, one of the world's largest design schools, is located on New York's Fifth Avenue in the heart of Manhattan. Students are exposed to cutting-edge art activities and forms in the downtown area, while their creativity contributes to the vitality of the city center. The University of the Arts London has 18 campuses in the city center, integrated with the city's art galleries, libraries, theatres, and restaurants to create a vibrant city.

Exhibition spaces can encourage a variety of people to add to public vitality. The opening of Pudong Art Museum attracted tourists to the Central District of Lujiazui and became a clock-in point for many young people and art lovers in their leisure time. Exhibition space does not necessarily only appear in independent art galleries or museums. There are now many office buildings with exhibition art spaces. For example, the Mori Art Museum in Japan is located on the top floor of a high-rise building in Roppongi Hills, which brings a variety of people to office areas and adds to daily vitality.

Insert Public Space into High-Rise Buildings

The public building space in central Lujiazui takes up less space and is mostly concentrated on the ground floor of the building. Non-office public activity spaces can be added inside high-rise buildings to enhance vitality, including small-business service spaces and public green spaces (Fig. 28.12).

Lujiazui Central District has many high-end business services, but lacks small businesses, such as bars, street food stalls, small restaurants, and launderettes. Additionally, businesses that sells fireworks, gas, and food are not only suitable for worker's activities, but also for the daily activities of ordinary citizens, especially in future residential areas. These small businesses can not only meet the needs of service objects, but also provide more diverse job opportunities, thus enriching the population structure in the Lujiazui area. Office buildings need to be placed in the

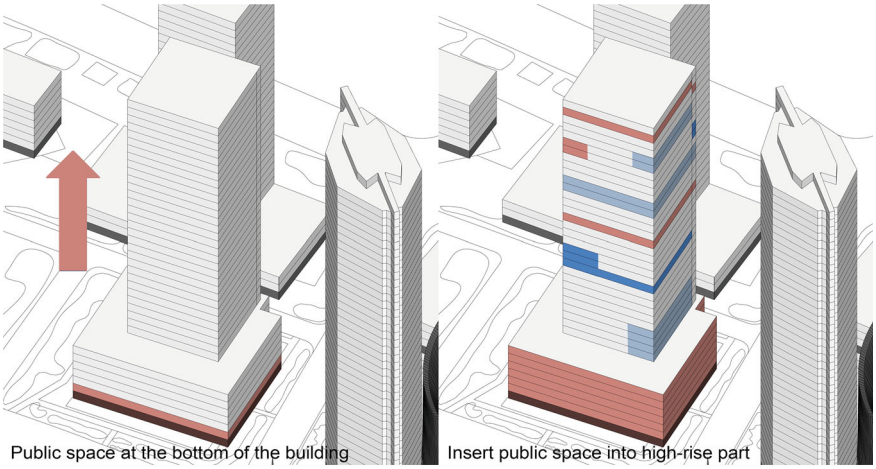


Fig. 28.12 Insert the public open space into the upper level. Made by author

very center of buildings to adapt to the needs of people and add public vitality to buildings.

Lujiazui Central District is not short of public open spaces, but the accessibility of these spaces is poor. The Central Green Space and riverside green space are high-quality public open spaces in the financial and business districts. However, the location of these green spaces is too centralized, and there is no pedestrian connection between them and office buildings; therefore, the daily utilization rate of these public spaces is not high. Public open spaces can be placed inside office towers, as well as green landscapes and places for people to communicate and relax, so as to increase the daily public vitality of office areas. For example, each of the nine floors of BBVA Financial Headquarters building in Mexico has a hanging garden, which can add to the general view of the city landscape, providing a large area of public open space inside the building, breaking up the monotony caused by the standard stacked construction of traditional high-rise office floors and enhancing the communication and interaction between people. The lobby, auditorium and restaurant of the building will hold some exhibitions or other public activities, which can enrich people's public life. Open spaces with non-office functions are scattered throughout office buildings, which is conducive to stimulating public vitality on upper floors, helping people balance the rhythm between work and leisure, and improving quality of life.

Improve Transportation Connections

The transportation connections in Lujiazui Central District can be improved in ground transportation, underground transportation and vertical traffic system (Fig. 28.13).

Ground Transportation

The scale of the traffic system centered on motor vehicles will create a strong sense of alienation for people. A relatively complete slow traffic system can improve people's

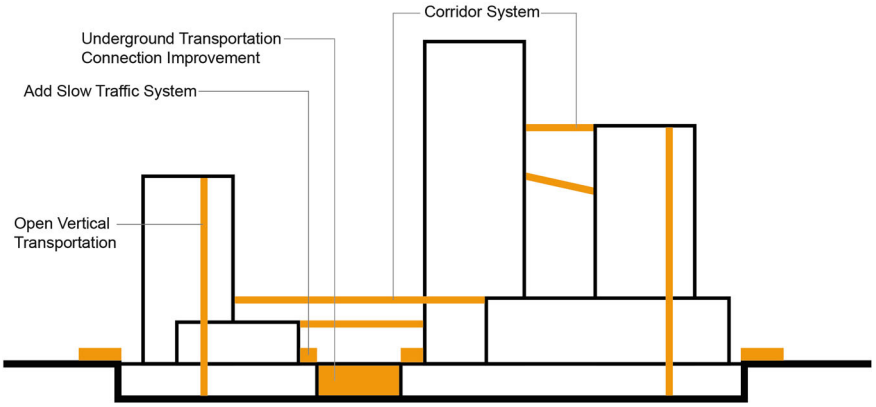


Fig. 28.13 Transportation connection strategy. Made by author

accessibility to space and is also beneficial to promote the generation of regional public vitality. Lujiazui Central District should add pedestrian, bicycle, and other slower modes of transport to the ground transportation system to increase the accessibility between human and building interface. The pedestrian system is also one way of achieving daily public activities, with the function of gathering people together.

Underground Transportation

The shaping of the underground transportation system can attract more people. For example, the PATH underground pedestrian system in Toronto has gradually developed into a commercial complex from its initial role as a pedestrian connection to add a public accessible interface to the city's buildings. Compared with the above-ground environment, the underground pedestrian system reduces the impact of Toronto's cold climate on pedestrians, relieves the pressure on pedestrians in the above-ground traffic, promotes the commercial development of the downtown area, and provides a way to effectively use space in high-density areas (Zhou et al. 2017). The underground passage system of Lujiazui Central District can be combined with subway stations and, at the same time, serve a commercial function by increasing the urban public interface.

Vertical Traffic System

Buildings can gradually open their second and third floors with more public spaces, and a slow system composed of corridors increases accessibility. Some small commercial spaces can be set up in the corridor for people to rest and stay, with several functions such as: accessibility, aesthetics, public activities, and so on. In the transformation of Hong Kong's urban image from a vertical city to a three-dimensional city, a slow traffic system is becoming more developed. There are three modes, namely "traffic corridor", "rail station + public buildings" and "rail station + business" (Xiao 2021), which increase the opportunities of daily walking traffic and the vitality of the city.

The open public spaces of the upper floors can be connected by way of an air corridor, so that these spaces are no longer limited to the office workers. This approach requires stronger technical support and more effective management. At present, vertical traffic is mainly located in the interior of each building, and the personnel in charge of these buildings cover each floor, which is in a closed and private state. The elevators in the upper floors can be properly opened to the public, and the public open interface in this area can be increased. In the future, a relatively complete air traffic network may be developed to connect horizontal and vertical traffic spaces using the vertical space gap between high floors. This can increase the traffic connection between spaces and improve the accessibility of public space.

28.4.3 Urban Design Experiment

In 2020, we selected the urban design of Lujiazui Central District as the graduation project. By focusing on the current urban form and public space use situation of Lujiazui Central District, this paper discusses how to adapt the central district to public life in modern urban spaces without changing the basic spatial framework of the district (Figs. 28.14 and 28.15). And we chose an abandoned high-rise building, the Golden Land Tower, as the specific design transformation object. It is located in the core of Lujiazui Central District, which was once valued at CNY 15 billion, but abandoned after being completed in 2007 (Fig. 28.16).

In office-oriented areas, residential and educational aspects will be introduced (Fig. 28.17), so as to increase the living space and drive the development of the daily public space, enhancing the vitality of the city. To add a service function

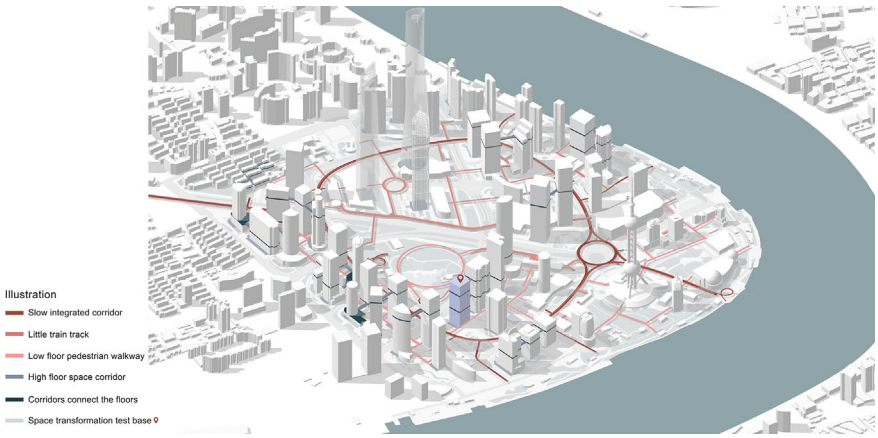


Fig. 28.14 Overall design strategy. From: Lujiazui Urban Design 2020 graduation project group, Shanghai University, including Wenjin Xue, Dishu Ding, Jiaxin Ding, Yunfei Lu, Xuanying Wu, and Peng Chen

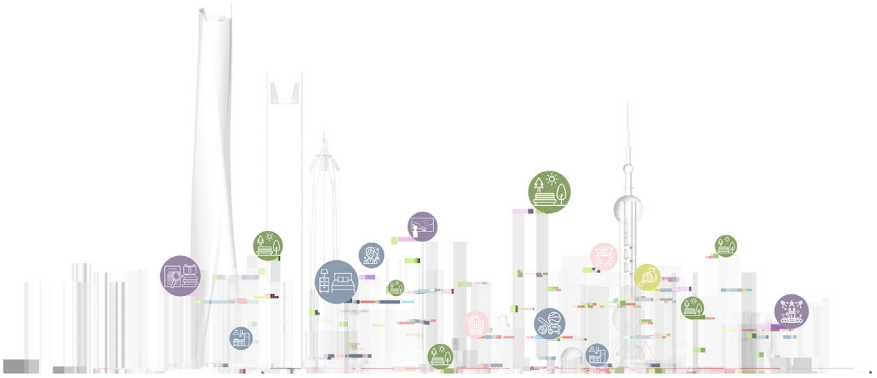


Fig. 28.15 Urban design of Lujiazui central area. From: Lujiazui Urban Design 2020 gradua-tion project group, Shanghai University, including Wenjin Xue, Dishu Ding, Jiaxin Ding, Yunfei Lu, Xuanying Wu, and Peng Chen

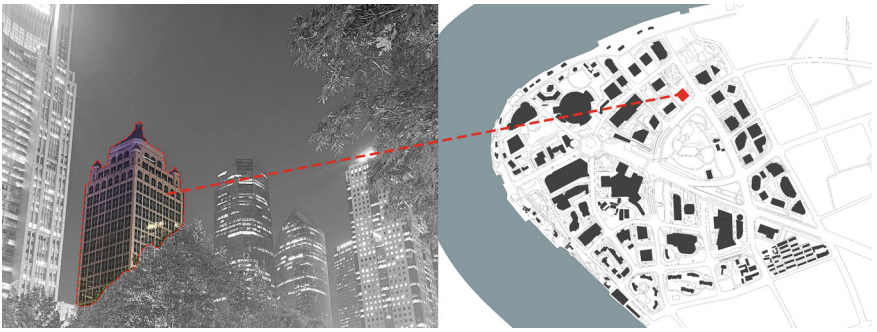


Fig. 28.16 The location of Golden Land Tower. Left: photographed by author. Right: made by author

module to single-function office spaces and activate vertical public space; landscape plants are placed in high-rise buildings, and open public activity space adds daily vitality to office high-rise buildings (Fig. 28.18). The transportation network consists of comprehensive public passageways, low-rise pedestrian walkways and high-rise space corridors (Fig. 28.19), improving the slow traffic system in the Central District of Lujiazui, and connecting the public interface of architectural space, increasing the connection between different spaces.

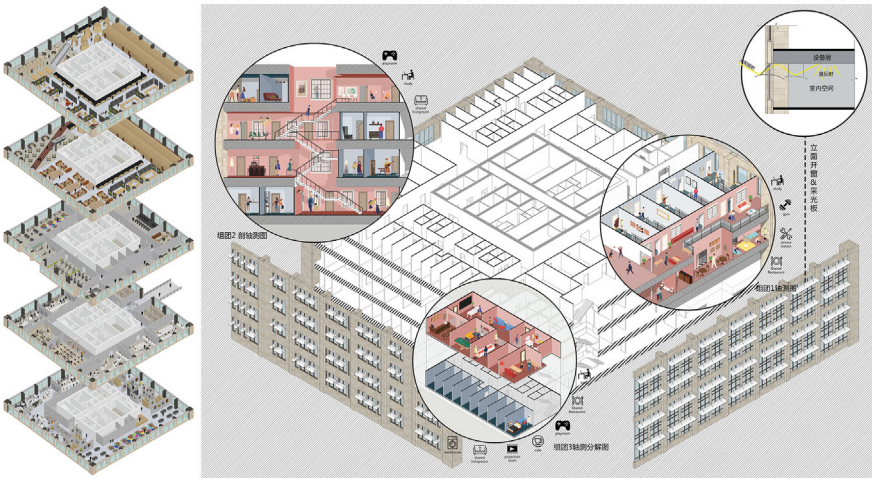


Fig. 28.17 Art college, residential apartment. From: Lujiazui Urban Design 2020 gradua-tion project group, Shanghai University, Yunfei Lu and Dishu Ding

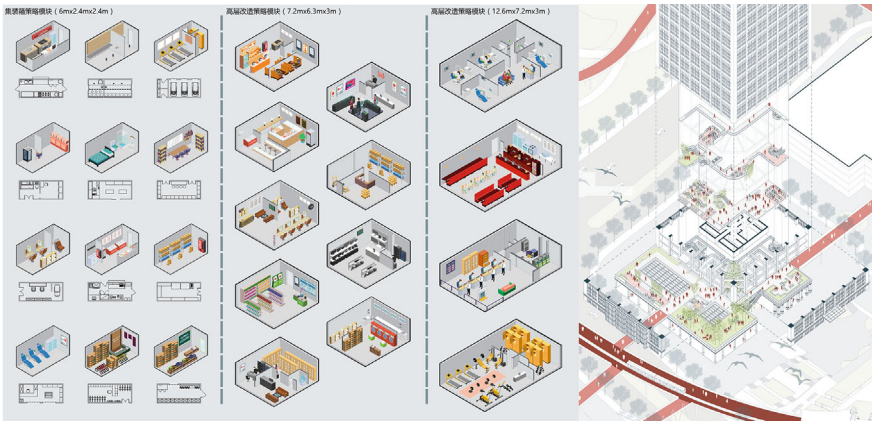


Fig. 28.18 Adding public spaces into high-rise buildings. From: Lujiazui Urban Design 2020 graduation project group, Shanghai University, Jiaxin Ding and Wenjin Xue

28.5 Conclusions

After 30 years of construction, Lujiazui Central District has become an important economic, financial and trade center in China, playing a major role from a national perspective. As the urbanization of Shanghai has now entered a stage of finer development, it is particularly important to shape the daily public vitality of the city, and the existing spatial characteristics of Lujiazui Central District raise certain questions regarding the nature of public vitality in this area.

Fig. 28.19 Improving traffic system. From: Lujiazui Urban Design 2020 graduation project group, Shanghai University, Peng Chen and Xuanying Wu

The space characteristics of single-function, low-density, high-rise buildings, with a priority toward mobile vehicles, led to the problem of single-function, less open spaces in public buildings, a lack of public interfaces, an overly concentrated open public space distribution, and weak accessibility, which affect the formation of public activity. Without changing the characteristics of low-density and high buildings, the connection between spatial function and traffic systems can be strengthened to improve public vitality in this area.

Increasing the functional mixing degree and promoting the functions of living, education, and exhibitions brings a variety of people and activities to the business office area and adds public vitality. Public spaces can be created on higher floors of buildings to enrich their interior. Open spaces also provide a place for office staff to rest and socialize. Other important steps include: adding a walking system, improving the underground transport networks, connecting high-rise spaces with corridors, and enhancing the openness of the office spaces by improving traffic connections.

The improvement of the physical environment can promote public activities and has a great influence on the development of urban vitality; however, office building renovations in Lujiazui Central District need public policy guidance. Investment from the Government, supplements via preferential tax, and the support of public organizations to help the transformation in high-rise buildings can help to improve the quality of office environments, attract more tenants, and improve the economic benefits of office buildings.

In recent years, the renewal and improvement of the riverside green space and the opening of the Pudong Art Museum have stimulated the public vitality of the urban central district. It is believed that soon Lujiazui Central District will not only be a business and office complex, but also a place for the public vitality of citizens' daily lives.

Acknowledgements This study was sponsored by National Natural Science Foundation of China (Grant No. 52008237).

Thanks to the Lujiazui Urban Design 2020 graduation project group, Shanghai University, including Wenjin Xue, Dishu Ding, Jiaxin Ding, Yunfei Lu, Xuanying Wu, and Peng Chen.

References

Cai YJ, Xu K, Zhang Z, Zhou Y (2018) Repair of urban cell in reconstruction of new town: teaching experiment for reurbanization of Lujiazui. Urban des 01:64–73

Cai YJ, Zhang Z, Xu K (2019) Reconstruction of new town core: second teaching experiment for reurbanization of Lujiazui. Urban des 01:50–57

Cai YJ, Jia T, Xu K (2020) From century avenue to century valley: third teaching experiment for re-urbanization of Lujiazui. Urban des 04:28–35

Cao JM (2018) Adopting strengths from all references, thinking in both cautious and innovative ways: review on urban design of the Lujiazui central financial district. Arch Pract 1(11):14–17

DCL Fund (2022) Research report on Office buildings, business parks and bulk trading markets in Beijing and Shanghai 2021, https://mp.weixin.qq.com/s/VXhyEv7CDDCpS46cRua7vA. Accessed 11 Mar 2022

Hong XJ, Zhu ZJ, Cai YN, Li KM (2005) Building city's vitality district: taking urban design of Jianshe road in Tangshan central area for example 05:19–21

Jacobs J (1961) The life and death of great American cities. Random House, New York

Xiao RQ (2021) Experience and enlightenment of Hong Kong elevated walking system. Shanghai Urban Plan Rev 01:119–126

Jin X, Long Y, Sun W et al (2017) Evaluating cities' vitality and identifying ghost cities in China with emerging geographical data. Cities 63:98–109

Le Corbusier (2010) La Ville Radieuse. Translated by Jin QY and Wang YJ, China Architecture & Building Press, Beijing

Li L, Liu K (2018) Planning and development of central Lujiazui high-rise buildings based on the statistical analysis. Huazhong Arch 36(02):75–78

Liu K (2018) A study on urban spatial form based on density, PhD thesis, Southeast University, China

Liu XX, Chen Y (2012) From state perspective to everyday life perspective—a research on urban spatial transformation of Lujiazui central area. Urban Plan Forum 03:102–110

Lopes MN, Camanho AS (2013) Public green space use and consequences on urban vitality: an assessment of European cities. Soc Indic Res 113(3):751–767

Sun SW (2006) City centre and city public space: a planning review on the construction of Lujiazui area of Pudong district, Shanghai. Urban Plan 08:66–74

Tang ZL (2018) Study on the slow system of city centre in China—based on the case of Lujiazui, PhD thesis, Southeast University, China

Wang JG (2019) Inclusiveness and sharing, explicit and implicit mutual learning, livability predicted: historical prospect and contemporary creation of urban vitality. Urban Plan 43(12):9–16

Wang Y (2022) Practical exploration of promoting urban vitality based on traffic microcirculation: taking the planning and design of street space in Dayang area of Luyang district of Hefei city as an example. Arch Cult 02:99–100

Yang LL (2022) Research on commercial space design of university campus from the perspective of urban vitality, Master's thesis, Shanghai Normal University, China

Ye Y, Li D, Liu X (2018) How block density and typology affect urban vitality: an exploratory analysis in Shenzhen, China. Urban Geogr 39(4):631–652

Zha J (2011) Urban design taking urban vitality demand as direction: urban design in the southern city key sections of Nanjing. Urban Arch 10:111–113

Zhang LS (2021) A study on microtransformation design of environment and space in dynamic block—taking Wenxing block in Nangang district Harbin as an example, Master's thesis, Harbin Normal University, China

Zhao XX, Wang G (2022) Research on renewal strategy of old industrial zone from the perspective of urban vitality—a case study of Jinan Brewery. Arch des Manag 39(03):47–55
Zhou X, Li SN, Wang F (2017) Research on exploitation and utilization of sustainable developmental city underground space: case study of the underground pedestrian system of Toronto. Int Urban Plan 32(06):116–124

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 29
Urban Form of Settlements on Water: A Morphometric Comparison Between Makoko and Venice

Alessandro Venerandi, Johan Mottelson, and Sergio Porta

Abstract Recent studies highlight morphological similarities between centrally located informal settlements and historical cities, suggesting that, despite infrastructural deficiencies, the former possess valuable urban form features, e.g., human-scale design, compactness, and walkability, that are also characteristics of the latter. This research challenges the negative connotations often associated with informal settlements, advancing advocacy for the prevention of evictions and the support of legalisation. In line with these works, we compare the urban form of two aquatic settlements: Makoko, an informal settlement in Lagos, Nigeria, and the Italian city of Venice. Both are analyzed through statistical and visual comparisons of nine metrics of urban form. Since Venice is historical and Makoko was only recently established, the most consolidated part of the latter is also included in the analysis. The outcomes show similarities between Makoko and Venice in terms of building elongation, alignment to streets/canals, diversity of building footprints, and coverage area ratio. Importantly, these similarities are more pronounced in the most consolidated part of Makoko, suggesting that if the settlement continues to develop along its current patterns of change, the similarities to Venice will likely increase. Accordingly, policymakers should reconsider the current eviction approach and facilitate the adaptive development of the settlement.

Keywords Urban morphometrics · Case study comparison · Informal settlements · Makoko · Venice

A. Venerandi (✉) · S. Porta
Urban Design Studies Unit (UDSU), Department of Architecture, Faculty of Engineering, University of Strathclyde, Glasgow, UK
e-mail: lncs@springer.com

J. Mottelson
Institute of Architecture, Urbanism and Landscape, Design, Conservation, Royal Danish Academy of Architecture, Copenhagen, Denmark

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_29

29.1 Introduction

Most contemporary urbanization occurs in cities in the Global South (UN 2018). Much of this urban growth is accommodated through the proliferation of informal settlements, driven by inadequate resources to manage urban expansion, particularly in the context of sub-Saharan Africa (Jenkins and Mottelson 2020). Against this backdrop, approximately one billion people worldwide live in informal settlements characterized by disputed land rights and housing constructed without state authorization (Satterthwaite et al. 2020). On one side, this development is often opposed by local authorities, who present a variety of justifications for the forceful evictions of settlements (Dekel 2020; Manji 2015; Phillips 2011). On the other side, several scholars recommend distinguishing informal spatial production (Dovey et al. 2020) from poverty and social deprivation, suggesting that informal settlements are places with inherent spatial qualities (e.g., human-scale and well-connected urban fabric) comparable to historical urban centres broadly praised for their urban form characteristics (Kellett and Napier 1995; Lawrence 1990; Rapoport 1988; Stea and Turan 1990).

More recently, several quantitative studies further explored these similarities. Porta et al. (2014) indirectly addressed this when comparing the main street networks of a hundred different settlements worldwide, documenting that in cities built before the modernist period (roughly pre-WWII), the average distance between main street crossing was 400 m, whereas in mainstream cities built after WWII, this distance was consistently at least twice as long. Interestingly, the pre-modern *400 m rule* (Mehaffy et al. 2019) was observed in *spontaneously* grown informal settlements built after WWII, which lacked planning regulations. Similarly, Iovene (2018) conducted a diachronic comparison of several metrics of urban form across an informal settlement in Peru and a Venetian neighbourhood, reporting strong similarities between the two, particularly in terms of settlement growth. More recently, Venerandi et al. (2021) carried out a comparative study based on 12 metrics of urban form (block size, coverage ratio, street length, density of amenities, global and local betweenness at 400, 800, 1600 m, and local closeness at the same radii) across three informal settlements in Sub-Saharan Africa and three Italian medieval towns. Similarities were found for basic features of the urban environment, such as street length, plot coverage area ratio, and the configuration of the main street network. The study also reported significant correlations between density of amenities and betweenness centrality, which quantifies the potential through-passage in streets. The main idea underpinning this literature is that systematically demonstrating hidden similarities between seemingly different cases of contemporary informal settlements and widely praised historical towns would do justice to the former, thereby supporting their legalization, and advancing advocacy against evictions.

Interestingly, popular culture has also recognized these similarities, nicknaming Makoko, a large informal settlement in Lagos (Nigeria), the "Venice of Africa" due to its urban environment of organic street and canal patterns, buildings on stilts, and boat-based transport, reminiscent of Venice, the renown historical city

in Italy's Veneto region (Methu 2014). This paper contributes to the body of knowledge on similarities between informal settlements and historical cities with a novel emphasis on aquatic settlements. It ascertains to what extent the analogy Makoko-Venice holds, by comparing a set of nine metrics of urban form (or *morphometrics*) in the two settlements. More specifically, first, we compute such morphometrics, including dimensions, orientations, and shapes of buildings, streets, and canals. These are extracted from openly accessible geo-data sets and computed through *momepy*, a tool for urban morphometric analysis (Fleischmann 2019). Second, we compare these metrics by means of a nonparametric test assessing the similarity of distribution functions and visual summary statistics (i.e., probability density functions). Considering that Makoko developed much more recently than Venice, we also analyse the most consolidated part of the former, to provide insights into the trajectory of the development of the settlement.

Findings show that the distributions of five out of nine morphometrics (building elongation, building alignment to streets/canals, diversity of building footprints, and coverage area ratio) are similar in Makoko and Venice, with the most consolidated part of the former showing stronger similarities. This trend is consistent across all morphometrics, suggesting that, if the current urban development of Makoko is allowed to continue, similarities will likely increase. Accordingly, the study suggests that Makoko will, over time, acquire spatial and configurational properties more similar to those of the widely praised historical Italian city. On this basis, we argue that the current eviction-oriented approach in Makoko (Ajayi et al. 2019) should be abolished. Instead, we propose that authorities focus on investing in infrastructure, improving access to public services, and supporting the incremental development of the neighbourhood in dialogue with local communities.

29.2 Case Studies

Settlements on water are inhabited areas in aquatic environments where boats serve as primary mode of transportation. Such settlements are found in many parts of the world and typically emerge in cultures with economies dominated by fishing (Evers 2020; Lusterio 2008; Sutton 1974). The initial formation of aquatic settlements is typically characterized by simple houses on stilts. As the settlements evolve, more complex forms emerge, including networks of pedestrian paths and more solid building foundations. Archaeological evidence suggests that settlements on water emerged in Oceania at least 3,000 years ago and in South America at least 1,900 years ago (Felgate 2003; Navarro 2018). Tenochtitlan, the famed ancient capital of the Aztec empire, was a city built on water, upon which Mexico City was later founded (Fox 1965). Similarly, Bandar Seri Begawan, the present-day capital of Brunei, was a water-settlement more than 500 years ago (Azman et al. 2021). Although these settlements constitute important cultural heritage, their urban forms remain understudied. In this paper, two notable cases are analysed: Makoko (Lagos, Nigeria) (Fig. 29.1, left) and Venice (Italy) (Fig. 29.1, right). These were selected as (i) they are both

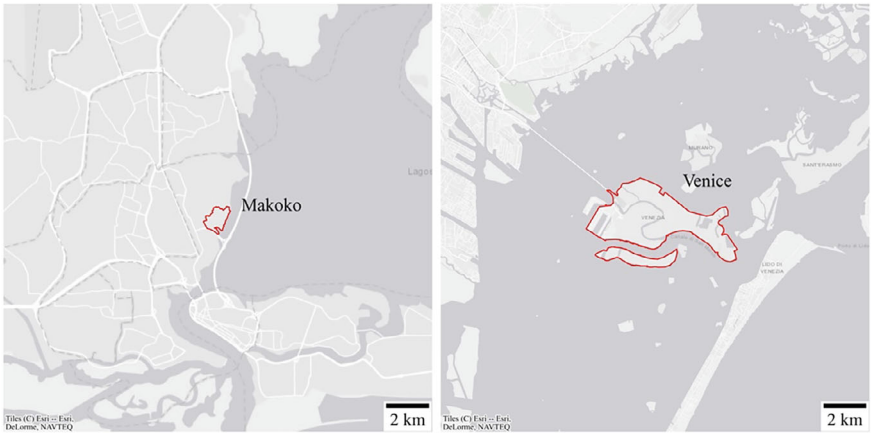


Fig. 29.1 Geographical contexts of Makoko (Lagos, Nigeria), left, and Venice (Italy), right. *Source* the authors and Esri, DeLorme, NAVTEQ (base map)

sizable settlements on water; (ii) Makoko is a recently built informal settlement and Venice is a historical city; (iii) the cases are characterized by fundamentally different contexts, including different geographic, cultural, legal, and economic settings. On this basis, this study provides insights into morphological similarities between an informal settlement and a historical city, with a novel focus on aquatic settlements.

29.2.1 Makoko (Lagos, Nigeria)

Makoko is an informal settlement with more than 200,000 residents situated in the Lagos Lagoon (Ajayi et al. 2019) (Fig. 29.1, left). It is colloquially known as the 'Venice of Africa' due to its unique architecture built on water and picturesque urban features (Methu 2014) (Figs. 29.2 and 29.3). However, the neighbourhood is characterized by poverty, inadequate basic infrastructures and limited access to public services (Ajayi et al. 2019). Makoko developed as a fishing village during the nineteenth century, on the swampy banks of the Lagos Lagoon (Oloko et al. 2022). The local geographic conditions and the fishing-based economy has led to the emergence of the unique characteristics of the neighbourhood, i.e., houses built on stilts in the water and boats as a primary mode of transportation. Following the independence of Nigeria in 1960, Lagos grew rapidly and Makoko went from a peripheral to a centrally located neighbourhood, engulfed in the metropolis (Barredo and Demicheli 2003). Lagos is the largest city in Africa and one of the fastest growing cities in the world. The high level of demand for land in the city is intensifying the pressure on the housing and land markets in Makoko due to the central location of the settlement. The authorities have adopted a hard-line eviction-oriented approach to the development of the settlement due to its extra-legal status (Ajayi et al. 2019).

Fig. 29.2 Aerial photo of Makoko. *Source* Johan Mottelson

Fig. 29.3 Kids sailing in front of a small shop (left). Elevated pathway system and water tank (right). *Source* Johan Mottelson

The urban structure of Makoko is characterized by a system of canals leading directly from the inner shore of the lagoon to the open water, with secondary smaller canals between them. Close to the inner coastline, an elaborate network of elevated pathways and small bridges connect and provide access to the individual buildings. As the distance from the coastline increases, built-up density decreases and the fabric of the settlement becomes more dispersed. This gradient broadly reflects the development of the settlement, whereby the first nucleus was built on the coastline while later expansions were added progressively towards the lagoon's open waters. Closer to the inner coastline, shallow waters were transformed into habitable land by filling simple timber frames with soil, as well as sawdust and scrap wood from the timber mills located in the southern part of the neighbourhood. Houses are built on stilts directly hammered into the bottom of the lagoon and are largely made of timber, bamboo, plywood, and corrugated iron sheets (Ilechukwu et al. 2022).

Much of the housing stock is substandard and does not provide adequate protection from the environment (Gambo et al. 2012). Some households closer to the mainland have access to water, through flexible plastic pipes. However, many families also store water in large tanks due to the unreliability of the water system. Households located further from the coastline lack direct access to fresh water and buy it closer to the mainland, transporting it by boats to their homes (Babalobi 2013). There is no functioning sewage system in the neighbourhood. Toilets and showers consist of simple timber platforms with a hole in the floor, enclosed by plastic sheets or timber walls for privacy. Consequently, the lagoon water underneath and around the settlement is highly polluted. Only a few parts of the neighbourhood are connected to the electricity grid, and the power supply in Lagos is very unstable. Consequently, many households have private gas fuelled generators causing a constant background noise in the area. In the periphery of Makoko**,** a large part of the lagoon is full of floating logs. These are transported from outside of Lagos and cut in sawmills south of the neighbourhood, supplying the city with timber for construction.[1]

The residents of Makoko lack formal legal ownership of the land they occupy, despite many families having lived there for generations. Authorities justify forced evictions by citing the illegal occupation status. These evictions occur without proper compensation for property loss and often lead to violent confrontations with the police (Ajayi et al. 2019). The authorities can only clear out small parts of the neighbourhood gradually, due to its size and the risk of political turmoil. As a result, the fate of this unique urban area and its community remains highly uncertain.

29.2.2 Venice (Italy)

Venice is a city located in the Venetian Lagoon, in the Veneto region, north-eastern Italy (Fig. 29.1, right and Fig. 29.4). The city is built on top of an archipelago of around 100 small islands, connected through over 400 bridges. It has a declining population currently standing at roughly 50,000 residents.[2] However, tourism raises this number considerably, especially in the high season.

There are no written records on the origins of the city; however, tradition and available evidence suggest that it was founded in the period of the Western Roman Empire (421–476) by refugees from nearby towns (e.g., Padova, Aquileia, Treviso) and rural areas of mainland Italy, who were fleeing recurrent lootings by Germanic and Hun tribes (Bosio et al. 1987). Later Roman texts reveal the presence of fishermen, referred to as *incolae lacunae* (inhabitants of the lagoon), on the islands emerging from the marshy lagoon (Fig. 29.5).

At the fall of the Western Roman Empire, only a small strip of coastline (including Venice) became part of the Eastern Roman Empire and was directly administered

[1] There exist limited academic sources on the current conditions of Makoko. The observations reported here are the result of field work carried out by one of the authors of this paper.

[2] https://www.comune.venezia.it/it/node/40751.

Fig. 29.4 Venice as seen from the top of Saint Mark's Bell Tower (left). *Source* Alessandro Venerandi. A canal of Venice (right). *Source* Johan Mottelson

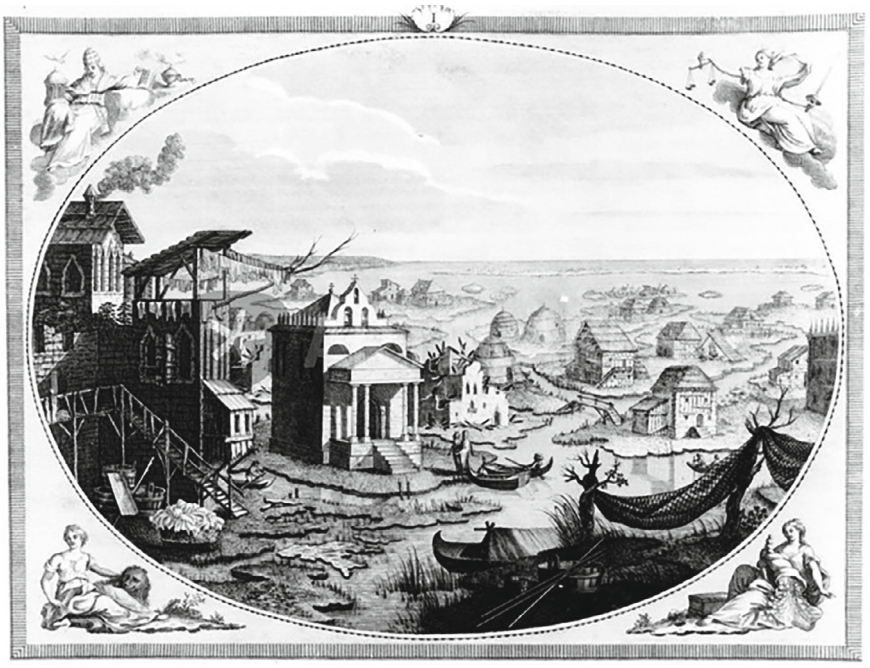


Fig. 29.5 "Stato delle isolette di Rivo-alto, prima culla della città di Venezia (State of the small islands of Rivo-alto, first cradle of the city of Venice)". *Source* https://www.iconografiacittaeuropea.unina.it/cms/stato-delle-isolette-di-rivo-alto-prima-cull

by the Exarchate of Ravenna, a nearby city on mainland Italy. In 751, the Lombards conquered most of the exarchate, leaving Venice as the last autonomous Byzantine outpost. During this period, the settlement grew further as people escaping the Lombards' invasion sought asylum in Venice. The famous Basilica of Saint Mark was founded soon after (828) to host the relics of Saint Mark the Evangelist, acquired from Alexandria (Egypt).

Between the ninth and twelfth centuries, the Republic of Venice developed into one of the most powerful financial and maritime empires of its time, becoming the main trade centre, especially of grain, silk, spice, and art, between Europe and Asia. The current configuration of the internationally renowned Saint Mark's Square dates back to this period, resulting from extensive renovation work on the nearby Ducal Palace (Ortalli and Scarabello 1990). More specifically, the square was subdivided into two spaces: a larger one in front of the main Basilica and a more secluded one located between the Ducal Palace and Saint Mark's Bell Tower. However, the most relevant changes to the urban fabric of Venice occurred in the first half of the sixteenth century, when it reached the status of global metropolis. During this period, the city had more than 150,000 inhabitants, and hundreds of new buildings, including houses, palaces, churches, and monasteries, were still being erected using traditional stilt foundations (Ortalli and Scarabello 1990).

From the seventeenth century, Venice experienced a period of decline, mainly due to the Italian plague of 1629–31, which killed a third of its population (Lindemann 2010), and the loss of its hegemonic role in favour of the rising Portuguese empire. In modern and contemporary times, Venice's urban fabric has undergone only minor changes, primarily consisting of the addition of a few representative buildings, demolitions, and road rectifications. Thus, the image of the city that we see today is largely the product of the urban development from the Medieval and Renaissance periods.

Despite originating and evolving in different geographical and historical contexts, Makoko and Venice share similar foundational conditions: both are settlements established in lagoons, with populations displaced by extreme poverty or military invasions, and both utilize stilts for building foundations, with fishing as the primary occupation of their residents. This paper will delve deeper into determining whether these similar initial conditions also resulted in similarities in urban form.

29.3 Investigating Similarities Between Makoko and Venice

In this section, we describe the methodology and datasets used to conduct the morphometric comparison between Makoko, its most consolidated part and Venice, as well as the results of this comparison. The methodology relies on two main parts: (i) the computation of a set of nine morphometrics from openly accessible datasets and (ii) statistical and visual comparisons of these morphometrics across the three case studies.

29.3.1 Datasets and Morphometrics

The set of nine morphometrics used in this study are computed via scripts included in *momepy*[3] (Fleischmann, 2019), a Python package for the quantitative analysis of urban form, and relies on two georeferenced datasets: (i) polygons of building footprints and (ii) centre lines of streets and canals. For Makoko, both datasets were obtained from OpenStreetMap (OSM), the first free, editable map of the world.[4] As OSM is crowd-sourced, the data can be patchy and may not cover informal settlements. However, several mapping campaigns in recent year have provided highly detailed and consistent open-source geospatial data for the neighbourhood (Adeshokan 2020). The data obtained for Makoko comprise 9,321 buildings, 449 canals, and 152 streets. As mentioned in the introduction, in addition to the urban form analysis of the entire Makoko area, we also focus on the oldest and most consolidated part of the settlement, located in the north-western section of the neighbourhood (Fig. 29.7). This part consists of 4,784 buildings, 143 canals, and 144 streets. Data for Venice were retrieved from the official data portal of the city[5] and consisted of 8,335 buildings, 384 canals, and 6,454 streets. Data for both settlements were cleaned of geometrical and topological errors, including duplicated or overlapping geometries and false intersections (i.e., street/canal segments erroneously separated where no intersections are present) to avoid introducing bias in the computation of the morphometrics.

The spatial units of analysis were generated from the building footprints, streets, and canals, through a Voronoi-based algorithm accounting for distances between these elements. The resulting *morphological cells* (Fleischmann et al. 2020) express a proxy of the "area of pertinence" of each building (Caniggia and Maffei 2001). These cells replace plots or cadastral parcels, which are ontologically ambiguous (Kropf 2018), difficult to retrieve in more challenging contexts, such as informal settlements, differently defined in traditional and modern planning (Levy 1999), and often inconsistent across different geographical or administrative boundaries. For illustrative purposes, an extract of the morphological cells generated in Makoko is presented in Fig. 29.6.

The following nine morphometrics are computed for each morphological cell of the two case studies:

- *Building footprint's area* (m^2).
- *Gini-Simpson diversity* (Jost 2006) applied to building footprint areas up to three topological steps from each morphological cell.
- *Irregularity of building corners* (measured as the difference in degrees from the 90-degree angle).
- *Alignment of buildings to streets and canals* (measured as the difference in degrees between the solar orientation of the building and that of the nearby street/canal).

[3] Http://docs.momepy.org/en/stable/

[4] Https://www.openstreetmap.org/

[5] Https://www.comune.venezia.it/it/geoportale

Fig. 29.6 Morphological cells generated in Makoko. *Source* the authors

- *Building elongation* (measured as the ratio between length and width of the minimum bounding rectangle created around the building footprint).
- *Percentage of built-up area* (measured as the proportion of morphological cell which is covered by buildings).
- *Average street/canal width* (measured as the mean value of section lines generated every 3 m alongside the street/canal segment).
- *Street/canal width deviation* (measured as the standard deviation of the above sections).
- *Street/canal edge permeability* (measured as the ratio between the number of sections hitting buildings and the sum of sections created in a street/canal).

Maps for each morphometric for all case studies are provided in Figs. 29.7 and 29.8.

A visual inspection of Fig. 29.7 highlights that the most consolidated part of Makoko has larger and more diverse building footprint areas compared to the south-eastern part of the settlement. Most buildings are overall regular, with 90-degree angle corners. Buildings are largely aligned to streets and canals, with small deviations (between 0 and 11 degrees), while more significant deviations (between 29 and 44 degrees) are found in the northern part of the settlement. In terms of building elongation, the pattern is mixed and scattered, with more elongated building footprints lying next to more square-shaped ones. In terms of percentage of built-up area on the cell, the most consolidated part of the settlement shows cells almost fully built-up (with coverage ranging from 67% to 97%). Most streets/canals tend to have overall limited widths (below 14 m, with very few cases above 21 m) and very varied sections (with differences greater than 5 m in most cases), with mostly continuous

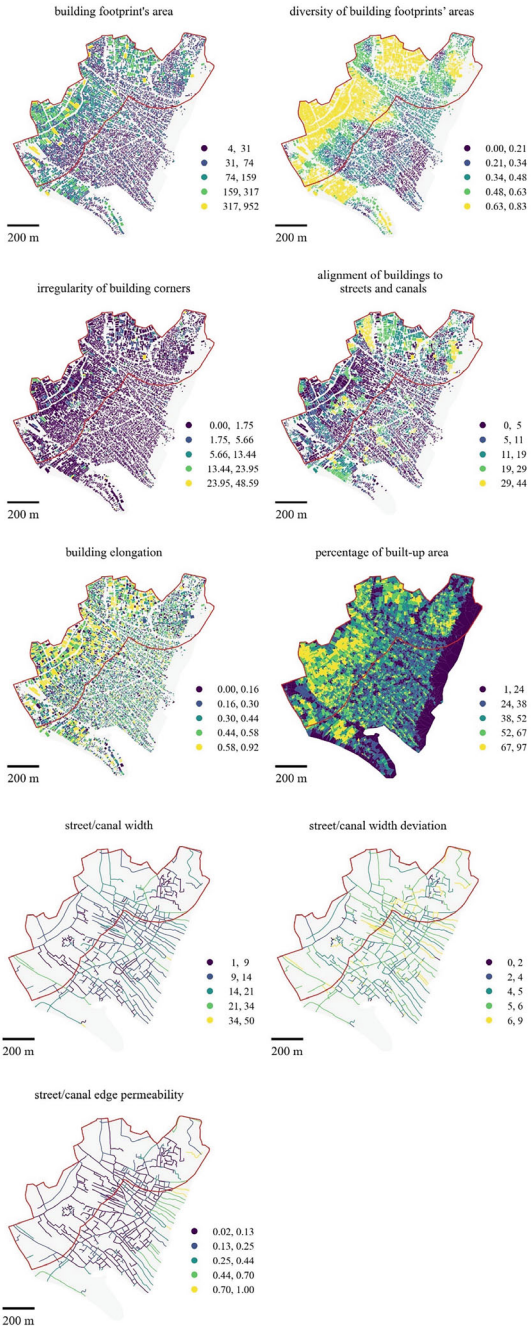


Fig. 29.7 The nine morphometrics computed in Makoko. Yellow corresponds to greater values and purple to smaller ones. The red line denotes the most consolidated part of the informal settlement (continued on next page). *Source* the authors

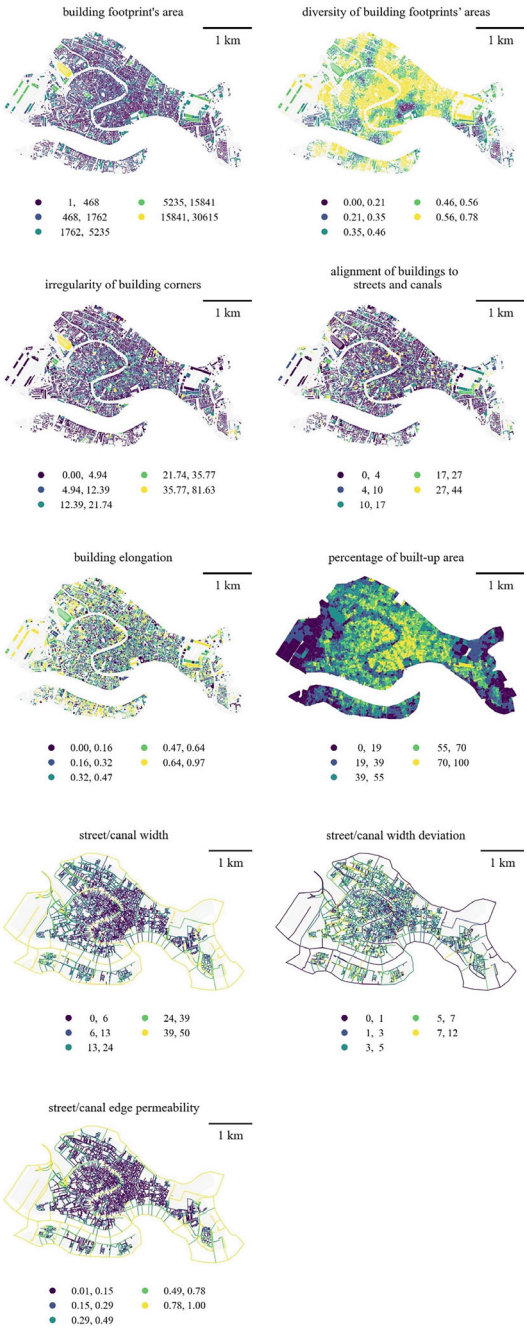


Fig. 29.8 The nine morphometrics computed in Venice. Yellow corresponds to greater values and purple to smaller ones (continued on next page). *Source* the authors

built frontages (the only exceptions being the canals at the south-east periphery of the settlement).

A visual inspection of Fig. 29.8 highlights that building footprint areas in Venice are relatively small (below 1,762 square meters), with few exceptions like the Santa Lucia station, the ferry terminal and Arsenale (the historical shipbuilding district). Building footprints are also highly diversified at the local level, with the exceptions of an area located north of Saint Mark square and the more recent neighbourhoods located south-east of Arsenale. As in Makoko, building footprints consist of a mix of mostly square-shaped and elongated forms, positioned close to one another. In terms of building corners and alignment to streets and canals, there is greater regularity, with most corners only slightly deviating from 90 degrees and buildings generally well-aligned to nearby streets and canals, with misalignments typically smaller than 10 degrees). Density concentrates in the heart of the city, especially north of Saint Mark square, in *sestiere* (i.e., the Venetian appellation for neighbourhood) San Marco and San Polo. Street and canal widths are overall small (below 13 m), with few exceptions above 39 m, such as Canal Grande (the main water artery zigzagging through Venice) and nearby waterways. In terms of street and canal width deviations, greater values (above 7 m) correspond to larger streets and canals, characterised by a more scattered urban fabric, mainly consisting of a mix of industrial/port facilities and residential units. The core of Venice has much more consistent street and canal sections, with deviations of less than 5 m. Greater values of edge permeability (above 0.49) are found in large streets and canals, such as Canal Grande and main waterways, while built-up frontages in denser parts of the city are generally much less permeable (below 0.29).

29.3.2 Kolmogorov–Smirnov Test and Summary Statistics

The values of the nine morphometrics are then compared across Makoko, its most consolidated part and Venice both statistically and visually. The statistical comparison relies on the two-sample Kolmogorov–Smirnov (KS) test, a non-parametric statistical technique that quantifies the similarity between the probability distribution functions of two variables through a null hypothesis test (Conover 1999). Operationally, the KS test measures the distance (D) between the empirical distributions of two samples, with the null hypothesis being that these samples are taken from the same distribution. When two distribution functions are very similar, D is small, corresponding to a small distance between them, and the p-value is not statistically significant (i.e., p-value >0.05). The two-sample KS test is one of the most widely used techniques for assessing similarities between two variables which is sensitive both to differences in location and shape of distribution functions (Conover 1999).

The two-sample KS test is applied to quantify similarities across the distribution functions of the nine morphometrics for the couples Makoko (entire settlement)-Venice and Makoko (most consolidated part)-Venice (Fig. 29.9). P-values are statistically significant (<0.05) in all tested combinations, meaning that the null hypothesis

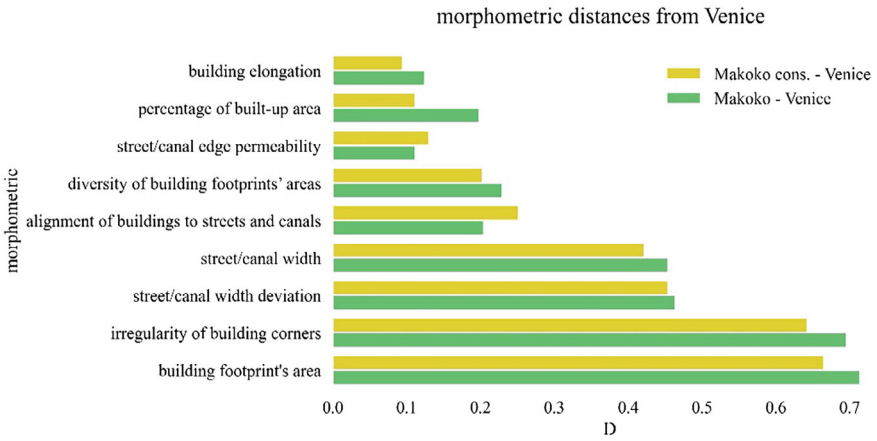


Fig. 29.9 Distances (D), computed via two sample KS test, between distribution functions of morphometrics, for the couples Makoko and Venice (green) and consolidated part of Makoko and Venice (yellow). *Source* the authors

of statistical similarity can be rejected (i.e., distribution functions are not identical across the case studies). Nevertheless, distances (D) in Fig. 29.9 highlight that the distribution functions of five morphometrics out of nine (i.e., building elongation, percentage of built-up area, street/canal edge permeability, diversity of building footprints' areas, alignment of buildings to streets and canals), are relatively close to the ones observed in Venice ($D <= 0.25$) for both Makoko and its most consolidated part. Interestingly, for all morphometrics except two (street/canal edge permeability and alignment of buildings to streets and canals), the distributions in the latter are more similar to those of Venice than to those computed for the entire settlement.

Since the KS test only provides statistical information on the similarities of distribution functions rather than comparing the actual values of the morphometrics, Probability Density Functions (PDFs) are computed and plotted to offer both visual representations and numerical insights into these similarities. A PDF is a function whose values, at any given point in the range of possible values that a variable can take, correspond to the relative likelihood that the variable's value will be close to that point (Grinstead and Snell 2009). In practice, the PDF is a smoothing function that estimates probability density per unit length, making it extremely useful for visually comparing the same variable across different case studies.

PDFs for each of the nine examined morphometrics in each case study are calculated and presented in Fig. 29.10. Visual assessment confirms the results of the KS test: the distribution functions are relatively dissimilar across the tested case studies. However, the distributions of the five morphometrics previously mentioned are very similar in Makoko and Venice. Again, the same patterns are even stronger for the most consolidated part of Makoko and Venice. More specifically:

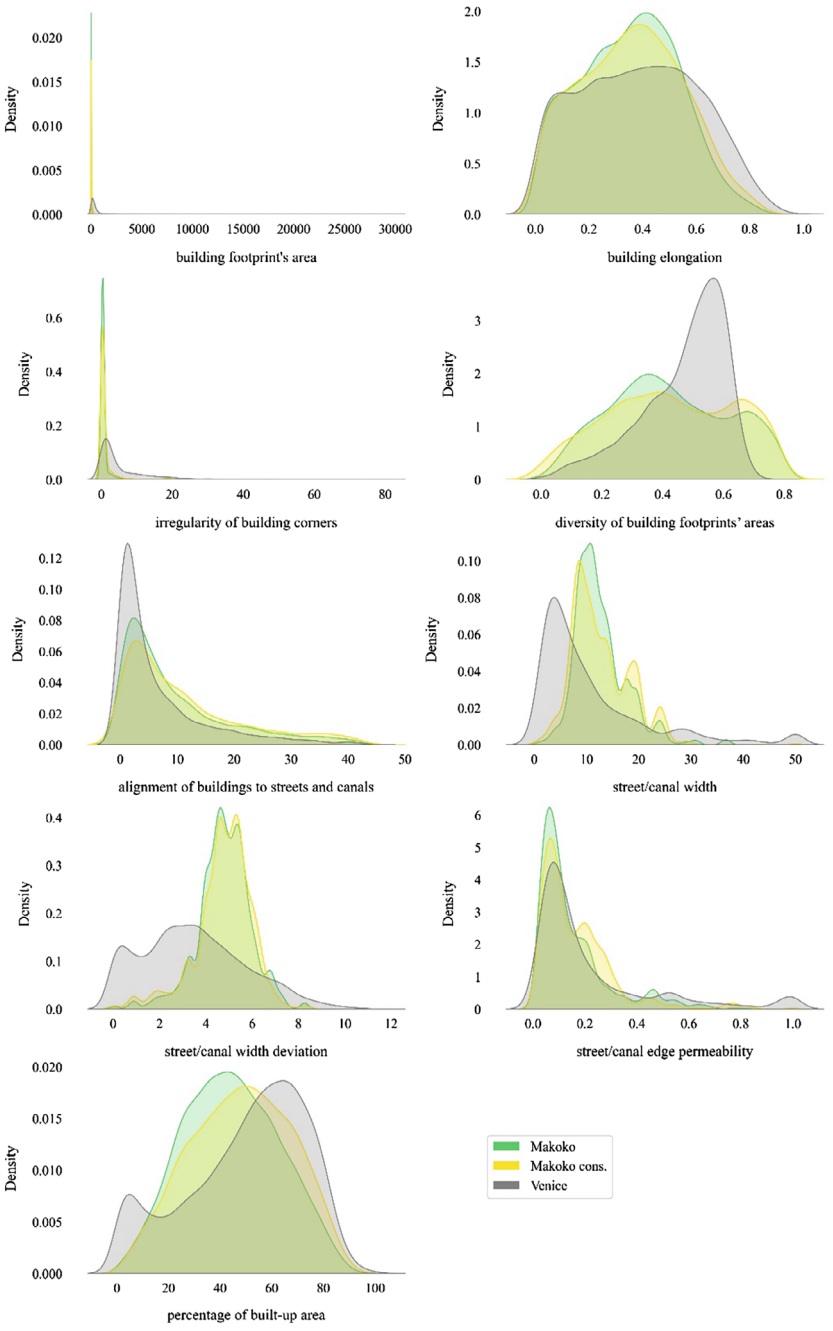


Fig. 29.10 Probability density functions (PDFs) of the nine morphometrics for Makoko (green), the consolidated part of Makoko (yellow) and Venice (grey). *Source* the authors

- In terms of building elongation, Venice has a larger proportion of very elongated building footprints, with values between 0.6 and 0.9, compared to the other case studies. However, the distribution of values in the consolidated part of Makoko tends to be more similar to Venice than to the entire informal settlement, showing a small peak at 0.4 and a growing curve with values between 0.6 and 0.8.
- The distributions of percentage of built-up area show a similar behaviour, with the whole Makoko peaking at around 40%, its most consolidated part at around 50% and Venice at around 60%. Interestingly, the first peak in Venice (corresponding to several cells having built-up areas close to 0%) may be attributed to the targeted demolitions and addition of new public spaces (e.g., square, wider streets) during the eighteenth and nineteenth centuries, which reshaped the extremely compact and dense urban fabric of the medieval city.
- The gradient Makoko (whole settlement), Makoko (most consolidated part), Venice is also visible in the distribution functions of street/canal edge permeability, where the trend indicates more streets and canals with fully built-up frontages (see peaks at 0.1).
- In terms of diversity of building footprints' areas, the previously observed trend is less apparent. However, the most consolidated part of Makoko shows a higher diversity in footprint sizes compared to the entire settlement (see the second peak of the distribution function). It may, therefore, be that over time, the distribution of this metric will become more similar to that of Venice.
- In terms of alignment of buildings to streets and canals, the distribution functions for the three case studies show clear similarities, with most buildings closely aligned to nearby streets and canals (see peaks just above 0 degree, indicating near-perfect alignments).

Further observations can be made from the morphometrics, whose distribution functions, although statistically less similar across the three case studies, still provide a common overall picture. The peaks and very long tail distributions of building footprint's area and irregularity of building corners, which correspond to many small and regularly shaped buildings and very few large and irregularly shaped ones, refer to more spontaneous and adaptable forms of urban development. These forms are typical of bottom-up, plot-based (Porta and Romice 2014) processes of urbanization. The same types of distributions also characterise natural systems, in contrast to the normal distribution that consistently emerges in top-down processes of urban planning, which results in less adaptable forms, such as most modernist developments (Jiang 2019; Salingaros and van Bilsen 2005). In terms of street/canal width and street/canal width deviation, the distributions of values in Makoko (both the entire settlement and the most consolidated part) suggest an earlier formative stage compared to Venice. This is evidenced by slightly larger streets and canals in Makoko and its most consolidated part (peaks around 10 m) compared to Venice (peak around 5 m), as well as larger deviations in section sizes, with peaks of 5 m for the former two and 2.5 m for the latter. Nonetheless, both findings highlight an underlying similarity between the settlements under examination and support the hypothesis of a

longer-term evolutionary trajectory that is bringing Makoko increasingly close to Venice.

To make the results of the analysis more tangible, map extracts of the most and least statistically similar morphometrics (building elongation and building footprint's area) are presented in Fig. 29.11. In terms of the former (first row, Makoko on the left and Venice on the right), elongation values are more evenly distributed across the intervals, indicating that both case studies have a similar number of buildings with comparable elongation values. In terms of building footprint's area (second row, Makoko on the left and Venice on the right), the first two value intervals (10 to 22 square meters and 22 to 41 square meters) are almost entirely absent in Venice. This suggests that, unlike Makoko, Venice does not exhibit a fine-grained fabric of very small buildings due to its higher degree of consolidation.

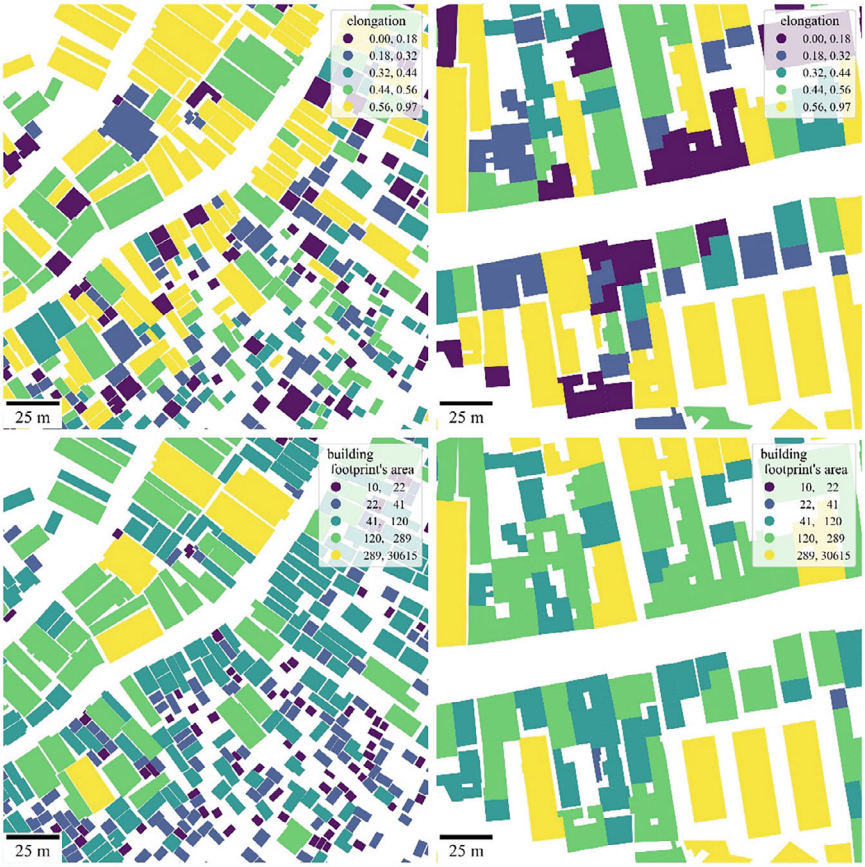


Fig. 29.11 Most (top row, Makoko left, Venice right) and least (bottom row, Makoko left, Venice right) statistically similar morphometrics across the case studies. *Source* the authors

29.4 Discussion

Is Makoko the "Venice of Africa"? The short answer is partially, or not yet. The results highlight that the distributions of the nine morphometrics under examination are not statically identical across Makoko, its most consolidated part and Venice. However, distances between distribution functions are relatively small for five morphometrics out of nine. Moreover, the distinct characterisation of Makoko's oldest part suggests an ongoing pattern of consolidation, eventually leading to spatial configurations more akin to those of Venice. In a nutshell, Makoko seems to be on an evolutionary trajectory towards Venice. This finding suggests that if Makoko's growth continues along the same spatial principles we have observed so far, rather than being jeopardized by widespread evictions and housing demolitions, it is likely to bring urban qualities to the settlement similar to those acknowledged and celebrated in Venice (Gehl 2013).

This study contributes to the body of knowledge built by previous qualitative studies of 'bottom-up' urban growth (Kellett and Napier 1995; Lawrence 1990; Rapoport 1988; Stea and Turan 1990) and quantitative studies examining the similarities between historical cities and informal settlements (Iovene 2018; Porta et al. 2014; Venerandi et al. 2021). It also provides further legitimacy to the inherent spatial qualities of informal settlements. While we acknowledge the significant issues linked to inadequate infrastructure provision and the lack of state recognition (e.g., insecure land tenure, substandard housing, overcrowding, and limited access to water and sanitation), we argue that informal settlements often exhibit favourable morphological preconditions (as evidenced in this study on Makoko and in the previous studies mentioned above), which should be considered assets to preserve and enhance in any slum upgrade policy. More sensitive, community-oriented and fine-grained design policies that recognise and value the spatial assets built over generations by local inhabitants while addressing deficits in sanitation, infrastructure, and services, could, in the long run, lead tounexpected benefits in terms of both diversity and adaptability, similar to those that have contributed to the development of Venice and continue to shape its character. As Andres Duany, founder of the Congress of New Urbanism, repeatedly said in various contexts: *"even Florence was once a shanty town. But its technology allowed it to evolve into what it became. Suburban technology is not able to do that. Over time it is able only to decay"* (A. Duany, personal communication, December 18, 2019).

Finally, informal urban development often results from the failure of formal housing markets to provide affordable accommodation. Eviction-based approaches to informal urban development do not address the underlying issue of housing affordability and may, in fact, increase the cost of informal housing by limiting its supply (Goytia et al. 2023; Mottelson 2020). Based on this, and in line with the findings of this study, we argue that authorities in Lagos should recognize the cultural heritage of Makoko, abandon eviction-focused policies, and promote community-driven in situ upgrades, infrastructure provision, and access to services.

29.5 Conclusion

In line with previous works focusing on morphometric similarities between informal settlements and historical cities, we compared the urban fabrics of Makoko, a large informal settlement located in Lagos, Nigeria, and the renown Italian city of Venice. The comparison was carried out by (i) extracting data on buildings, streets, and canals from openly accessible datasets (i.e., OSM and the official geodata portal of Venice); (ii) computing nine morphometrics descriptive of the urban fabrics of the two case studies; and (iii) using the two-sample KS test to compare distribution functions of the nine morphometrics across case studies. The results showed that distributions were not identical across Makoko (the entire settlement and the most consolidated part) and Venice. However, the distances between distribution functions were very small for five morphometrics out of nine (i.e., building elongation, percentage of built-up area, street/canal edge permeability, diversity of building footprints' areas, alignment of buildings to streets and canals), highlighting similarities across the settlements. These similarities were even more pronounced when comparing Venice to the oldest and most consolidated part of Makoko, suggesting that, over time, the informal settlement may develop morphological qualities increasingly similar to those of Venice. By extension, we suggested that this may apply to informal settlements in general, provided that the underlining principles of their largely bottom-up and locally managed evolutionary patterns of urbanisation are not disrupted by extensive clearances or top-down redevelopment. A shift towards alternative approaches, based on minor interventions generated and supported through a participatory environment, is urgently needed. These approaches should prioritize addressing infrastructural, service, and sanitation gaps while recognizing the value embedded in the settlement's existing morphology, shaped by generations of dwellers. Finally, given the existence of many informal water settlements across the Global South (e.g., Cambodia, Vietnam, Benin, the Philippines, Indonesia, Guatemala, and Papua New Guinea), this study's relevance extends beyond Lagos and Africa. A deeper understanding of these settlements' spatial qualities may challenge their extra-legal status and strengthen advocacy for their legalization and preservation.

Acknowledgements This work was supported by the Axel and Margaret Ax:son Johnson Foundation as part of "The Urban Form Resilience Project" at the University of Strathclyde.

References

Adeshokan O (2020) How Makoko, Nigeria's floating slum went digital with new mapping project. *CNN*, 26 February. Available at: https://edition.cnn.com/2020/02/26/africa/nigeria-makoko-mapping-intl/index.html (accessed 8 July 2022)

Ajayi O, Soyinka-Airewele P, Samuel O (2019) Gentrification and the challenge of development in Makoko, Lagos State, Nigeria: A rights-based perspective. Environ Justice 12(2):41–47

Azman NAH, Shukri SM, Bachek SH (2021) The city on stilts: a historic settlement in the heart of brunei capital city. MAJ-Malays Arch J 3(1):18–22
Babalobi B (2013) Water, sanitation and hygiene practices among primary-school children in Lagos: a case study of the Makoko slum community. Water Int 38(7):921–929
Barredo JI, Demicheli L (2003) Urban sustainability in developing countries' megacities: modelling and predicting future urban growth in Lagos. Cities 20(5):297–310
Bosio L, Pesavento S and Ghedini F (1987) *Le Origini Di Venezia.* Novara: Istituto Geografico De Agostini
Caniggia G and Maffei G (2001) *Architectural Composition and Building Typology: Interpreting Basic Building*. Firenze: Alinea
Conover WJ (1999) Practical nonparametric statistics. John Wiley & Sons, New York
Dekel T (2020) Spatial and organizational aspects of anti-eviction strategies. Environ Urban 32(2):389–406
Dovey K, van Oostrum M, Chatterjee I et al (2020) Towards a morphogenesis of informal settlements. Habitat Int 104:102240
Evers H-D (2020) Living on water: Water settlements in Borneo. Continuity and Change in Brunei Darussalam. Routledge, Abingdon-on-Thames, pp 145–151
Felgate MW (2003) Reading Lapita in Near Oceania: Intertidal and shallow-water pottery scatters, Roviana Lagoon, New Georgia. University of Auckland, Auckland, Solomon Islands
Fleischmann M (2019) momepy: Urban Morphology Measuring Toolkit. J Open Source Softw 4(43). The Open Journal: 1807
Fleischmann M, Feliciotti A, Romice O et al (2020) Morphological tessellation as a way of partitioning space: Improving consistency in urban morphology at the plot scale. Comput Environ Urban Syst 80:101441
Fox DJ (1965) Man-water relationships in metropolitan Mexico. Geogr Rev 55(4):523–545
Gambo YL, Idowu OB, Anyakora IM (2012) Impact of poor housing condition on the economy of the urban poor : Makoko, Lagos State in view. J Emerg Trends Econ Manag Sci 3(4):302–307
Gehl J (2013) Cities for People. Island press, London
Goytia C, Heikkila EJ, Pasquini RA (2023) Do land use regulations help give rise to informal settlements? Evidence from Buenos Aires. Land Use Policy 125:106484
Grinstead CM, Snell JL (2009) Grinstead and Snell's Introduction to Probability. University Press of Florida, Gainesville
Ilechukwu V, Salau T, Adegbile M, et al. (2022) Socio-economic determinants of urban housing materials types in poor area of Makoko, Lagos. Lagos J Environ Stud 11(1)
Iovene M (2018) Understanding the morphology of informal settlements. Univ Strat, Glasgow
Jenkins P, Mottelson J (2020) Understanding density in unplanned and unregulated settlements of peri-urban Africa: a case study of Maputo, Mozambique. Densifying the City? Edward Elgar Publishing, Cheltenham, pp 114–124
Jiang B (2019) Living structure down to earth and up to heaven: Christopher Alexander. Urban Science 3(3):96
Jost L (2006) Entropy and diversity. Oikos 113(2):363–375
Kellett P, Napier M (1995) Squatter architecture? A critical examination of vernacular theory and spontaneous settlement with reference to South America and South Africa. Tradit DwellS SettlS Rev 6(2):7–24
Kropf K (2018) Plots, property and behaviour. Urban Morphology 22(1)
Lawrence RJ (1990) Learning from colonial houses and lifestyles. In: Turan M (ed.) Vernacular Architecture: Paradigms of Environmental Response. Aldershot: Avebury
Levy A (1999) Urban morphology and the problem of the modern urban fabric: some questions for research. Urban Morphology 3:79–85
Lindemann M (2010) Medicine and society in early modern europe. Camb Univ Press, Cambridge
Lusterio AC (2008) Living with water: the settlements of Vietnam Mekong delta. Water and urban development paradigms. CRC Press, Boca Raton, pp 85–92

Manji A (2015) Bulldozers, homes and highways: Nairobi and the right to the city. Rev Afr Polit Econ 42(144):206–224
Mehaffy MW, Kryazheva Y, Rudd A et al (2019) A new pattern language for growing regions: places, networks, processes. Sustasis Press, Portland
Methu S (2014) Postcards from home: documenting Nigeria's floating community. CNN. Available at: https://edition.cnn.com/2014/12/24/world/africa/nigeria-makoko-photograph-sulayman-afose/ (accessed 21 July 2022)
Mottelson J (2020) A new hypothesis on informal land supply, livelihood, and urban form in sub-saharan african cities. Land 9(11):435
Navarro AG (2018) New evidence for late first-millennium AD stilt-house settlements in Eastern Amazonia. Antiquity 92(366):1586–1603
Oloko A, Fakoya K, Ferse S et al (2022) The challenges and prospects of women Fisherfolk in Makoko, Lagos State. Nigeria. Coast Manag 50(2):124–141
Ortalli G and Scarabello G (1990) Breve Storia Di Venezia. Pisa: Pacini
Phillips T (2011) Rio World Cup demolitions leave favela families trapped in ghost town. The Guardian. Available at: https://www.theguardian.com/world/2011/apr/26/favela-ghost-town-rio-world-cup (accessed 6 July 2022)
Porta S, Romice O (2014) Plot-based urbanism: towards time-consciousness in place-making. In: Mäckler C and Sonne W (eds) Dortmunder Vorträge Zur Stadtbaukunst [Dortmunder Lectures on Civic Art]: New Civic Art. Sulgen: Niggli, pp. 82–111
Porta S, Romice O, Maxwell J, a, et al (2014) Alterations in scale: Patterns of change in main street networks across time and space. Urban Studies 51(16):3383–3400
Rapoport A (1988) Spontaneous settlements as vernacular design. In: Patton CV (ed) Spontaneous shelter: international perspectives and prospects. Temple University Press, Philadelphia, pp 51–77
Salingaros NA, van Bilsen A (2005) Principles of urban structure. Technepress, Delft
Satterthwaite D, Archer D, Colenbrander S et al (2020) Building resilience to climate change in informal settlements. One Earth 2(2):143–156
Stea D, Turan M (1990) A statement on placemaking. In: Turan M (ed.) Vernacular Architecture: Paradigms of Environmental Response. Aldershot: Avebury, pp. 102–121
Sutton JEG (1974) The aquatic civilization of Middle Africa. J Afr Hist 15(4):527–546
UN (2018) World Urbanization Prospects. The 2018 Revision. New York: UN
Venerandi A, Iovene M, Fusco G (2021) Exploring the similarities between informal and medieval settlements: A methodology and an application. Cities 115:103211

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 30
Interface Regeneration and Place-Making Spatial Revitalisation of Shapowei Historical Environment in Xiamen

Biao Yin and Lijun Wang

Abstract Urban regeneration plays a significant role in optimizing the existing urban infrastructure. With the rise of the digital age, the phenomenon of instant online celebrities has influenced the approach to urban regeneration. A trend has emerged towards focusing on single-space renovations and attracting capital, neglecting the historical context that has shaped the city and the importance of interface regeneration and place-making. This paper takes Shapowei in Xiamen as a case study and examines the special historical elements that have contributed to its spatial evolution, with a particular focus on interface regeneration and place-making. Through literature review and field research, the paper explores the relationship between interface regeneration and place-making in the revitalisation of Shapowei's historical environment, aiming to offer new insights into urban regeneration and the preservation of historical culture.

Keywords Urban regeneration · Place-Making · Interface regeneration · Spatial revitalisation · Historical environment

B. Yin · L. Wang (✉)
School of Architecture, Tianjin University, Weijin Road 92, Tianjin, China
e-mail: wljjudy@tju.edu.cn

Tianjin Key Laboratory of Healthy Habitat and Smart Technology, Tianjin, China

B. Yin
College of Design and Engineering, National University of Singapore, Singapore, Singapore

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_30

30.1 Introduction

30.1.1 Interface Regeneration and Place-Making Under the Background of Urban Regeneration

As urbanization rapidly advances in China, urban development has undergone profound changes in society, policy, economy, and other aspects (Xiaocheng 2016). The earliest urban spaces that were constructed and developed have gradually encountered issues such as declining social functions and aging material spaces (Jingxiang and Huanyuan 2009; Qifeng and Tianshu 2016; Wenjin et al. 2011). To improve the urban spatial structure and enhance the urban spatial quality, China passed The Fourteenth Five-Year Plan in 2021, which defined urban regeneration as an important aspect of urban construction. With this policy guidance, urban regeneration theory and practice in China have made significant progress. Research objects include historical blocks, industrial heritage, old communities, and public spaces, with research content focusing on regeneration strategies, design methods, and guideline applications (Daria and Chunyang 2022; Chen et al. 2022). Aging adaptation of urban regeneration has also become a key research focus due to increasing attention to aging and other issues.

Place and interface are two crucial concepts for urban regeneration and spatial revitalisation. The media era has introduced new requirements for urban regeneration. Urban regeneration is no longer limited to a single physical field, but involves a comprehensive system that includes practice, perception, experience, history, present, and future (Andong 2021). The emphasis on unitary space renovation and capital attraction has resulted in the destruction of the urban historical context and the confusion of place space. In the new era, urban regeneration should re-evaluate and sort neglected urban spatial relationships, and use interface regeneration and place-making methods to intervene or activate the relationship between people and space. This approach can drive urban development and the revitalisation of historical environments (Tony and Sophie 2022).

30.1.2 The Marine Settlement of Shapowei in Urban Regeneration

Shapowei marine settlement, located on the southwest coast of Xiamen Island, has a rich history dating back to the Ming Dynasty. Over time, it has developed a distinct marine culture and unique city texture. Its history of being a port city, combined with multicultural influences, has also fostered an inclusive, free, and open social atmosphere. Initially, Shapowei was a beautiful arc-shaped bay with golden sandy beaches known as Jin Shapo (Ruoxi et al. 2019). From 1685 to 1784, it was the only

ferry from Xiamen to Tainan, and officials in the Qing Dynasty would stop at the Chaozong Palace and Feng temple to pray for blessings during the crossing.

Shapowei is a significant representation of Xiamen's marine culture and the hometown of overseas Chinese culture, which forms an integral part of the collective memory of Xiamen citizens. As a living cultural and historical field, it has undergone numerous spatial regenerations in response to the media era. While retaining its original historical and cultural characteristics, Shapowei has also excavated its material space and social culture, resulting in a renewed historical environment.

30.2 Concepts and Relationships

30.2.1 Interface Regeneration in the Context of Urban Regeneration

Interface regeneration is an important method for urban regeneration. In the media era, there are various types of spatial configurations, and the interface is no longer a single entity building facade, but a medium for communication, guidance, and transmission for end-users. The forms of interfaces are diverse and involve various elements of life. Additionally, interfaces are linked to core urban development issues, such as property rights, laws, and capital. Therefore, the content of interface updating can be divided into three aspects: material space, architectural interface, and regenerative regulations.

Material space is a spatial state that develops over time from various elements within a field, and is closely linked to a place's geographical location and historical and cultural heritage. It encompasses a city's spatial layout, network infrastructure, urban maps, and street relations. The architectural interface is the most direct reflection of a field's historical and cultural heritage and local character, serving as a medium for people to communicate with buildings and cultural information. It includes the environmental field, building facades, interior spaces, and architectural decorations.

In urban regeneration, the evolution of material space and the design of architectural interfaces are complex and intertwined with core elements of social and urban development, such as property rights, laws, and capital. Effective institutional regulations ensure the direction and pace of urban regeneration, guiding and regulating the evolution of the city's material space and the update of architectural interfaces (see Fig. 30.1).

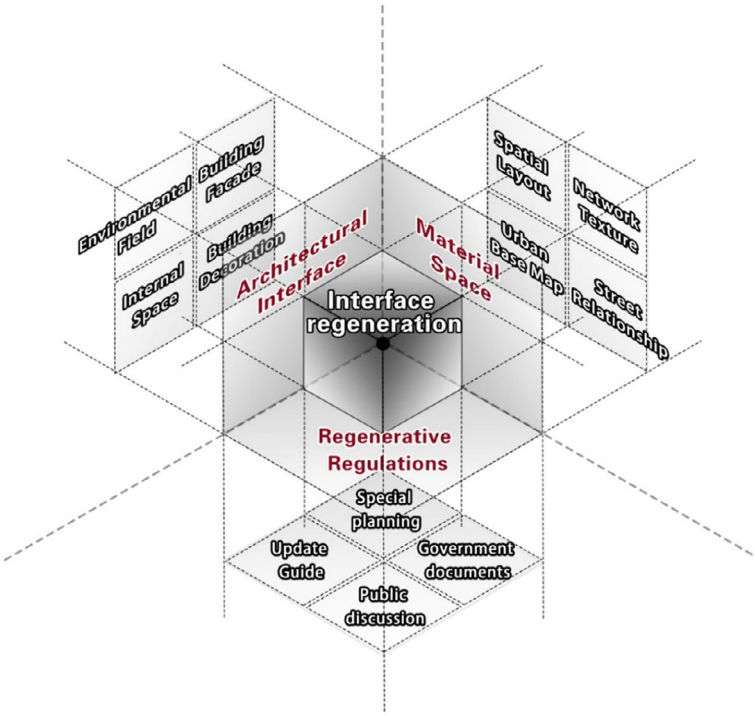


Fig. 30.1 Elements of Interface regeneration. (Author personal archives)

30.2.2 Place-Making in the Context of Urban Regeneration

According to Norberg-Schulz, the Place is a space with distinct characteristics where life takes place. It is the combination of material essence and form that defines the environment's characteristics and essence (Yan 1999). The key to successful urban regeneration lies in creating meaningful places through place-making. This involves preserving, restoring, and even creating new places that contribute to the spirit of the places. A prime example of meaningful place-making can be found in Stonehenge. The circle built with boulders in the primitive era gave a clear definition of space, creating boundaries between natural space and man-made place. This has become a meaningful place for humans, providing a foothold in the vast natural environment and promoting a harmonious relationship with nature.

In contrast, disorderly regeneration and transformation in urban regeneration can lead to meaningless spaces without clear boundaries or characteristics. To promote the healthy development of urban regeneration, it is essential to excavate the essence of living materials and preserve the relationship between people and the environment. Only then can we transform a site into a meaningful place and contribute to the healthy development of the urban.

30.2.3 The Relationship Between Interface Regeneration and Place-Making

Interface regeneration is a crucial aspect of urban regeneration, with place-making being the key to its success. In the media era, the concept of space and place has expanded, and urban regeneration has evolved into a multi-dimensional network that contains local and global elements, and is a superposition of multiple relationships. Therefore, modern urban regeneration must be multi-dimensional, localized, and rich in spatial forms to express the characteristics of the times. Integration of various technologies, cognition, and governance systems through interface regeneration is necessary to form the interaction of core issues and bring the spatial relationship into the intervention system of place-making. This will trigger empathy and strengthen a sense of belonging, enabling urban regeneration to pay enough attention to new fields and localize new social activities that it produces.

30.3 Analysis

30.3.1 The Interface Regeneration Analysis of the Shapowei

30.3.1.1 The Evolution and Protection of Material Space

Shapowei is located on a natural shelter bay, surrounded by mountains on three sides and facing the sea on the other, with Kulangsu Island across the sea to the west (see Fig. 30.2). Starting from the late Qing Dynasty, it has served as an important port for ship berthing and marine trade due to its advantageous location. In the 1930s, a shelter and arcade commercial block were built in response to the terrain, creating the spatial prototype of modern Shapowei. However, since the 1990s, the depletion of offshore fishery resources and rapid development of Xiamen have led to a growing conflict between traditional industries and modern economic development. The fishing ports in the central area of Xiamen have gradually declined, leaving Shapowei as the only remaining fishing port and carrier of Xiamen's marine culture. Despite its significance, Shapowei faces serious environmental pollution caused by sludge accumulation and illegal construction, resulting in disorderly and dilapidated material space. As a result, the historical and cultural field of Shapowei is now challenged to revitalise the space and reconstruct social relations in the face of severe changes (Wetshan 2011) (see Table 30.1).

To protect its unique marine spatial form, Shapowei has implemented various regenerative schemes to rectify environmental issues and revitalise the space. In 2003, fishery-related industries were relocated, and vacant factory buildings were replaced with commercial buildings, promoting population diversification and driving the local economy (Zhenfu 2006). In 2004, Shapowei was designated as an art leisure port, highlighting the direction for field protection and space revitalisation. In 2006,

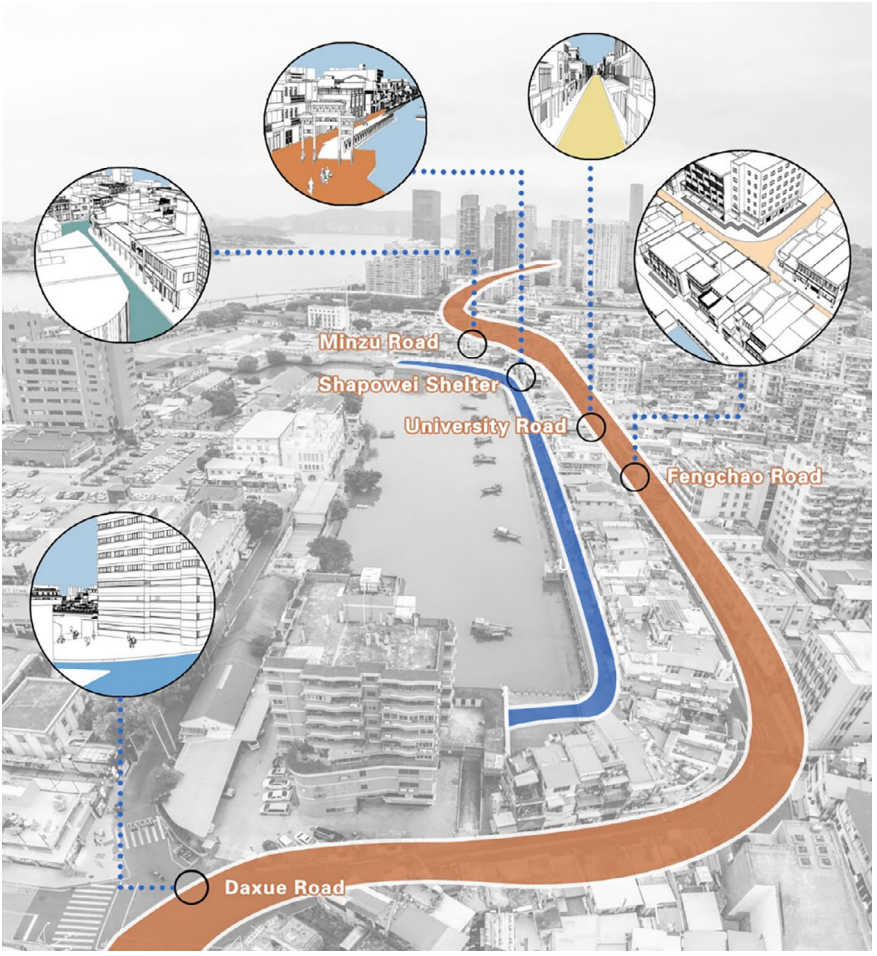


Fig. 30.2 The shape and composition of Shapowei. (Author personal archives)

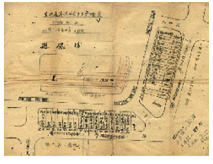
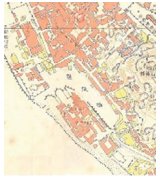
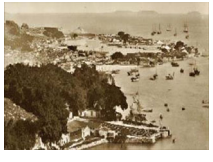
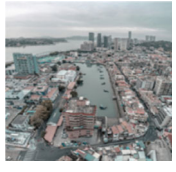
the Shelter Area was included in the protection scope of historical blocks, which led to all-round environmental and spatial governance of the Shelter Area. In 2011, small-scale regeneration and industrial cultivation were carried out along the Shelter Area with the homestead as the basic unit, and the organic regeneration of industrial heritage plants was promoted, forming the creative leisure block with the theme of marine culture. In 2013, Shapowei was upgraded to a marine cultural and creative port, with defined goals of improving the Shelter Area landscape, protecting traditional marine culture, improving cultural taste, and introducing personalized shops to comprehensively drive spatial revitalisation. At the same time, Shapowei accelerated the treatment of sewage and sediment in the Shelter dock and repaired the dock dike. The spatial form of Shapowei has realized the protection of material space

Table 30.1 The historical development and material space evolution of Shapowei

period	Before 1840	1840–1937	1938–1945	1946–2003	After2003
Development policy	• Private self-management • Xia Gang Bao established during the Emperor Qianlong	• Encouraging fishermen to reclaim mountains ·Spontaneous construction of single family residence	• Local land integration • Development of collective housing·	• Retaining the original function of living area • Strengthening the industrial production function	• Adhering to the basic immobility of land property rights • Adhering to the basic unchanged of the spatial texture • Adhering to the basic unchanged of the human ecology
Regional functions	• Fishing village • Military port • Commercial port	• Fishing village • Commercial port	• Fishing village • Industrial area	• Fishing village • Industrial area	• Living quarters • Tourist area
The change of Material space	• Traditional texture of fishing port town • Obvious street features	• Land reclamation, construction of shelter, National Road and University Road in 1925 • Unify street interface planning and increase industrial plant land	• Expanding and repairing the Shelter, and keeping the street interface basically neat • Reducing the commerciality of traditional commercial streets and lanes and increasing the liveliness	• Perfect scale in 1969	• Building Yanwu Bridge • Building Chenggong Avenue and demolishing one quarter of the streets and lanes

(continued)

Table 30.1 (continued)

period	Before 1840	1840–1937	1938–1945	1946–2003	After2003
The change of Regional economic	• Fishing port economy • Small peasant society • Self sufficiency in life	Carrying out production and economic activities with families as units	Development of national industry and Commerce Introducing new production technology and new instruments by Overseas Chinese Building power stations, power companies, aquatic processing plants, etc	• Building cod liver oil plant, shipyard, photosensitive chemical plant and other excellent enterprises	• Developing cultural and creative industries
The change of Material space					
Morphological features					

Note the materials are compiled from *illustration of Xiamen, Siming cultural and historical materials (Volume VIII) memories of Xiamen and Hong Kong, Records of Xiamen in the Republic of China, Records of Xiamen urban construction* and *History of Xiamen Port*

Fig. 30.3 The scene of Shapowei shelter before and after regeneration. (Author personal archives)

through multiple and multi-stage updates. In 2015, Shapowei proposed community construction based on micro-regeneration of material space, aiming to improve the landscape style through gradual organic regeneration (see Fig. 30.3).

30.3.1.2 The Design and Guidance of Architectural Interface

The architectural interface serves as a crucial medium and carrier for individuals to connect with the architecture and the surrounding environment, enabling feedback from the multi-dimensional network of global and local elements contained within. Thus, optimizing the elements within the architectural interface can enhance regional vitality and promote the spatial revitalisation of the entire area. During the 1930s, the rise of national industry and commerce in China resulted in considerable progress in industrial development. Shapowei introduced new production technologies and instruments from overseas Chinese and constructed a series of modern factories, including power stations, power companies, and aquatic processing plants, which facilitated the integrated development of fishing and fishery production. However, as regional development underwent transformation in the twenty-first century, Shapowei relocated various industrial plants to improve the overall environmental style, leaving behind numerous industrial structures that serve as collective memory of the previous generation. Protecting and utilizing these industrial buildings has become a primary focus of spatial revitalisation efforts.

In 2013, Shapowei repositioned itself as a marine cultural and creative port and chose a refrigeration plant as a pilot to carry out cultural transformation (see Fig. 30.4). The update of the area focused on four aspects: the environmental field, building facades, internal space, and building decoration. The environmental field was designed as a cultural and leisure area with twelve concrete walls of different heights forming a semi-enclosed square with a sports theme, and the original unloading platform was transformed into a small activity site to enrich the use of field functions. To achieve the regeneration concept of low cost and high innovation, the building facade used white walls to create a clean and tidy artistic atmosphere, while steel cables and circular halos added interest and recognizability to the field

Fig. 30.4 The outdoor square and indoor space on the first floor before the reconstruction of the refrigeration plant (Zhengfei et al. 2014). (https://kns.cnki.net/kcms2/article/abstract?v=j6HAoO1nZAyS9-3B9NbCIva524KxK1_TshFBUBjZOqlK8JjN9n58tlPjYkySmGa2mjpd6NvWFd6-DiY6EfznsexJ-eiTaMY6fBJlTMDbm-_pDkNsB2RFg9LdiHKBQgBCUgUVqnluZ1jOHa0vbq8rAg==&uniplatform=NZKPT&language=CHS)

(see Fig. 30.5). The large space of the industrial plant was transformed into various sizes of spaces, some for commercial stores and others for artist studios, through internal space regeneration (see Fig. 30.6). After the industrial field's update, it was named the "Art West Area," which has become a well-known comprehensive cultural and art area in Xiamen, integrating sculpture, pottery, printmaking, fashion design, craftsmanship carpentry, music, and more. This revitalised area has driven the vitality of the field and promoted the revitalisation of space.

30.3.1.3 The Formulation and Implementation of Regenerative Regulations

Urban regeneration is a complex process that involves property rights, laws, capital, and other essential elements of social and urban development. The evolution of physical space and the design of architectural interfaces can become disorderly without proper regulations. To ensure the direction and speed of urban regeneration, regenerative regulations must be formulated and implemented. These regulations play a guiding and normative role in the evolution of urban physical space and the regeneration of architectural interfaces.

Shapowei's urban regeneration lies between the two levels of historical protection and urban development. To avoid the destruction of regional culture caused by large-scale demolition and reconstruction, the reserve zone and construction zone are divided through institutional norms, and a small-scale and gradual regenerative strategy is adopted for the reserve zone. The building functions in the construction zone are updated according to the specific positioning of urban development.

Since 2000, Shapowei's regenerative regulations have included four aspects. In 2006, the Special Plan for the Control of the Purple Line in Xiamen was issued, and Shapowei Shelter Area was included in the protection scope of historical blocks. The old city regenerative mode led by economic development was comprehensively

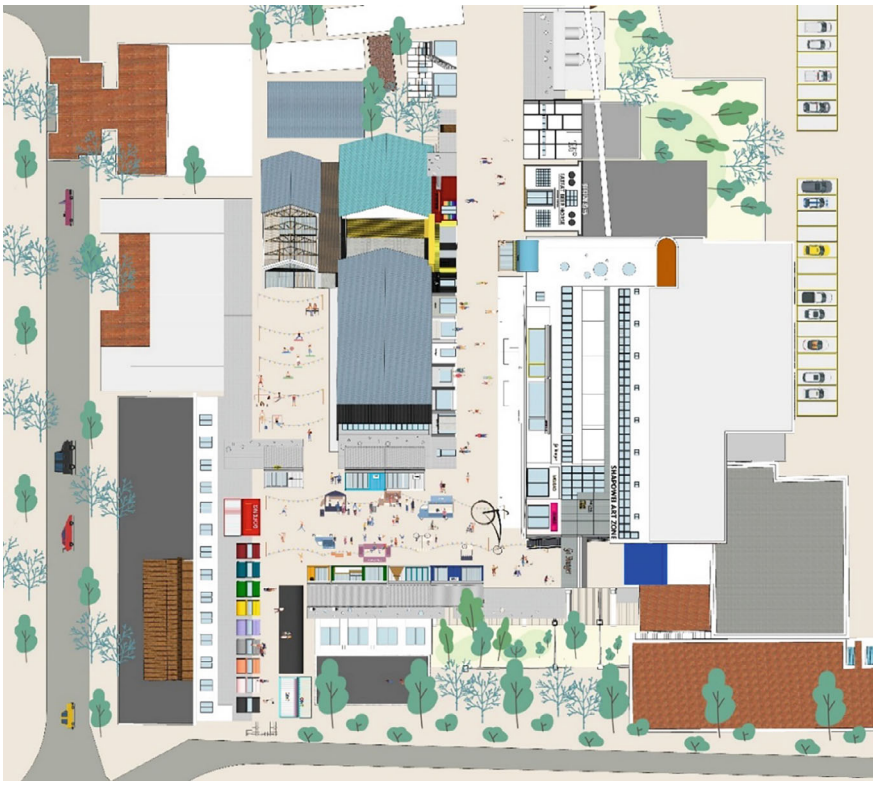


Fig. 30.5 The scene of Art West Area of Shapowei. (Author personal archives)

constrained, and Shapowei regeneration turned to the spontaneous promotion of industrial regeneration, driving space revitalisation (Guocheng 2015). In 2011, the Action Plan for Shapowei Marine Cultural and Creative Port was prepared, proposing the regeneration principle of basically unchanged land property rights, spatial texture, local residents, and human ecology. This plan combines space regeneration with business forms, carries out small-scale regeneration and industrial replacement cultivation, promoting the organic regeneration of industrial heritage plants and deepening the positioning of Marine Culture Themed Creative Leisure Blocks (Jin 2014; Yuan 2013). In 2015, the Xiamen Shapowei Organic Regeneration Plan and Shapowei Landscape Improvement and Transformation Plan were prepared, proposing to carry out community construction guided by the micro-transformation of physical space and realize the improvement of landscape style through gradual organic regeneration. In 2016, the Shapowei Community Regeneration Synergy Seminar was held to explore effective ways for the regeneration and development of Shapowei region through comprehensive and effective public participation, involving five groups, including management, investment, residents, society, and experts.

Fig. 30.6 Indoor scene of Shapowei Art West Area. (Author personal archives)

30.3.2 The Place-Making Analysis of the Shapowei

Shapowei has experienced regional and historical cultural development and accumulated profound marine culture. This cultural essence is manifested not only in tangible aspects such as historic edifices and street scenes, but also in intangible elements like fishery traditions, religious practices, and folk activities. Moreover, Shapowei serves as a significant bridge linking overseas Chinese communities worldwide. Therefore,

as we embark on the process of urban regeneration, it is essential to prioritize the preservation and localization of these social and cultural facets. We must also identify or create spatial configurations capable of embodying these attributes, thereby fostering empathy and bolstering a sense of belonging.

30.3.2.1 The Social and Cultural Elements of Shapowei

Shapowei's social and cultural fabric comprises of three core elements: fishery culture, religious beliefs, and folk activities.

(1) Fishery Culture

Shapowei's marine culture is epitomized by the Tangka, a community of fishermen who live on boats (Yangbang 2017). Historically, the Tangka were regarded as inferior during the early Qing Dynasty, but discrimination against them has since subsided. Shapowei served as a gathering place for the Tangka in its early days, and has witnessed their struggles for survival both at sea and on land. The Dan people live on boats, comprising of production and living boats. Living boats cannot operate in high winds, and need to rely on two masts and two sails to paddle. The traditional clothing and headwear of Tangka women are characterized by unique regional features, with dark blue backgrounds and vivid red and blue floral patterns that are exclusive to the coastal area of Southern Fujian. Notably, the decorative style of clothing is harmoniously linked with the decorative style of ships, forming a seamless and distinctive visual aesthetic (see Fig. 30.7).

(2) Religious beliefs

Maritime safety is an important concern for seafarers. In ancient times, people often entrusted their safety to deities, hoping for a safe voyage. Mazu, also known as Tianhou and the Heavenly Queen, is a deity widely worshipped by generations of boatmen, sailors, travelers, and fishermen. The Mazu belief originated from Putian, Fujian during the Northern Song dynasty and has since spread to inland regions

Fig. 30.7 The traditional costumes and fishing boats of Tangka *Note*: the materials are compiled from illustrations of Xiamen, Siming cultural and historical materials (Volume VIII)

and many countries. Meanwhile, as the most important traditional religious belief for Taiwan's people, the Mazu belief has become an important cultural symbol connecting compatriots on both sides of the Taiwan Strait (Yangbang 2017). Due to the region's dependence on fishing and navigation, the Mazu belief has become one of the important religious beliefs in the Shapowei area, where temples such as the Longzhu and Chaozong Palace are built to worship Mazu. During the Kangxi reign of the Qing Dynasty, the only ferry terminal to Taiwan was set up in front of the Chaozong Palace, and therefore the "Mazu" at the Chaozong Palace became a spiritual comfort for officials, merchants, and people traveling to Taiwan.

(3) Folk Activities

Shapowei boasts a rich array of folk activities, with Song Wangchuan being a notable example that reflects the region's distinctiveness and historical heritage. Song Wangchuan is a 600-year-old tradition of praying for peace that originated in Southern Fujian, China, and Malacca, Malaysia. The practice involves sacrificing and burning a king ship as a means of praying for good weather and peace. In Shapowei, Song Wangchuan is held in September of the lunar leap year, and the king ship is typically made of wood or paper. The ritual activities include welcoming the king, praying for the king, offering sacrifices, patrolling the border, and sending off the king before ultimately burning the king ship and tribute by the seaside (see Fig. 30.8). Song Wangchuan reflects the people's ancient understanding of nature and the universe, and serves as a testament to human creativity and cultural diversity. It is also a prime example of cultural transmission and integration in multinational cities. In 2010, Song Wangchuan was designated as a Chinese national intangible cultural heritage.

Fig. 30.8 The sacrificial activities of the Song Wangchuan. (Author personal archives)

30.3.2.2 The Place-Making of Historical and Cultural Elements

The rapid development of the media era affects all aspects of people's lives. In the process of urban regeneration, modern architecture gradually replaces traditional architecture, resulting in the weakening of local culture and regional differences. The development and evolution of the region have experienced the precipitation of time, and the field of people's lives is composed of multiple elements, which leads to people's sense of identity and belonging. Place construction is an important part of urban renewal. Through the place-making, urban elements can be integrated into people's life, making space a meaningful place containing environment and history. At the same time, it also protects the historical culture and folk customs, and retains the emotional nature of people's living space (Yang and Hong 2004). For the three prominent social and cultural elements, Shapowei designed and retained the relevant bearing space in the process of urban regeneration to realize the localization of elements.

(1) Fishery Culture

Marine culture is a defining social and cultural element of Shapowei. To showcase this aspect, the place-making strategy has focused on preserving the integrity of the space. The spatial form and port function of the Shapowei shelter are significant manifestations of marine culture, closely linked with the culture of Tangka. As fishing activities dwindled and Tangka transitioned to land-based living, the port function declined. However, the Shelter Area's landscape has been revitalised through careful design and preservation. The original port line has been maintained, old fishing boats have been repurposed, and the shelter's architectural style has been retained, all to recapture Shapowei's original marine characteristics (see Fig. 30.9).

(2) Religious beliefs

Shapowei's religious culture is typified by Mazu, a significant cultural symbol that connects compatriots on both sides of the Strait. The approach to place-making for religious and cultural sites involves two parts: preserving the integrity of religious space and evoking the memory of religious scenes. To achieve the former, the protection and management of the site and buildings of the Chaozong Palace

Fig. 30.9 The overall view of Shapowei. (Author personal archives)

Fig. 30.10 The Chaozong Palace of Shapowei. (Author personal archives)

have been strengthened, and the entire worship scene has been restored by incorporating archways, stone tablets, stages, and other structures. The outdoor space has been designated for the worship sequence, which preserves the ritual significance of worshipping Mazu. In terms of evoking memory, the archway's framing effect directs people's gaze towards the Chaozong Palace, while the outdoor censer's fragrance heightens the recollection of the scene (see Fig. 30.10).

(3) Folk activities

In terms of folk activities, they are carried out by creating new spaces for the events. Song Wangchuan is a representative of folk activities in Shapowei and a non-material cultural heritage of China. In order to emphasize this historical and cultural element, Shapowei has set up Longzhugong and an exhibition hall of Song Wangchuan along the Shelter Area, and in conjunction with the local Shapowei exhibition hall, recorded and displayed the development and sacrificial process of Song Wangchun. On the other hand, an open space for worship has been set up not far from the Chaozong Palace, providing a space for the folk activity of Song Wangchuan. The worship team passes through the arcade street on Daxue Road and walks towards the beach. After completing all the sacrificial ceremonies, the King's Boat is ignited on the sea. All sacrificial activities are carried out within Shapowei, which is conducive to the inheritance and development of traditional folk activities.

Shapowei has undergone a long period of historical development and has accumulated a profound social and cultural heritage. Shapowei has excavated and preserved these social and cultural elements, and designed spatial forms to carry these elements. By enhancing the overall and diverse spatiality of the place, as well as the readability

of the scene, it provides a space for the protection and development of historical and cultural heritage, realizing the spatialization of social and cultural elements and triggering empathy among people.

30.4 Result

Urban regeneration presents both opportunities and challenges for urban development. With the development of the media era, people's living space types are becoming more diverse, resulting in more complex and diverse content for urban regeneration. The spatial revitalisation of Shapowei has undergone a long process of urban regeneration, which has not been without difficulties. Prior to 2000, Shapowei relocated many local factories to quickly realize regional transformation and economic growth, leading to a destruction of the local population structure and a neglect of environmental renovation in the Shelter Area, which resulted in a dirty environment. After 2000, however, with the implementation of numerous urban regeneration schemes and the involvement of concepts such as community construction, Shapowei was able to upgrade the regional landscape through interface regeneration and place-making, transitioning from an industrial fishing port to a cultural and art port. This was accomplished while retaining local customs and collective memory, thereby realizing the spatial revitalisation of Shapowei's historical environment.

Interface regeneration and place-making are critical concepts and methods for urban regeneration and regional space revitalisation, and play a vital role in protecting regional history and culture. Through a field investigation of Shapowei, this paper excavates the historical and cultural elements of Shapowei from two aspects: interface regeneration and site construction, and summarizes the urban regeneration process of Shapowei spanning over two decades. It also examines Shapowei's experiences in material space protection, architectural interface design, and regulation formulation, with the goal of exploring methods for urban regeneration and spatial revitalisation in historical environments. However, as theoretical research on urban regeneration continues to deepen, the methods and contents of interface regeneration and place-making need to expand. The revitalisation of Shapowei's space should also be approached through multidisciplinary ideas, such as sociology and human geography, which may provide more innovative ideas and methods for urban regeneration.

Funding: This research was funded by the National Nature Science Foundation of China (NSFC) (No.52038007).

References

Andong L (2021) Back to the place to talk about urban regeneration. Urban wisdom,advancing with CHINA, 2021, (90).

Chen J, Pellegrini P, Wang H, et al. Sustainable Urban Form Based Old Community Regeneration — Taking Jing'anli Community in Tianjin as an Example %J International Journal of Architecture, Arts and Applications[J], 2022, 8(2).

Daria L, Chunyang Z (2022) Morphological and physical characteristics of the historic urban fabric and traditional streets of Xiguan in Guangzhou %J Journal of Urban Design, 27(4)

Guocheng HZH (2015) Research on the housing property rights and planning strategy in the old city based on the "micro update" mode : take the old city of Xiamen as an example. Urban Dev Stud 22(11):51–56

Jin Z, Jingtao H, Chen L et al (2014) The planning transformation of the traditionai community renovation under the market aiiocation—a case study of shapowei community in Xiamen City. J Hum SettlS West China 29(05):48–52

Jingxiang Z, Huanyuan D (2009) On the forming of consumer space in modern urban historical & cultural areas——an analysis from the perspective of spatial production Theory. Urban Plan Int 23(01):43–47

Qifeng Y, Tianshu C (2016) The dilemma of historic district reconstruction based on the perspective of space production: a case study of smaii park historic district Of Shantou. Mod Urban Res 07:68–77

Ruoxi Z, Qin W, Biao Y (2019) The transformation and response of urban regeneration under the background of public participation—taking shapowei community in Xiamen as reference. J Hum SettlS West China 34(05):18–26

Tony M, Sophie G (2022) Public art for placemaking and urban renewal: Insights from three regional Australian cities %J Cities, 127

Wenjin J, Keshi C, Xueguang M (2011) Study on the spatial production of urban renewal in China: A Case of Shanghai Xintiandi Square. Urban Dev Stud, 18(10): 84–89+96

Wetshan W (2011) An empiricai research on old town redeveiopment (1980–2010) in Xiamen. Urban Plan Forum 04:51–58

Xiaocheng L (2016) Spatial production and governance mechanism of new urbanization: based on the perspective of spatial justice. Urban Dev Stud 23(09):94–100

Yan F (1999) Phenomenology and the spirit of place. J Civ Eng Manag 04:20–24

Yang DS, Hong Y (2004) Space construction of traditional blocks in urban renewal. J Civ Environ Eng 05:1–5

Yangbang O. A preliminary study on urban development and renewal in the historical area of the old city—A case study of Shapowei area in Xiamen. Anhui Architecture, 24(03): 4–6+10

Yuan G (2013) Study on the renewal of the old urban area under the informal renewal mode—A case study of Shapowei planning in Xiamen. City 09:53–55

Zhenfu L (2006) Study on the renewal strategy of old city under the condition of market economy, taking Xiamen port area reconstruction as an example. 2006 China Urban Planning Annual Meeting, 2006: 8

Zhengfei W, Luming W, Qi W (2014) Shapowei art zone renovation of shapowei refrigeration piant in Xiamen. Urban Environ des 11:108–118

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 31
Urban Form, Plans and Procedures in Serbia: Recent Transformations of Urban Tissue and Its Inherited Values

Ana Niković and Božidar Manić

Abstract This paper attempts to determine the relationship between the theory of urban morphology and the practice of urban conservation and urban planning based on the example of modernist and postmodernist open residential blocks created in Belgrade and other cities in Serbia in the second half of the twentieth century. The starting point of the paper was based on the fact that these configurations represent both urbanistic and cultural and historical heritage. It examines the values/criteria based on which the two Belgrade urban units have been categorized as cultural heritage. Furthermore, it demonstrates that these criteria can be generalized and applied to numerous examples of urban blocks and units that are still not institutionally protected but are recognized through the work of organizations, researchers, and experts studying the relevant era in the development of architecture and urbanism. The paper indicates the current urban planning and building practices that ignore the values of these units and analyzes relevant literature and documents in order to find out the cause of this problem. It points out the missing elements in the planning and protection systems that would potentially mitigate the effects and prevent further damage to these units. The forms and reasons for endangering these urban units can be viewed in relation to the issues of identification and protection of spatial values, i.e., valuable elements of the urban and physical structure; the key concept/scale at which the plans are developed and implemented; instruments for the spatial value protection at the urban block/groups of blocks level; and implementation/control of the planning solutions. Combining protection and planning practices identifies urban morphology as a common platform for consolidating knowledge about this type of urban heritage and integrating it into practice.

Keywords Built heritage · Urban protection · Urban planning · Urban morphology

A. Niković (✉) · B. Manić
Institute of Architecture and Urban and Spatial Planning of Serbia, 11000 Belgrade, Serbia
e-mail: anan@iaus.ac.rs

B. Manić
e-mail: bozam@iaus.ac.rs

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_31

31.1 Introduction

This paper explores the modernist and postmodernist urban blocks in Belgrade and other cities in Serbia, from the point of view of their spatial values in the processes of urban and spatial planning. The research has been motivated by the significant achievements of the modern and postmodern architecture of numerous eminent architects and urbanists of the second half of the twentieth century (Blagojević 2012; 2007; Vesković and Jovanović 2018; Mecanov 2008, 2009, 2010, and also: List of articles about Serbian interwar and post-war modernism in architecture. Docomomo-Serbia, http://www.docomomo-serbia.org/en/references/ (accessed June 15, 2022)). These achievements are mostly present in the form of recognizable typologies of open city blocks intended for multi-family housing. They are the result of complex spatial and urban-economical analyses that preceded the plans' design (Svoboda et al. 1969; Mišković, 1969; Petričić 1969; Maksimović 1970; Janković and Zarić 1970; Milašinović 1971 and many other texts published in the journal 'Urbanizam Beograda'). Some of them are protected as cultural property, and there are also initiatives to protect the plans on the basis of which they were built as cultural property (Vuksanović-Macura and Banković 2018).

Due to changes in urbanistic paradigms and planning context over the last three decades, the initial values of these urban blocks have been threatened (Marić et al. 2010; Kantarek et al. 2022). Furthermore, urban units with modern, postmodern, and contemporary architecture have not been adequately recognized as spatial, cultural, and historical units of value, putting them at risk of inadequate treatment in planning documentation (NARS 2019b). Forms and causes of threats to these areas can be viewed in relation to the issues of spatial values identification and protection, that is, in relation to valuable components of urban and physical structure; the key concept/scale on the basis of which the plans are developed and implemented; spatial values protection instruments on the urban block/group of blocks level; and planning solutions implementation/control. Answers to these issues are sought in the narrower theoretical framework of the existing research in architectural and urbanistic practice in Serbia and the possibility of its improvement, as well as in the wider theoretical frame of urban morphology. This shows the usefulness of urban morphology in the processes that connect urban conservation with urban planning. The research findings represent a theoretical contribution to the field of urban planning methodology improvement, particularly in the protection of modern, postmodern, and contemporary architecture, which is underappreciated as a subject of institutional and urban protection.

Theoretical starting points and research materials are represented by the following: international documents on protection and planning that emphasize the values of architecture and urbanism as cultural heritage of the era (COE 1976; 1985; ICOMOS 1987, 2004; UNESCO 1972, 2011); literature and documents about the protection of architecture and urbanistic heritage, as well as vernacular architecture in Serbia (RIPCMS 2021; NARS 2019a, 2021c); literature about modern and postmodern

architecture, urbanism and planning in Belgrade and Serbia (Perović 2008; Blagojević 2007, 2012, texts in the publications Nasleđe and Urbanizam Beograda, etc.); literature dealing with the protection and planning practices in Serbia, problems faced and recommendations for improvement (Niković and Manić 2018, 2021; Niković et al. 2011, 2013, 2014, 2015, 2016; Manić et al. 2011; Marić et al. 2010, 2013; Gajić, 2015; Gligorijević and Graovac 2017); descriptions of plans on the basis of which both the typical spatial configurations of modern and postmodern architecture and urban planning in Belgrade were designed and current transformation of these blocks realized (Stojanović and Stjepanović 1995; Bela Crkva Municipality Assembly 2011, 2015; Regional Institute for the Protection of Cultural Monuments Smederevo 2016) and research and contributions from the discourse of urban morphology (Kantarek et al. 2022; Sjöholm and Hidman 2020; Kropf 2006, 2011, 2018; Tieben 2011; Berghauser and Haupt 2010; Habraken 2009; Hall 2008; Levy 1999, etc.).

The paper has three chapters. The first one gives an analysis of the current approach to the valorization of modernist and postmodernist architecture and urban planning, that is, the urban heritage created in Serbia after World War II. The second chapter illustrates, through a selection of examples, how these values are threatened in present-day architectural and urbanistic practice. The third part offers recommendations for improving the practice of planning and protection of the subject units from the perspective of urban morphology by recommending the instruments that are largely recognized in Serbian scientific and expert circles as improvement options, but are underutilized because they are not legally binding.

31.2 Background

In international charters and documents in the field of the protection of cultural heritage, the definition of the object of protection varies regarding the identified values (Table 31.1).

The World Heritage List: Filling the Gaps - an Action Plan for the Future. An Analysis by ICOMOS, February 2004, gives a list of recommendations for categorization of the cultural goods which also include modern heritage (ICOMOS 2004). In Serbia, this heritage is still underappreciated (NARS 2019b). Some of the basic elements missing in the current regulatory framework of cultural heritage protection are: (1) New cultural goods categories in accordance with international legislation; (2) Effective prior protection instruments in immovable cultural property law, as well as urban planning protection instruments in the law of planning and construction; (3) Involvement of professional protection services throughout the planning process; 4) Coordination bodies that allow the impact of professional practice on regulating laws, as well as commissions that monitor the implementation of planning solutions (Niković and Manić 2021).

Table 31.1 Definitions of cultural heritage with respect to the identified values and objects of protection—according to the international documents

Title of the document	Definition of the cultural heritage/object of protection
UNESCO (1972) Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris)—Article 1	'Groups of buildings: groups of separate or connected buildings that, because of their architecture, homogeneity, and integration into the landscape, are of exceptional universal value from the standpoint of history, art or science;' (underlined by the authors)
COE (1985) Convention for the Protection of the Architectural Heritage of Europe (Granada)—Article 1	'Groups of buildings: homogeneous groups of urban or rural buildings conspicuous for their historical, archaeological, artistic, scientific, social or technical interest which are sufficiently coherent to form topographically definable units; Sites: the combined works of man and nature, being areas which are partially built upon and sufficiently distinctive and homogeneous to be topographically definable and are of conspicuous historical, archaeological, artistic, scientific, social or technical interest.' (underlined by the authors)
ICOMOS (1987) Charter for the Conservation of Historic Towns and Urban Areas (Washington)	'This charter concerns historic urban areas, large and small, including cities, towns and historic centers or quarters, together with their natural and man-made environments.' (underlined by the authors)
European Commission (2004) Sustainable Development of Urban Historical Areas Through an Active Integration within Towns (Brussels)—p.11	'A significantly enlarged definition of the built urban heritage. Three main categories have been identified: (1) monumental heritage of exceptional cultural value; (2) non-exceptional heritage elements but present in a coherent way with a relative abundance; (3) new urban elements to be considered (for instance): the urban built form. It is to say the architecture of the town and not the individual building architecture, or some of its aspects like the urban silhouette; the "architecture" of the open space existing between the buildings: streets, public open spaces, etc.' (underlined by the authors)
UNESCO (2011) Recommendation on the Historic Urban Landscape (Vienna)	'The historic urban landscape is the urban area understood as the result of a historic layering of cultural and natural values and attributes, extending beyond the notion of "historic center" or "ensemble" to include the broader urban context and its geographical setting.' (underlined by the authors)

Modernist urban planning concepts, present to a lesser extent in urban planning practice before World War II, fully prevailed after this period through the adoption of a series of documents planning the development of new settlements in Serbia. Between 1945 and 1970, new urban and physical structure typologies were developed. Later, in the 1970−980 period, the tendencies in planning and construction that were modernistic in their essential characteristics were manifested, but with the elements of the period that followed postmodernism. The new urban structure was developed based on the plans adopted by the state and is characterized by a system of open blocks on the state-owned land.

Contemporary architectural and urban planning practice in Belgrade, which can be roughly observed since the nineties of the twentieth century, is characterized by a change in the scale of construction. The character of construction changes due to the reliance on private investments and, instead of the development of larger constructions—the entire residential areas and blocks—it turns towards individual construction on plots. Beginning in the 1990s, with the change in land policy, this type of urban structure—open residential blocks—was exposed to the processes of intensification and densification (Gajić 2015). Processes of deregulation in the specific post-socialist context of Serbia led to negative manifestations at the level of urban form: illegal construction; urban infilling regardless of the original concept and context; unregulated way of managing open spaces in a block due to ownership problems; uncontrolled increase in density with parking space requirements and reduction of greenery and open spaces; new plots concentrated along the edge of the block in the case of block 21 in New Belgrade. The general explanations for all of these negative manifestations include: the lack of state control and the abolition of state ownership; a lack of strategic leadership under new circumstances; the conversion of land use rights into ownership rights, whereby the tenants acquired ownership of the land beneath the building while the rest of the block remained in public and adaptable ownership. Private ownership and plot fragmentation are seen as key obstacles to comprehensive development (Kantarek et al. 2022).

The recommendations originating from the research of contemporary architectural and urban practice in Serbia refer to the improvement of the planning, design, and organizational aspects (Marić et al. 2013). The way in which building rules are formulated is seen as a particular problem. It is recommended that the building rules should be concise, non-contradictory, directional, and not determinative in the functions of urban protection, improvement of the image of the city, quality of life, privacy, and security (Niković et al. 2015). In Serbia, the problems can be connected with the urban-morphological discourse and the issue of the introduction of the concept of form into planning: (1) analysis of the existing state; (2) creation of planning solutions through the introduction of variant solutions and integrated graphic analyses; and (3) control of planning solutions through the establishment of quality criteria for the built environment and their introduction into the regulations (Niković and Manić 2018). The institutional and legal framework leaves enough room for applying the lessons learned and for using alternative studies, and examples of good practice (Gligorijević and Graovac 2017).

In the wider theoretical frame of urban morphology, there is a well-developed discussion about its relationship with conservation and heritage (i.e., Whitehand 2015a, b; Rodwell 2009; Samuels 2010, etc.), as well as its application in the practice of urban design and planning (i.e., Marshall and Caliscan 2011; Nasser 2013; Mckormack 2013; Hall 2013; O'Connel 2013). In urban morphology, the valorization of the built environment is connected with the attributes of the urban form. Urban morphology defines the urban form as a complex entity and the physical result of various development processes: socio-economic, technical, functional, psychological, etc. As such, it represents a source of knowledge about development processes and a starting point for future development. This is close to the definition of the

historic urban landscape in urban conservation. The values defined in urban conservation—social, sociological, cultural, historical, artistic, aesthetic, scientific, professional, etc.—are inherent in the urban form and can be identified through the analysis of the physical characteristics of the form through space and time, proving its relevance for urban protection.

31.3 Methodology

Based on the analysis of international documents in the field of cultural heritage protection, as well as on the basis of the analysis of laws in Serbia, sets of values are distinguished that are relevant for the definition of the object of institutional protection and its valorization. The need to improve the practice of protection in Serbia is pointed out so that instruments are developed for more effective recognition of values and inclusion in the system of institutional protection of the heritage of modernist and postmodernist architecture and urbanism in Serbia, which was created in the period after World War II. This paper is particularly concerned with the types of open residential urban blocks and groups of blocks that marked this period.

Documents are examined based on the distinguished sets of values—decisions on the designation of two urban units in Belgrade as cultural goods. It draws attention to the relations between nominal values and elements of the urban and physical structure that were not consistently elaborated in the decisions. The publications of organizations dealing with the protection of modern architecture in Serbia (Docomomo), as well as periodicals containing descriptions and representations of original planning concepts, are nalysed. This emphasizes the values of numerous examples of urban heritage from the given period that were not recognized through the regime of institutional protection. In addition, it shows the possibilities of valorizing the attributes of the urban form in the urban morphology. The urban form is a complex whole consisting of elements of the physical structure and their mutual relations are connected with the different aspects of the functioning of the form.

Furthermore, a section follows that indicates that even the plans' urban protection instruments fail to recognize these values. One postmodernist block stands out as an example, where recent transformations highlight problems that are symptomatic of Serbia's current architectural and urban practice. In addition to that, other issues from the experience of urban planning practice are pointed out. The forms and reasons for endangering these entities are viewed in relation to the issues of identification and protection of spatial values, that is, valuable elements of the urban and physical structure; key concept/scale at which plans are developed and implemented; instruments through which spatial values are protected at the urban block/groups of blocks level; and implementation/control of the planning solutions. Answers to these questions are sought in the narrower theoretical framework of the existing research on the topic of architectural and urban practice in Serbia and the possibility of its improvement, as well as in the broader theoretical framework of urban morphology.

31.4 Valorization and the Problem of Institutional Protection of the Modern and Postmodern Architecture and Urban Planning in Serbia

The newly adopted Law on Cultural Heritage (NARS, 2021a) in Serbia represents a step forward in comparison to the previously valid law from 1994 (NARS, 1994). Definitions of cultural heritage and spatial cultural-historical units have been expanded, and values and criteria for valuing cultural heritage have been specified. While the Law from 1994 attributes physical, artistic, cultural, and historical values to cultural goods, the Law from 2021 adds: social, archaeological, ethnological, anthropological, technical and industrial, arts and crafts, architectural, construction and construction-structural, spatial (urban and rural) and scientific values. Spatial cultural-historical entity units are also valued for "architectural features, homogeneity, or their position in space…" (NARS 2021a). For the purposes of the systematization in this paper, the sets of values listed in individual documents are grouped into: cultural and historical; artistic and aesthetic; scientific and professional; and social and sociological values (Table 31.2).

The declaration of two spatial cultural-historical units, the Cerak Vinogradi settlement and the Central Zone of New Belgrade, which belong to the period of planning and construction after World War II, took place in the last three years and reflects this shift and improvement of planning regulations, as well as the recognition of the architectural and urban values of these units. The proclamation decisions in accordance with the law (NARS 2019a, 2021c) do not specify any values. Instead, entity unit descriptions are given, and it is done in an inconsistent manner. Therefore, the elements of these descriptions are classified according to the previously mentioned value sets (Table 31.2). That should facilitate both the reading of the decisions from the standpoint of the recognized values and the application of the criteria to new settlements and parts of settlements from the same period.

Numerous studies have focused on both settlements, highlighting their importance and values (Blagojević 2007, 2012; Vesković and Jovanović 2018; Mecanov 2008, 2009, 2010 and also: List of articles about Serbian interwar and post-war modernism in architecture http://www.docomomo-serbia.org/en/references/accessed June 15, 2002). The settlement of Cerak Vinogradi is part of the permanent collection of the MOMA museum in New York (Marušić et al. 2018), and the modernism heritage in Serbia was exhibited at the preceding exhibition (Stierli and Kulić, 2018). It has to be underlined that these are the only two spatial entities from the period of modernism that are included in the central register of immovable cultural assets in Serbia (RIPCMS 2021). In general, the problem in the protection system was observed regarding the absence of a spatial dimension and the insufficient participation of spatial cultural and historical units in the overall structure of cultural assets in the central register (86 out of a total of 2592, more about this in: Niković and Manić 2021; NARS 2019b). However, there are indications of positive changes in accordance with the changes in the new law.

Table 31.2 Elements of decisions on the declaration of two spatial cultural-historical units from the period of modernism/postmodernism, classified according to the sets of values created in this paper

Significance/value	Central Zone of New Belgrade (1962–1979)*	Cerak Vinogradi Settlement (1978–1985)**
Social and sociological values: Social, political, and sociological significance	It consists of 9 blocks; A great architectural accomplishment that marked the period after World War II in Belgrade. Connecting the two existing city cores of old Belgrade and Zemun, arranging the marshlands, and building a completely new city thanks to the application of special technology	Cerak 1 and Cerak 2 form four neighborhoods—a grouping of blocks. An example of a modern residential complex conceived on traditional postulates and on the introduction of content, which significantly improved the coexistence of tenants and achieved a high quality of housing in a settlement far from the center of Belgrade
Cultural and historical values: Cultural, historical, prehistorical, socio-cultural, etc.	A representative of CIAM ideology and Le Corbusier's Charter of Athens from 1943. Realized as a city of "sun, space, and greenery"; An anthological and original example of post-war Yugoslav architecture	The synthesis of urban, architectural, and construction methods as a kind of "experiment"; respect for natural features and terrain flows, formation of neighborhood units, and smaller environments; The first ecological settlement in Belgrade
Artistic and aesthetic values: Artistic, aesthetic, visual-aesthetic, artistic-craft qualities	The profession had the freedom to search for its expression, which resulted in the formation of its own identity of Yugoslav post-war architecture, reflected in the composition of facades and volumes at the level of a block	The conceptual solution of all buildings, both residential and public, is based on respect for the existing terrain and landscape, with mild elevations and straight lines that create the impression of a dynamic urban landscape. Great attention was paid to architectural design, materialization, and details

(continued)

Table 31.2 (continued)

Significance/value	Central Zone of New Belgrade (1962–1979)*	Cerak Vinogradi Settlement (1978–1985)**
Scientific & professional values: Scientific, professional, archaeological, ethnological, anthropological, technical, technological, industrial, urban, architectural, construction, constructional-structural value Educational value Spatial value	Creation of typical spatial organization of the apartment, the so-called. "Belgrade School of housing" (flexibility of residential complexes, the two-sided orientation of apartments, sleeping outside the living room and in small apartments, the introduction of the economic terrace, affirmation of apartments on the ground floor, and individualization of apartments on the attic); The result of long-term systemic planning is supported by the state institutionally, procedurally, and economically. Based on successively adopted plans: 1950, 1960, 1962; The architectural-urban concept of PKIC is based on the consistency of the implementation according to the original competition solutions For the first time, a constructive system of prefabrication was applied, which provided much greater possibilities than the traditional type of construction	The organization of the apartment is based on the basic principles of the Belgrade School of housing (flexibility of residential complexes, the two-sided orientation of apartments, sleeping outside the living room even in small apartments, introduction of an economic terrace, affirmation of apartments on the ground floor and individualization of apartments in the attic); The innovativeness of the built structure and spatial organization is the result of the application of the authors' four design principles: a sense of place, reaffirmation of traditional urban forms, application of methods of the spatial organization of objects, and consideration of movement (orientation) factors in the settlement; The concept of gardens on the lower floors of residential buildings in order to achieve greater intimacy in the private living space on the ground floor is also a novelty; A sloping ceiling as a new structural element in the standard system of flat ceilings is a construction innovation

* *Authors*: M. Glavički, U. Martinović, L. Lenarčić, M. Mitić, D. Milenković, A. Stjepanović, B. Janković, B. Karadžić, I. Arnautović et al.
** *Authors*: D. Marušić, M. Marušić, N. Borovnica

In accordance with the principles of the DOCOMOMO international organization (DOCOMOMO, Eindhoven, 1990), the activity of the Docomomo Serbia working group is focused on protecting the heritage of modern architecture and urbanism at the national level. The result of this activity is represented by registers that generally divide the modern heritage into objects from two periods: (a) 1918–1941 and (b) 1945–1990 (Jovanović 2018). The publication *Register of Modern Architecture and Urbanism in Serbia 1945–1990*. (Jovanović 2018) includes a total of 223 buildings

and units of the post-war architectural production in the country. They are classified into 18 typologies in accordance with the Docomomo methodology. This paper observed the categories of housing and urban units. A total of forty localities were presented in the special publication *Atlas of Typology: HOUSING. Residential settlements, blocks, groups, units (1945–1990)*. Fifteen of them were in Belgrade, three in Bor, two in Jagodina, three in Kraljevo, six in Kruševac, three in Leskovac, three in Novi Sad, two in Šabac and one in Majdanpek, Subotica and Čačak.

The preface specifies the following: 'The housing fund stands out because it represents the largest and most massive construction fund in Serbia. It stands out for its architectural, urban, technological, and landscape qualities. It is a relatively new fund that has only recently come out of the 30-year historical distance usually recommended for valuation. Little has been done on field reconnaissance, especially in smaller towns. The devastation of these buildings and units was accelerated due to the depreciation of the fund, inadequate repairs and remodeling, poor maintenance, and public criticism. Thanks to the Internet, research projects, and exhibitions, the attitude towards modernism is changing (Jovanović 2020).

Authors used to present their current plans and projects for various new parts of Belgrade in the journal *Urbanizam Beograda* (published in the period 1969–1982). That is how their attitudes and aspirations stood out:

- Revitalisation of old city cores with new construction and traffic flows, form attitudes—achieving a special expression in urban units, silhouettes and visions, spatial plasticity (Svoboda et al. 1969);
- Spatial composition is envisaged in relation to neighboring blocks; the formation of functional, compositional, and visual connections between the central public space and the river; towers and lower residential longitudinal buildings are combined in such a way that they are placed in an appropriate relationship with each other and with the surrounding elements (boulevards, rivers, etc.) (Mišković, 1969);
- The leveling of the terrain in order to revive terrain plastic, the realization of a horticultural art ensemble, the disposition and spacing of objects that ensure "intimate living" and "deeper vistas" (Petričić 1969);
- Finding compositional solutions that fit in the best way with the natural features of the terrain and the heritage of the fund; artistic expression; forming silhouettes and dynamizing the experience of movement through the way of forming groups of series of objects arranged in horizontal and vertical positions (Maksimović 1970);
- Assumptions that the residential area will fit well into the organism of modern Belgrade and quickly develop into a spatially and sociologically healthy community. Prevention of illegal construction; emphasizing the characteristic elements of the relief in relation to the physical structure (Janković and Zarić 1970);
- Adaptation of new buildings to the terrain and disposition of masses of the buildings in the surrounding area; emphasizing the amphitheatre shape of the terrain; planning in relation to the existing and the future; accents and silhouettes; sights; clear and complete spatial impression (Milašinović 1971).

As it was stated in the previous chapter that there is a lack of recognition of this type of heritage, although there are signs of progress, the activities of DOCOMOMO and journalism can significantly help the recognition and evaluation of these units.

31.4.1 Valorization of Spatial Units in Urban Morphology

What makes both cultural-spatial-historical entities, as well as the entities described in the texts of the journal 'Urbanizam Belgrade' morphologically relevant are the integrative and holistic approaches applied in all conceptions. They involved complex spatial, urban, and economic analysis and resulted in recognizable typologies—elements of physical structure and various positive aspects of the functioning of the urban form. That does not imply only technical and functional aspects (connectivity, walkability, permeability, adaptability, an adequate ratio between built and unbuilt areas, private and public areas) but also spatial and experiential (character, identity, meaning) and visual and aesthetic aspects (legibility, recognizability). Table 31.3 shows the connection between certain elements of the physical structure and positive aspects of the functioning of the resulting form.

31.5 Threats Posed by Current Architectural and Urban Practice in Serbia to the Identified Values of Modernist and Postmodernist Architecture and Urbanism

On the basis of the example of a postmodernist grouping of blocks that was partially realized according to the comprehensive original conception, but whose contemporary development has been carried out according to the principle of partial construction, it is possible to, on the one hand, observe the relations between the original architectural and urban qualities, aspirations and views of the planners expressed in the texts presented at the time (Stojanović and Stjepanović 1995; Milašinović 1971), and current transformations that endanger and disrupt these values, on the other hand. These transformations can be traced at the level of:

(1) *Surroundings*, where there is a complete disregard for the context in both the visual and functional sense;
(2) *Street/traffic*, where the internal vehicular and pedestrian traffic suffered from the introduction of the city traffic regime in the block (with appropriate signaling, the introduction of parking fees, and a reduction in the number of accesses to the block).
(3) *Blocks*, where the functional and formal coherence of blocks and the groups of blocks are neglected or lost;

Table 31.3 Relationship between good performances of urban form and the elements of physical structure

Elements of physical structure	Positive aspects of the functioning of the blocks/ groups of blocks/urban form	Achieved qualities/form values
(1) Wider context	Visually and functionally connected with the wider surroundings	Connectivity, walkability, permeability, adaptability, an adequate ratio between built and unbuilt areas, private and public areas. character, identity, meaning legibility, recognizibility.
(2) Streets and traffic	Well-developed external and internal connections Equal treatment of vehicular and pedestrian traffic (covered sidewalks along pedestrian streets, colonnades, and pedestrian penetrations through the block, etc.) Internal vehicular traffic intended for block tenants, with accompanying parking spaces The streets are profiled so that they accommodate the infrastructure intended for the planned facilities	
(3) Blocks	The blocks are treated as a unique entities—formally and functionally, with carefully composed relationships between buildings and open spaces	
(4) Plots	The whole block was treated as a single building plot according to the land management system of the time (public-state ownership)	
(5) Open spaces and greenery	An integral part of the planning solutions were common open spaces—children's playgrounds and micro-ambients formed by the disposition of buildings In addition, rows of trees are planted along the streets and green areas between buildings	
(6) Buildings	The type of multi-family residential buildings dominates, of balanced height (4–6 floors), and design elements (type of roof, windows, materials). The goals of harmony and avoiding spatial monotony are achieved through the application of variant solutions at the level of the whole. By introducing non-residential functions on the ground floor of buildings (shops and services) with the accompanying element of colonnades, pedestrian communications have been revived	
(7) Flats	By varying the basic type, different sizes and structures of apartments with a flexible organization are obtained. The rooms are designed according to design standards and the larger apartments have a two-sided orientation and spacious terraces. There are auxiliary/service areas on the ground and basement floors, and parking is provided at ground level in the block	

(4) *Plots*, on which private ownership has been re-established and private interests dominate, expressed through the demand for the maximum utilization of the building capacity of the plot, at the expense of other parameters, such as open spaces and greenery;
(5) *Open spaces and greenery*, whose amount is minimized in favor of reaching the maximum built-up index. New construction on certain plots increases the need for infrastructure and parking, which the existing street profiles cannot serve. It also does not leave the possibility of realizing new open spaces;
(6) *Buildings*, where the well-studied appearance at the level of block give a way to arbitrary styles of new single buildings. Multi-family residential buildings, often inconsistent with each other in terms of floors, architectural design, and quality of construction, reflect the approach of partial construction and the preferences of individual investors.
(7) *Apartments*, do not reflect a consistent typology and design methodology. They are often of very different quality with a high percentage of non-standard rooms. This is a consequence of the imperative to achieve the largest number of apartments within the permitted volume of the building. The parking regulations dictate the provision of parking spaces so that instead of basements, which are one of the factors of comfort space, underground garages are introduced. They, therefore, become an indispensable element of the typology of buildings, but they also represent an element of a violation of the safety of movement in the block due to special access driveways.

There are two additional specific and, in the context of this paper, important problems from urban practice, which can be demonstrated through appropriate examples.

The first problem is the alienation of land in public ownership due to unfavorable economic circumstances, which occurs especially in smaller and poorer municipalities. Two examples of plans for blocks in the municipality of Bela Crkva demonstrate how to overcome the problem of ownership and adapt the modern market model of land management, with the emphasis on obtaining as many plots as possible (Niković and Manić 2011). In the case of block 23 in Bela Crkva, part of the block was built according to an urban project from the 1980s. It has significant artistic qualities both at the level of individual buildings and at the level of the urban entity. However, the demands of the Investor (in this case the municipality, which owns the land in the block) were not to follow the original planning concept, but to implement a solution that rationalizes the area of public land, the arrangement and maintenance of which burdens the city budget. Instead of free-standing buildings and common open and green areas, a subdivision was carried out and a total of 44 new construction plots were formed, 36 of which were for individual housing, i.e., for sale. A common green area was replaced with an area intended for urban agriculture—in the form of sample block gardens that the municipality, as the owner, would lease to interested residents of the block (Manić et al. 2011). In the case of block 27 in Bela Crkva, the situation is further complicated by the existing condition. Unlike block 23, where the land is owned by the municipality, block 27 consists of irregularly shaped privately

owned plots on which construction is not possible. The existing plots do not meet the construction plots requirements, so the procedure of urban consolidation, i.e., re-parceling, must be carried out in order to create adequate plots. The planning decision requested the subdivision, after multiple analyses and variants of the subdivision. The proposal that achieves the largest number of new plots, with a minimum of public areas intended for traffic, was adopted. The proposal to form a common open area in the center of the block was rejected as irrational. This is another of the problems of the existing state of blocks in settlements of Vojvodina, which requires the application of the procedure of urban consolidation of private plots in order to enable planned construction at the block level.

Another problem from urban planning practice is present in the example of a block intended for multi-family housing in the city of Požarevac, and it refers to the instrument of prior protection. At the time the plan was started, the block was under prior protection as an entity within a larger urban unit (Regional Institute for the Protection of Cultural Monuments, Smederevo 2016). In the discussion during the Planning Commission, it was stated that it is one of the more organized and pleasant residential areas in the city, but which, due to the change of owner, is experiencing transformations in the form of converting the ground floor of buildings and self-initiated joining of common green areas. In the meantime, this unit has lost the status of previous protection, which means that it will be left for treatment in the planning document. This is a special problem in the planning system in Serbia, because the methodology is not legally defined, and the preparation of studies and additional elements is not binding, so it depends on the attitude of the urban planner-developer and his resistance to pressure from private individuals and investors (Gligorijević and Graovac 2017). The instrument of prior protection is not effective enough and indicates that it is necessary to verify the participation of protection services in the all stages of the process even when it is not binding.

According to the above, today's practice shows the impossibility of realizing and preserving spatial entities that were created in the second half of the twentieth century. The reason for this is the change in the planning system and the legislative framework, which prescribes future construction at the plot level, and not at larger complexes. An additional problem is the situation with land ownership and subdivision. Even in the case of detailed regulation plans and urban projects that are adopted for the block level, due to problems with subdivision, these plans are not feasible. Therefore, even some plans whose implementation was started according to the original conceptions could not be completed consistently with those conceptions, but the planning solution had to be adapted to the new requirements and the new context. Also, in the blocks planned for new construction, the formation of public free spaces is not accepted because the question of their maintenance and profitability arises, especially in the case of poorer municipalities. In addition to the issue of recognizing and protecting the value of the planning level, there are also problems related to the applied instruments and the control of the implementation of plans (Tables 31.4, 31.5, 31.6, and 31.7).

Table 31.4 The issue of identification of morphological characteristics

Problem/form of violation of existing values	Possible explanation	Instruments, measures, and models for improvement in practice
Insufficient recognition of the value of the heritage of modernist and postmodernist architecture and urbanism in Serbia *** In planning practice: deviations from the original urban-architectural concepts of open blocks, created in the period of modernism and postmodernism *** In conservation practice: An instrument of prior protection that recognizes values but does not ensure permanent urban protection of the area	Insufficiently clear relationship between nominal values and elements of physical structure in the practice of cultural heritage protection and planning practice *** Insisting on short deadlines for developing plans; insufficient time devoted to the analysis of the current state; domination of economic interests *** The loss of the status of prior protection due to the expired legal deadline for declaration *** Inadequate cooperation among all professions involved in the planning and protection of spatial values	Instrument of nomination and proclamation of cultural assets: Making decisions on the protection of cultural assets in a consistent and systematic way that connects the values and elements of spatial entities and enables the application of criteria to entities that are not under institutional protection *** Instrument of analysis of the existing state: Valorization of the existing physical and urban structure in the planning process—through special procedures and studies *** Multidisciplinary cooperation, especially between protection and planning services; transfer of knowledge and information about both protected goods and goods under prior protection and those that have lost the status of prior protection

Table 31.5 The issue of resolution/key concept of planning

Problem/form of violation of existing values	Possible explanation	Instruments, measures, models for improvement in practice
A plot-based approach, a lack of relationships with neighboring plots, a block, and a context *** Impossibility of comprehensive planning and/or implementation of plans due to private ownership of plots *** Alienation of land in public ownership due to unfavorable economic circumstances	Changes in the socio-political system, planning system, land management system, and the stakeholder relationship in decision-making	Management models at the block level: Application of an integrative approach to design and planning at the level of a block or a grouping of blocks of a homogeneous structure *** Private–public partnership *** An instrument of urban consolidation

Table 31.6 The issue of instruments for the improving practice

Problem/form of violation of existing values	Possible explanation	Instruments, measures, and models for improvement in practice
Violation of general interests of the community: safety, health, cultural and historical heritage, environment, etc. *** Violation of spatial comfort and interests of the end users of the space/residents of the block through reduction of: the percentage of open and green areas, pedestrian communications, traffic access, adequate parking; unfavorable relationship between built-up and open space that worsens the conditions of sunlight, ventilation, etc. *** Intensification and densification of land use, which leads to overloading of infrastructure capacity, as well as parking. The need for new parking spaces is reflected in the treatment of open spaces and building typology *** Introduction of inadequate/ arbitrary new typologies and purposes *** Violation of ambient values, views, and silhouettes; the lack of connection to the immediate environment and larger context	Regulation plans do not sufficiently recognize the specificity of the location. In accordance with the legally determined principle of vertical coordination of plans, rules from higher order-plans are often used without adaptation to the specific location *** The rules are given explicitly in the form of quantitative indicators. Implicit rules based on qualitative descriptions that provide opportunities for different solutions in design are missing *** Abuse of the possibility of alternative use of the occupancy index (OI) or construction index (CI) as an option given by law: Depending on which parameter is used, the GUBFA (gross unfolded building floor area) can differ by up to 100% *** Overly rigidly formulated rules limit the range of architectural design possibilities *** The absence of instruments that ensure the choice of the best design solution, reflected in the low quality of architecture and urban planning *** The law and practice do not require additional analysis of the existing state, especially not the analysis of the characteristics of the physical structure. Most often, only the number of floors and volume of buildings are considered	Regulatory Plan Instrument: Introduction of complex urban planning parameters that sublimate various aspects of the desired urban form/physical environment. Establishing a relationship between the properties of the form and the planning/designing tools that achieve the desired quality *** Building rules instruments: an instrument of the regulatory plan and, within it,

Table 31.7 The issue of implementation and control of the planning solutions

Problem/form of violation of existing values	Possible explanation	Instruments, measures, and models for improvement in practice
Dominance of private and economic interests in the decision-making system *** Decisions based on insufficient recognition of space as a sustainable development resource and urban form as its physical manifestation *** The officials who control the plans must adhere to the building rules from the plans, instead of considering the specific location and its conditions (the plans are controlled to the extent necessary to make them enforceable, without thinking much about the results): controlling only those aspects that concern quantitative indicators	There is a lack of mechanisms that connect different levels of professional interventions *** There is a lack of coordination of the interests of all participants through a strategic approach to planning *** Insufficient awareness of the importance of the quality of architecture and urbanism *** Insufficient education of experts in charge of control of plans *** Depending on the parameter used, the GUBFA can differ by up to 100% Lack of procedural steps/ commissions for quality control of solutions, as a link between plans and projects	Instruments for controlling the implementation of planning solutions: defining a list of criteria for checking spatial solutions *** Education of services that control plans in the direction of quality control of spatial values achieved by the plan *** The introduction of architectural commissions to check the quality of architecture and compliance of the typology of buildings with the character of the area or context

31.6 Possibilities for Improving Contemporary Architectural and Urban Planning Practice in the Context of Urban Morphology Discourse

The connection of urban morphology, urban planning, and urban conservation suggests an integrative and multidisciplinary approach that has the urban form as a common reference. Starting from the problem of valorization of the urban environment, we came to the identification of positive aspects of the functioning of the observed units and their generalization as attributes of the urban form. These attributes can be applied as valorization criteria for new entities in the processes of urban protection, but also as valorization criteria of existing state and planning solutions in the processes of planning.

Four key topics/issues are highlighted: (1) protection of spatial values, that is, valuable elements of the urban and physical structure; (2) the key concept/scale at which plans are developed and implemented; (3) instruments that protect spatial values at the block/grouping of blocks level; (4) implementation/control of planning solutions. Within each topic, after a reminder of the relevant contributions from urban

morphology, Tables 31.4, 31.5, 31.6, and 31.7 are given with the simultaneous observation of the problems, the cause of the problems, and the suggested improvements within the context of Serbian practice.

31.6.1 Protection of Spatial Values

The issue of applying morphological analysis in valorization stems from the problem of insufficiently analyzed and valorized existing physical structure in general. It is proposed to understand the value of contemporary, modern, and generally non-traditional fabric based on morphological analysis/identification of typical elements, their dialectical relations, and relations with values (Table 31.4).

Albert Levi (Levy 1999) emphasizes research questions in the field of urban morphology in relation to the modern urban tissue, which has evolved from closed and compact to open, heterogeneous, and fragmented tissue. New urban elements, whose development is largely induced by the development of traffic, the new pace of life and work, and the new relationship between trade and the city, have not been sufficiently explored both in terms of their emergence and in terms of their role in the city and the way in which they can be included in the modern urban vocabulary. It is, therefore, necessary to develop "new tools", as he claims, without trying to reduce something that is contemporary and modern to a traditional vocabulary that is suitable for a city whose conception, for example, cannot respond to the new needs of traffic. The comparison of the old and new tissue, and stating the old and new components of the urban structure, which further raises questions about the causes of this evolution, is the most significant part of the research. The goal is to establish the quality criteria for the development of a new urban tissue based on current demands and our understanding of the general principles governing the formation of urban tissue (Levi 1999).

These findings are supported by more recent research, which demonstrates that planned settlements have architectural and urbanistic values that led to their designation as protected cultural property, and they were also recognized as such by the residents. Their urban form is significantly different from traditional concepts, but nevertheless can be the subject of a morphological analysis that identifies specific characteristics. This further implies that traditional concepts and approaches in planning are not applicable to these units, but that methods and concepts of planning and design need to be updated on the basis of identified specificities and local context. The case of Kiruna opens a wider discussion on urban conservation that can help understand the links between heritage values and the physical, tangible dimensions of built heritage (Sjöholm and Hidman 2020).

31.6.2 The Key Concept/Scale

The issue of resolution/key concept for which plans are made and implemented—the key issue of planning concept/resolution/scale arises from the parcel-based approach and the lack of relationship with neighboring parcels, blocks, and context. Management models at the block level are proposed: and the application of an integrative approach to design and planning at the block level or the grouping of blocks of the homogeneous structure (Table 31.5).

Defining a key concept is one of the main interests of urban morphology in applying its knowledge in practice. In this sense, Kropf talks about the urban tissue as the essential unit of growth and transformation (Kropf 2006, 2011), while Hall and Samuels suggest a block structure (Hall 2008; McGlinn and Samuels 2000). There is also the question of the level of scale, detail, and representation at which it is possible to apply an integrative approach to the design and planning of the built environment. Through the Spacematrix method, Berghauser and Haupt (2010) obtain the result that urbanism is a suitable level of detail, and the city block and urban tissue are suitable scale levels. Dealing with the questions of the evolution of the city block and its role and position in the urban structure, the authors (Castex et al. 1980) come to the conclusion that the block can be viewed as a "building unit" or "planning unit". One of two prerequisites is necessary for the block to be treated as a "building unit": a social situation in which there is a need and possibility for construction to take place at an accelerated pace and in large-scale projects (as was the case in post-war Yugoslavia) and the existence of authority in the jurisdiction and decision-making system that ensures the consistent implementation of construction at the block level.

31.6.3 The Issue of Instruments

The issue of instruments that protect spatial values at the block/grouping of blocks level arises from the neglect of the general interests of the community, comfort in space, and the interests of end users. There is a need to introduce qualitative indicators, spatial checks, visual graphic analysis, and additional checks—instruments of regulatory plans and building rules, instruments of urban planning, instruments of urban consolidation, instruments of architectural and urban competitions (Table 31.6);

Design rules can be given explicitly, in the form of quantitative indicators, which are mandatory for obtaining construction and use permits, or implicitly, in the form of qualitative descriptions that offer opportunities for different design solutions (Tieben 2011). The way design rules are formulated and used most directly affects the quality of the built environment. They connect different scales of professional activities, that is, the macroscale of planning with the microscale of designing. Furthermore, there is a need for establishing a relationship between urban design goals and aspects of

physical structure, where Hall's research on the physical manifestation of planning goals can come in useful (Hall 2008).

The problem of the introduction of qualitative parameters into urban planning is particularly addressed by Berghauser and Haupt, through the use of a complex density parameter. Deflecting from pictorial representations and concepts, they give the density parameter structural properties and elasticity in the definition of spatial properties/performances of the future environment. Three performances groups are distinguished: urban physics, which includes lighting, solarization, aeration, and energy consumption; urban practice, which includes parking, the relationship between private and public, and profitability; and urban perception, which includes urbanity, privacy, and safety of movement. Special consideration is given to lighting, parking, and urbanity. Each performance is viewed as a descriptive layer that clarifies certain aspects of the quality of the urban environment. On the one hand, there are restrictions in terms of density, and on the other hand, performance is the potential of the urban structure to behave in accordance with certain requirements—parking, lighting, etc. However, for successful results, it is important to synthetically observe all the characteristics of the form and the desired performances—the typology of the buildings and the type of urban environment. For example, the desired performance of favorable daylighting depends on the ratio of the built and unbuilt, the distance between buildings, the ratio of the height of buildings, and the width of streets. However, it can be sabotaged by an inadequate number, size, and arrangement of openings (Bergahauser and Haupt 2010).

There is an open possibility in planning documents to include elements that are not legally binding but can be used in favor of good professional results in practice (Oliveira 2006). This primarily refers to integrated graphic analysis (McCormack 2013), through which different spatial planning solutions can be examined and evaluated. In this way, insufficiently analyzed solutions, based on an overgeneralized or partial approach or one-sided interests, can be mitigated, which, as a consequence, improves the quality of the built environment.

31.6.4 Implementation/Control of Planning Solutions

The question of implementation and control of plans arises from the way of control of plans, the fact that the officials who control the plans must adhere to the rules of construction from the plans, instead of taking into account the specific location and its conditions. Usually, only quantitative indicators related to the construction and occupancy index are considered. It is proposed to establish a consensus on criteria for evaluating the quality of the built environment with effective instruments for controlling the implementation of planning solutions (Table 31.7).

According to Habraken, for architects and urban planners, the essential question is what a well-built environment means, i.e., what the criteria for assessing the quality of the environment are. Thereupon, control appears as a true operative force in connecting different influences and qualities, which, on the one hand, causes change, and change reveals control. The participants in the process of designing and planning configure the form. Therefore, analyzing this process helps in finding common priorities and values. Habraken recognizes that the physical environment is hierarchically structured and that different environments reveal different types of hierarchies. In order to introduce control, a comparison procedure is applied to discover how the hierarchies influence each other. They do not have to be congruent, but they can certainly be placed in a mutual relative relationship. Where control is centralized and belongs to a small group of people, change is limited to large and infrequent operations, and uniformity occurs. Therefore, with today's turn towards decentralized management of space, it is necessary to study the connections between patterns of control and sustainability. Habraken develops the concept of territorial depth, which corresponds to the levels of hierarchy in the arrangement of the physical environment (Habraken 2009).

In addition to the four key questions, the overarching question of the role of urban morphology is precisely the connection between the existing and the future state of the built environment. That is possible through the recognition of the spatial values of the existing state and their association with the attributes of the urban form. The second step is to connect the identified characteristics of the form with planning goals and elements of the physical structure in planning solutions. In the scope of the work, there was no space for a more detailed elaboration of the application of morphological techniques, methods, and concepts. Still, it would certainly be one of the topics for future research.

Rationality and feasibility have been indirectly discussed. Bearing in mind that the planning and protection system in Serbia is based on a defined legal and institutional framework, the mentioned measures need to be recognized through legally binding criteria and instruments. The fact is that morphological analyses of the previous state require more extended time frames that currently need to be legally increased. Introducing new instruments and applying morphological concepts and techniques requires a broader education of the actors involved in the processes, not only those processing plans but also local authorities, users, investors, etc.

Different actors have different influences on specific aspects of the form. McGlynn and Samuels (McGlynn and Samuels 2000) classify actors into those involved in the implementation of plans and projects—plot owners, contractors, and investors; then those involved in the development of projects and plans—developers, local authorities, planners, traffic engineers, architects, urban planners and finally those for whom the space is intended—everyday users. Architects and urban planners have the most significant influence in all aspects of urban form—in terms of the street network and blocks, subdivision, land use, building form in terms of height and mass ratio, orientation to public space, appearance, typical organizations, construction elements, details, and materials. The basic problem in Serbia is that in all the examples mentioned, except for local authorities and everyday users who represent the public

interest, all other actors are usually in the domain of private interest. At the same time, private and public interest mediation mechanisms have not been developed. At the same time, it is a widespread case that both local authorities and professionals fulfill private interests. Therefore, it is crucial to strengthen local authorities, professionals as well as everyday users (especially by encouraging their participation) in defense of the public interest, which in the context of this work would mean the protection of spatial values and the creation of positive qualities of the urban form.

31.7 Conclusions

The paper points out the sets of values of modernist and postmodernist open blocks developed in Serbia after World War II: social and sociological; cultural and historical; scientific-professional, and artistic-aesthetic values. These sets of values were derived based on the analysis of the documentation by which representative types of the post-war heritage of architecture and urbanism were declared cultural assets. At the same time, numerous examples were pointed out, which were documented by the work of organizations dealing with the protection of modern architecture and urbanism. As stated in the publications, numerous examples present in smaller cities did not reach the scope of the research and their recording is yet to come. On the other hand, urban planning and planning practice show that during intermediate periods and discrepancies in procedures, set deadlines, and financial and technical possibilities, a significant violation of identified or potentially present values occurs.

It is necessary to establish a relationship between the values that define the object of protection in the laws on cultural heritage and the elements of the physical structure that justify the nomination and declaration of certain spatial entities as cultural assets. In this way, the elements of the urban and physical structure, their articulation and connection in the processes of architectural and urban design and planning are affirmed and further engagement in achieving these values through planning is stimulated. Also, in the practice of protection, it is possible to recognize these elements and their relationships within spatial entities and more effectively include them in the system of institutional protection.

Urban morphology offers recommendations for improving the practice of planning and protection in relation to issues of identification and protection of spatial values, i.e., valuable elements of the urban and physical structure; key concept/scale at which plans are adopted and implemented; instruments by which spatial values are protected at the block/grouping of blocks level; and implementation/control of planning solutions.

Acknowledgements This study was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (451-03-68/2022-14/200006).

References

Bela Crkva Municipality Assembly (2011) Plan detaljne regulacije dela bloka 23 (naselje Rasadnik 2) u Beloj Crkvi, Službeni list opštine Bela Crkva 7/11
Bela Crkva Municipality Assembly (2015) Plan detaljne regulacije bloka broj 27 u Beloj Crkvi, Službeni list opštine Bela Crkva 5/15
Berghauser Pont M, Haupt P (2010) Spacematrix: space. Density and Urban Form. NAi Publishers, Rotterdam
Blagojević, Lj (2012) The residence as a decisive factor: Modern housing in the central zone of New Belgrade. Architektura a Urbanizmus 46(3–4), 228–249
Blagojević, Lj (2007) Novi Beograd: osporeni modernizam. Zavod za udzbenike i nastavna sredstva, Arhitektonski fakultet Univerziteta u Beogradu, Zavod za zaštitu spomenika kulture grada Beograda, Beograd
Castex J, Depaule J, Panerai P (1980) Urbane forme. [Translation: Mihajlović-Ristivojević, M. and Bosnić, G., 1989], Građevinska knjiga, Beograd
COE: Convention for the protection of the architectural heritage of Europe (Granada) (1985)
COE: Recommendation 880 (1979) of the parliamentary assembly of the council of europe on the conservation of the European architectural heritage. Strasbourg (1976)
Do.co.mo.mo Serbia, http://www.docomomo-serbia.org/en/, Last accessed 2022/6/15
Henket HAJ, de Jonge W (eds.) (1991) Eindhoven Statement. In: DOCOMOMO: First International Conference, September 12–15, 1990. Eindhoven
European commission (2004) Sustainable development of urban historical areas through an active integration within towns. Brussels
Gajić R (2015) Urban morphology as a tool for exploring the land use in residential areas: example of New Belgrade. Spatium 33:76–83
Gligorijević Ž, Graovac A (2017) Kako do kvalitetnog urbanističkog plana po meri lokalne samouprave. Osnove i preporuke za unapređenje pripreme urbanističkih planova. Stalna konferencija gradova i opština, Beograd
Habraken NJ (2009) On designing, inhabitation, and morphology. Urban Morphology 13(2):131–133
Hall T (2013) The potential influence of urban morphology on planning practice. Urban Morphol 17(1):54–55
Hall T (2008) The form-based development plan: bridging the gap between theory and practice in urban morphology. Urban Morphol 12(2):77–95
ICOMOS: The world heritage list: filling the gaps-an action plan for the future (Paris) (2004)
ICOMOS: charter for the conservation of historic towns and urban areas (Washington) (1987)
Janković M, Zarić M (1970) Konjarnik—detaljni urbanistički plan. Urbanizam Beograda 6:14–15
Jovanović J (ed.) (2020) Atlas tipologije stanovanja. Stambena naselja, blokovi, grupacije, celine 1945–1990. Društvo arhitekata Beograda-Docomomo Srbija, Beograd
Jovanović J (ed.) (2018) Registar moderne arhitekture i urbanizma u Srbiji 1945–1990. Društvo arhitekata Beograda-Docomomo Srbija, Beograd
Kantarek A, Kwiatkowski K, Korbel W, Đokić V, Đorđević A, Niković A, Samuels I (2022) Mapping post-socialist changes in urban tissues. A comparative study of Belgrade and Krakow. Urban Morphology 26(1), 44–63
Kropf K (2006) Crisis in the typological process and the language of innovation and tradition. Urban Morphol 10(1):70–73
Kropf K (2011) Urbanism, politics and language: the role of urban morphology. Urban Morphol 15(2):157–162
Kropf K (2018) Plots, property and behaviour. Urban Morphol 22(1):5–14
Levy A (1999) Urban morphology and the problem of the modern urban fabric: some question for research. Urban Morphol 3(2):79–85
Maksimović S (1970) Rekonstrukcija XI i XII mesne zajednice na Vračaru. Urbanizam Beograda 6:8–10

Manić B, Crnčević T, Niković A (2011) Uloga zelenih površina u prostorno-funkcionalnoj koncepciji Bloka 23 u Beloj Crkvi. Arhitektura i Urbanizam 33:67–74
Marić I, Niković A, Manić B (2013) Enhancement of urban structure with the aim of reducing the impacts of climate change on the example of belgrade. In: Vujošević M, Milijić S (eds.). In: Proceedings of the 2nd International Scientific Conference 'Regional Development, Spatial Planning and Strategic Governance—RESPAG 2013', pp 823–851. IAUS, Beograd
Marić I, Niković A, Manić B (2010) Transformation of the New Belgrade urban tissue: filling the space instead of interpolation. Spatium 22:47–56
Marshall S, Çalişkan O (2011) A joint framework for urban morphology and design. Built Environ 37:409–426
Marušić D, Marušić M, Borovnica N (2018) Cerak Vinogradi Housing Estate, Belgrade, Serbia ("Flexible-plan" apartment diagrams, 1981). 1977–1987. Betonska utopija – arhitektura Jugoslavije 1948-1980, MOMA NewYork, Muzej moderne umetnosti, 2018–2019. https://www.moma.org/collection/works/221531, Last accessed 2022/6/15
McCormack A (2013) Informing and forming practice: the imperative of urban morphology. Urban Morphol 17(1):45–48
McGlynn S, Samuels I (2000) The funnel, the sieve and the template: towards an operational urban morphology. Urban Morphol 4(2):79–89
Mecanov D (2008) Tipologija oblika stambene arhitekture pedesetih godina XX veka u Beogradu. Nasleđe VIII, 129–153
Mecanov D (2009) Arhitektonski konkursi na Novom Beogradu od 1947. do 1970. godine. Nasleđe X, 113–140
Mecanov D (2010) Valorizacija arhitekture stambenih zgrada iz perioda moderne. Nasleđe XI, 79–101
Milašinović M (1971) Rekonstrukcija bloka u Ulici Vojislava Ilića. Urbanizam Beograda 12:8–10
Milenković B (1993) Pravila građenja. Edicija Arhitektonika, kolo A, sveska br. 1. Univerzitet u Beogradu-Arhitektonski fakultet, Beograd
Mišković J (1969) Detaljni urbanistički plan blokova 45 i 70 u Novom Beogradu. Urbanizam Beograda, 3:4–6
Mrduljaš M, Kulić V (2012) Unfinished Modernisations—Between Utopia and Pragmatism. Udruženje Hrvatskih Arhitekata, Zagreb
Nasser N (2013) The contemporary city: speaking the same language in design and theory. Urban Morphol 17(1):50–52
National Assembly of the Republic of Serbia—NARS: Zakon o kulturnom nasleđu [Law on Cultural Heritage]. Službeni glasnik RS [Official Gazette of the Republic of Serbia] 129/21 (2021a)
National Assembly of the Republic of Serbia—NARS: Zakon o planiranju i izgradnji [Law on Planning and Construction]. Službeni glasnik RS 72/09, 81/09, 64/10, 24/11, 121/12, 42/13, 50/13, 98/13, 132/14, 145/14, 83/18, 31/19, 37/19, 9/20 and 52/21(2021b)
National Assembly of the Republic of Serbia—NARS: Odluka o utvrđivanju Centralne zone Novog Beograda za prostorno kulturno-istorijsku celinu (blokovi 21, 22, 23, 24, 25, 26, 28, 29 i 30). Službeni glasnik RS 6/21 (2021c)
National Assembly of the Republic of Serbia—NARS: Odluka o utvrđivanju naselja Cerak—Vinogradi (Cerak 1 i Cerak 2) u Beogradu za prostornu kulturno-istorijsku celinu. Službeni glasnik RS 4/19 (2019a)
National Assembly of the Republic of Serbia—NARS: Strategija održivog urbanog razvoja Republike Srbije do 2030. godine [Sustainable Urban Development Strategy of the Republic of Serbia until 2030]. Službeni glasnik RS 47/19 (2019b)
National Assembly of the Republic of Serbia—NARS: Zakon o kulturnim dobrima [Law on Cultural Assets]. Službeni glasnik RS 71/94 (1994)
Niković A, Manić B (2021) Prostorna dimenzija zaštite kulturnog nasleđa u Srbiji: prilog unapređenju institucionalnog i pravnog okvira. In: Mrlješ, R. (ed.) XI naučnostručna konferencija „Graditeljsko nasleđe i urbanizam", pp. 346–359. Zavod za zaštitu spomenika kulture grada Beograda, Beograd

Niković A, Manić B (2018) The possibilites of introducing of form concept into the urban planning in Serbia. Spatium 40:18–24
Niković A, Manić B, Đokić V, Roter Blagojević M (2016) Contemporary architectural and urban design practice in Belgrade and Serbia through the perspective of urban morphology approach. In: Nencini D (ed) City as organism. New visions for urban life. vol. 2, 22nd International Seminar on Urban Form, Conference Proceedings, pp 1561–1566. Sapienza University of Rome, Faculty of Architecture, Rome
Niković A, Manić B, Maruna M (2015) Savremena arhitektonska praksa: institucionalni okvir i pravila građenja. Arhitektura i Urbanizam 40:66–70
Niković A, Đokić V, Manić B (2014) The morphological dimension of planning documents: case study Belgrade, capital of Serbia. In: Oliveira V, Pinho P, Batista L, Patatas T, Monteiro C (eds.) In: Our Common Future in Urban Morphology. 21st International Seminar on Urban Form, pp. 1568–1577. FEUP, Porto
Niković A, Marić I, Manić B (2013) Mogućnosti primene mera prilagođavanja klimatskim promenama pri projektovanju i planiranju užeg centra Beograda i integrisanja u strategije održivog razvoja. In: Dimitrijević, B., Pucar, M., Marić, I. (eds.) Klimatske promene i izgrađeni prostor. Politika i praksa u Škotskoj i Srbiji, pp 368–390. IAUS, Beograd
Niković A, Manić B (2011) Principi izgradnje novog urbanog bloka na primeru naselja Bela Crkva. Savrem Graditelj 7:38–48
O'Connell D (2013) Morphology and design: the developing dialogue. Urban Morphol 17(1):52–53
Oliveira V (2006) The morphological dimension of municipal plans. Urban Morphol 10(2):79–89
Perović, M.: Iskustva prošlosti. Građevinska knjiga, Beograd (2008).
Petričić B (1969) Izgrađeni stambeni blokovi 1 i 2 u Novom Beogradu. Urban Beogr 2:14–16
Regionalni zavod za zaštitu spomenika kulture Smederevo: Uslovi čuvanja, održavanja i korišćenja i mere zaštite nepokretnih kulturnih dobara i dobara koja uživaju prethodnu zaštitu za izradu Plana generalne regulacije 'Požarevac 4' (2016)
Republic Institute for the Protection of Cultural Monuments of Serbia (RIPCMS): Nepokretna kulturna dobra http://www.heritage.gov.rs/ cirilica/nepokretna_kulturna_dobra.php, Last accessed 2021/6/15
Rodwell D (2009) Urban morphology, historic urban landscapes and the management of historic cities. Urban Morphol 13(1):78–79
Samuels I (2010) Understanding place. Urban Morphol 14(2):121–123
Sjöholm J, Hidman E (2020) Urban conservation and urban morphology in Kiruna. Sweden. Urban Morphol 24(2):167–183
Stierli M, Kulić V (2018) Toward a concrete utopia architecture in yugoslavia, 1948–1980 Jul 15, 2018–Jan 13, 2019 [exhibition] MoMA https://www.moma.org/calendar/exhibitions/3931, last accessed 2022/6/15
Stojanović B, Stjepanović A (1995) X mesna zajednica 'Janko Lisjak'—Vračar. Arhitektura i Urbanizam 2:71–74
Svoboda J, Milašinović M, Zarić M (1969) Prostorno planiranje i građenje u Donjem Zemunu, sa prikazom detaljnih urbanističkih planova I i IV mesne zajednice. Urbanizam Beograda 2:2–7
Tieben H (2011) Review article: cities and design rules: an architect's approach. Urban Morphol 15(2):163–167
UNESCO: Recommendation on the Historic Urban Landscape (Vienna) (2011)
UNESCO: Convention concerning the protection of the world cultural and natural heritage (Paris) (1972)
Vesković I, Jovanović J (2018) Izgradnja blokova 21, 22, 23 centralne zone Novog Beograda i njihov značaj u okviru kulturnog nasleđa Beograda. Nasleđe XIX, 35–51
Vuksanović-Macura Z, Banković A (2018) Urbanistički planovi gradova u Srbiji: pitanje statusa kulturnog dobra. In: Jevtić, A. and Drašković, B. (eds.) 14. Letnja škola urbanizma Beograd, Bijeljina, pp. 81–90. Udruženje urbanista Srbije, Beograd
Whitehand J (2015a) Conservation, heritage and urban morphology. Urban Morphol 19(2):115–116
Whitehand J (2015b) Seeking an integrated approach to urban form: tasks ahead. Urban Morphol 19(1):3–4

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 32
Regenerative Learning Architecture. The School Campus of Vimercate as a Unit of Urban Morphology

Laura Anna Pezzetti and Helen Khanamiryan

Abstract Over the past decade, the need for innovation in school buildings has emerged globally. While schools are supposedly seen as pivots of districts' fabric and community life, insufficient theoretical explorations and design strategies have been devoted to *learning architecture* and its urban role. Innovation focusses merely on indoor environment in terms of learning zoning, modular furniture and flexible classroom settings in relation to new teaching forms and digital technologies. Rooted in the tradition of Italian urban studies, the paper discusses one research by design reframing innovation challenges from the indeterminate concept of environment to the language and themes of architectural space in the framework of the comprehensive concepts of learning and *regenerative architecture*. The case of the dilapidated Vimercate High Schools Campus, Italy, is a far-sighted take on the crucial theme of the redevelopment of a 1970s school campus that constitutes an extra-urban morphological region as wide as the town's medieval centre. Under the conceptual instrumentation of *regenerative architecture*, the research has inverted the traditional idea of the school as a self-contained citadel making the complex a potential cultural pole strategically located at the intersection between historical and rural landscape circuits. By defining precise themes and techniques of *rewriting,* learning spaces have been reshaped in analogy with urban form types and landscape, establishing porosity degrees with the surrounding urban structure, introducing functional promiscuity of activities between the town and the educational enclosure, reshaping learning environments as architectural *space-places* and finally designing new spatial concepts to guide the actions of the public administration.

Keywords School architecture design · Regenerative learning architecture · Rewriting adaptive reuse

L. Anna Pezzetti (✉) · H. Khanamiryan
Politecnico Di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy
e-mail: laura.pezzetti@polimi.it

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_32

32.1 Redefining Innovation and Urban Issues in School Buildings

Over the past decade, the need for innovation in school buildings has gained global attention. Taking Italy as an example, the recent data from the Italian Ministry of Education (MIUR) indicates a school building stock comprising 40,151 active buildings managed by local governments. Of these, approximately 22,000 were built before the 1970s, 1,500 date back to the nineteenth century and around 30% have been adapted from other functions (MIUR 2020). They are generally outdated, rigid in layout, poor in facilities, unsafe in terms of statics and fire prevention, and energy consuming.

Besides, the development of ICT technologies has introduced new learning modalities that have begun to change educational methods, leading to the "unstructuring" of both the classroom and the school as a whole (Borri 2018 and OECD 2011).

In specialised literature, innovation focusses merely on the correspondence between educational programmes and learning zoning, indoor environment and furniture layout in relation to new teaching forms and digital technologies. The building is treated as a "functional container" adorned by extrinsic aesthetic qualities, to be characterised by fluid layouts, modular furniture and flexible settings.

The Danish SKUB "school of the future" (1998–2009) is mostly associated either to concepts such as flexibility and modularity of learning spaces, which are no longer identified with stable classrooms (such as the Vittra School Telefonplan by European Schoolnet, 2011), or to the specific spatial possibility of the open plan (as in the Ørestad Gymnasium, 2007). The former model recalls the 1970s concept of the building as an undefined "container" and leads to a modular spatial flexibility qualified by zoning activities through innovative furniture layouts. However, this approach lacks the narrativity inherent in a structured architectural space and its defining character, thereby forfeiting the potential of architectural language as a "third teacher" (Malaguzzi 1995) in terms of symbolism, metaphors and experience of aesthetic knowledge. In turn, the latter model assumes one single possibility among all architectural types, namely the open plan, as a spatial ideology derived from unfiltered translations from mainstream pedagogical requirements and the unstructuring potential introduced by digital technologies.

It should be noted, though, that schools, as public buildings, are in fact cultural manifestations of a given society and heritage of local communities. As their life cycle is longer than changing pedagogical models, the issue of innovation in architecture cannot be confined to the translation of any specific approach. Instead, architectural research should explore spatial conditions that are flexible enough to respond to continuous changes in education (Hertzberger 2008) while remaining grounded in enduring themes and spaces (Pezzetti 2019).

In Italy, the MIUR *Guidelines* (2013) have introduced a new performance concept without, however, defining related dimensional indexes and design principles, which are, therefore, contradictory referred to the more than outdated dimensions and standards reported in the Ministerial Decree of 18 December 1975, still in force (MIUR

1975). In general, the pedagogical approach is aimed at defusing the inertial mechanisms of "transmissive teaching" through flexible classroom settings in order to carry out different activities, TEAL classrooms, new active uses of halls and corridors that still perform the mere function of circulation.

The role of space as "third teacher" makes it clear that the current emphasis on "innovative furniture" is misleading if the architectural qualities of schools' spaces remain poor and conventional. Remarkably, as Ernesto Rogers stated in 1947, "the problems of education cannot be accomplished without a *learning architecture*" (Rogers 1947). If existing conditions limit pedagogical innovation in learning spaces in terms of furnishings, this approach appears extremely reductive whether in refurbishment, redevelopment, or new construction. Besides, the mechanical identification of innovation and collaborative learning with an informal open plan focussed on new technologies and "innovative furnishings" poses further problems with respect to the meanings and symbolisms associated to the structuring language of architectural space.

If the boundaries among the various areas of the school are blurred, spaces lose their distinctive architectural character, the potential of tactile and dynamic exploration of physical space and the boundaries between individual and collective space. As observed by Hertzberger (2008), when learning spaces become indefinite environments there is not much left to explore, exchange or recognise.

However, since form and thought are interconnected, when flexibility is trivially associated with modularity and, above all, when the open plan is taken as a pedagogical ideology, the learning space tends to reflect the informal and dissolutive character of contemporary liquid society and its non-places described by Marc Augé (2008).

In fact, while architecture is a language, the vague and indeterminate concept of environment is not (Pezzetti 2019). Modularity and open plan are easy shortcuts compared to the design research for formal configurations that allow students to recognise and experience different architectural *space-places* and degrees of responsibility, while exploring the possibilities of self-learning.

Typological experimentation and architectural themes allow, instead, to develop new structuring principles to which innovative organisations of the classroom-*home base* and the different space units can be subordinated, thus preserving a sense of unity and identity for the entire school community.

Recently, the outbreak of Covid 19 pandemic has added unprecedented risks to students' education and well-being (UNESCO et al. 2020). The lockdown has also emphasised the inadequacy of existing building stocks while calling for an unpredictable *social distancing* and health requirements in buildings. These new requirements in turn need to be included in the design project and "translated" architecturally while exploring the previous renovation issues through new parameters and ideas, calling for a revival of interest and new conception in outdoor educational spaces (Pezzetti and Khanamiryan 2019).

A key issue for future designs is to consider health not only as the absence of disease and safety but as integral to a comprehensive idea of physical, mental and social well-being (Health City Institute 2020). The lockdown has emphasised that the school is a physical realm of learning spaces influencing cognitive, emotional

and affective relationships that cannot be replaced by distance learning technologies. As the "third teacher", space also plays a crucial role in the health, well-being and behavioural characteristics of individuals. It creates pre-conditions that might either enhance or impede learning outcomes (OECD 2010). Indeed, the aesthetic qualities of this physical realm are even desirable learning outcomes in themselves.

On the one hand, there is a need to translate jointly innovation, health, and well-being into spatial themes and strategies in a fruitful dialogue between pedagogy and architecture.

On the other hand, the role of the school building should be no longer confined to the educational function, and rather increasingly conceived in relation to its opening to the city. Educational institutions provide facilities that are critical to urban design (such as auditorium, library, gym and recreational facilities) and closely relate to community development, revitalisation and regeneration (Haar 2003).

Following the MIUR *Guidelines* (2013) and *Futura. Building and Designing the School* (2022), the concept of school is no longer defined as a self-contained institution but as part of the city open to the community and in synergy with the urban structure.

After all, the concept of the school as a civic centre integrating facilities for the whole community beyond the teaching hours is not a new concept in architecture. Openness and consolidation of multiple functions were intrinsic properties since the early types of Greek and Roman Gymnasiums. They found new interpretations in the Italian architecture of the 1970s-1980s, especially in the schools conceived as civic-cultural centres by Guido Canella (1965) and Carlo Aymonino (1980, 1988) acting as new functional and representative cores in the new anonymous suburbs.

Today the major challenge largely concerns existing structures. The relationships between the school and the context with its historical-morphological and landscape peculiarities is, therefore, crucial. This calls for a *learning architecture* intended as research by design that reopens questions of meaning in architectural forms. Innovation challenges become more complex when generic concepts of innovation face the constraints of a pre-existing structure and a real context. Besides, while the challenge of new schools concerns a few hundred buildings in Italy, the innovation and enhancement of existing schools concern thousands of buildings that cannot be replaced but must be renewed, modified and retrofitted without interrupting their use.

The paper presents one research by design funded by the Provincial Government of Monza and Brianza, Italy, critically facing the challenges of innovation, renewal and well-being by exploring the concept of "learning architecture" and integrating urban themes.

Besides, in the framework of a comprehensive concept of *regenerative architecture* the isolated campus-like Schools Campus of Vimercate has been investigated and redesigned "in form of the city" and reincorporated into civic life. Going beyond the dimension of the single building and of indoor learning zones, redevelopment and innovation becomes a matter of "architectural rewriting" in relation to the pre-existing order, stressing the dialectic between resilience and modification of the already built morphology as a primary component of sustainability.

Under the conceptual instrumentation of *regenerative architecture*, the research has defined precise themes and techniques of rewriting to reshape learning spaces in relation to urban form and landscape, establishing porosity degrees with the surrounding urban structure, introducing functional promiscuity of activities between the town and the learning enclosure, reshaping learning environments as *space-places* and finally designing new spatial concepts to guide the actions of the public administration.

The school is a place where students are introduced to the world. As an inspiring metaphor, the self-contained campus is redesigned in analogy with the city, forming an interlaced network of architectural spaces that stimulate the value of relationships and sense belonging. The inventory of urban *loci* and their spatial character are seen as opportunities for various kinds of learning and recreational spaces as well as different degrees of quietness, porosity and sharing with the community: neighbourhoods (the clusters of individual schools); squares, courtyards and gardens (the patios at different scales and hierarchical positions); urban interiors (the collective spaces); and private homes (the home-base classrooms) that stimulate the sense of belonging.

Within this urban-like strategy as an inventive adaptation to existing conditions, the grafting of a variety of *learning space-places* (Pezzetti 2019) interprets innovation issues beyond furniture layouts and flexible environments, under the concept of *learning architecture.*

32.2 The Case Study: The Vimercate High Schools Complex

The case study is the vast Vimercate's Omnicomprensivo, a suburban "campus-like" high school complex that constitutes a morphological region as large as the town's medieval centre, although deprived of its architectural quality and variety (Figs. 32.1c, 32.4).

The mega-school campus represents a typical reality of the 1970s-80s, when large or various schools were grouped within large sites that were necessarily located in suburban areas, far from the city core and on the edge of the peripheral neighbourhoods as well. Due to the demographic growth and socio-economic development of the town in the 1960s, the municipality of Vimercate initiated the ambitious design of an innovative mega-school campus in 1974–1975, i.e. in conjunction with the new National Legislation 18/12/1975 for school buildings.

The campus was originally designed for two sections of one school for 1,800 students, on 26,915 square metres and with a ratio of 16,04 square metres per student. Today it gathers four high schools (Banfi, Vanoni, Einstein and Floriani) ranging from "Licei" (high schools) to Technical Institutes, for a total of about 4,500 students. As a result, classrooms are currently resized in a completely uneven and inadequate way while shared spaces and facilities have been turned into classrooms. Today, the Vimercate schools complex represents a paradigm of the largest stock of

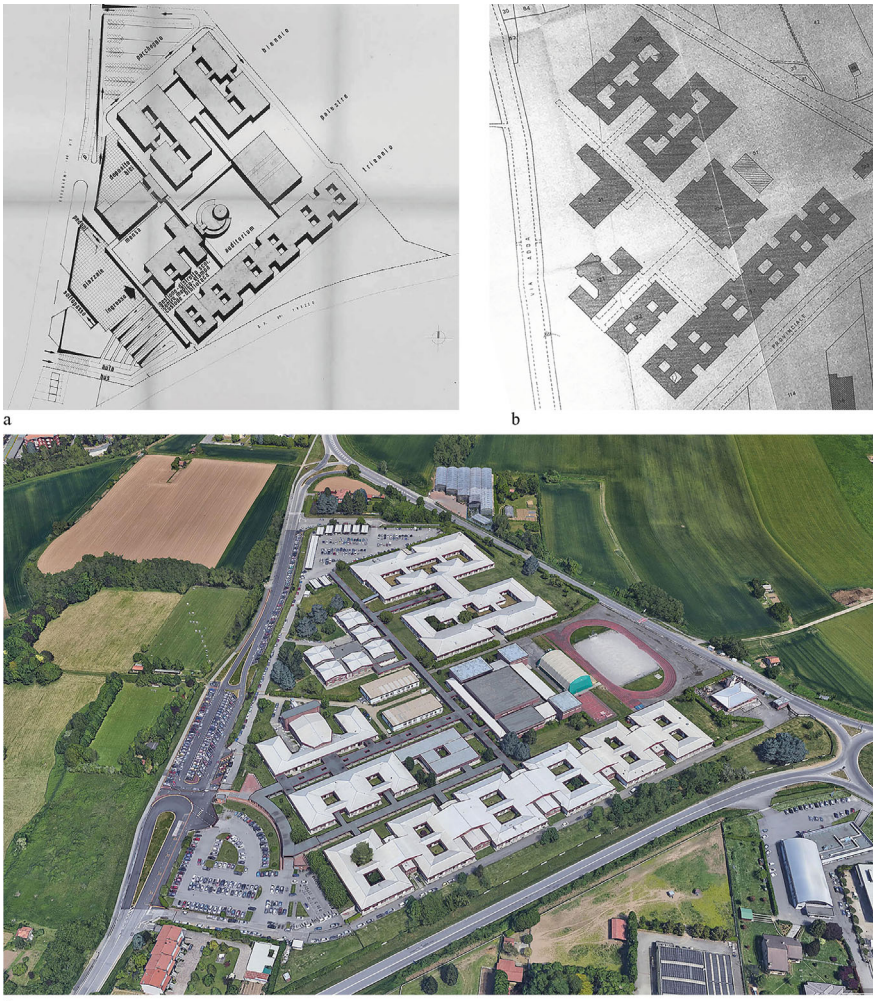


Fig. 32.1 Vimercate High Schools Complex: **a** First project 1974–75, **b** Second project 1975–76 (by Monza and Brianza Provincial Government); c. Current state, aerial view (by the authors)

Italian school buildings built in the 1970s-80s, affected by major problems of overcrowding, inadequacy and dilapidation of spatial quality, lack of facilities, security issues, energy consumption and seismic vulnerability.

Because of its remarkable size, the campus was located outside the town in an area of about 100,000 square metres forming a self-contained island among farmlands cut out of infrastructures (see the historic section in 1954, Flight GAI) that remained separated from the city by the North-East PANE Local Park (PLIS), on one side, and the farmlands opening the view towards the Pre-Alps on the other (Fig. 32.7). For this reason, the campus adopted a single-storey layout.

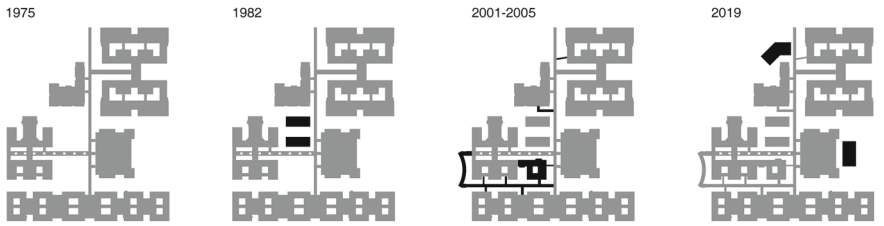


Fig. 32.2 The typological process from 1975 to 2019 (by the authors)

The mega-school campus concept defined an "anti-city" isolated from the urban reality while defining a morphology as large as the historic town.

Designed orthogonally to the main road Isola Cerisola, the layout contradicted the ancient rural structure inherited from the Roman centuriation. Moreover, the layout interrupted an ancient route (see the Cadastre of Charles VI) that linked Vimercate's historic nucleus to the village of Bellusco. This route still exists today outside the schools complex enclosure and, as we will see, holds a special interest for our design.

The first project (1974, arch. Diego Malvezzi) presented a clearer layout than the built one. The system focussed on a central sequence of collective facilities (entrance square, library, auditorium, gymnasium) and the circulation canopy was framing enclosures rather than fragmenting space (Fig. 32.1a).

In 1975, the layout was banalised and the sequence of collective facilities disappeared, and the canopies became mere circulation pathways fragmenting the green areas (Fig. 32.1b). In 1978, the school complex appeared substantially completed.

Despite the poor and dull prefabricated architecture, the original plans in the Provincial archives show an ambitious project from the point of view of the richness of cultural, sports and leisure facilities and a wealth of ateliers, which unfortunately were gradually dismantled to be replaced by new classrooms when the campus came to be shared by four schools (Fig. 32.3).

In the typological process map (Fig. 32.2), the campus development was reconstructed. Two containers-like blocks for provisional classrooms, still in use today, were then added in 1982. Later, between 2001 and 2005, the entrance hemicycle canopy was added resulting in a useless bottleneck entrance, impossible to be managed (Fig. 1c). Besides, the entrance square was not executed while the central lawn was also compromised by the coeval construction of a new building. Since 2019, a new building has been in construction, adding a separate and banal classroom-corridor space.

32.2.1 The Functional Structure of the High School Complex

The buildings of the Ommicomprensivo are typically prefabricated and anonymous structures, which modular dull layout anaesthetises any sense of belonging.

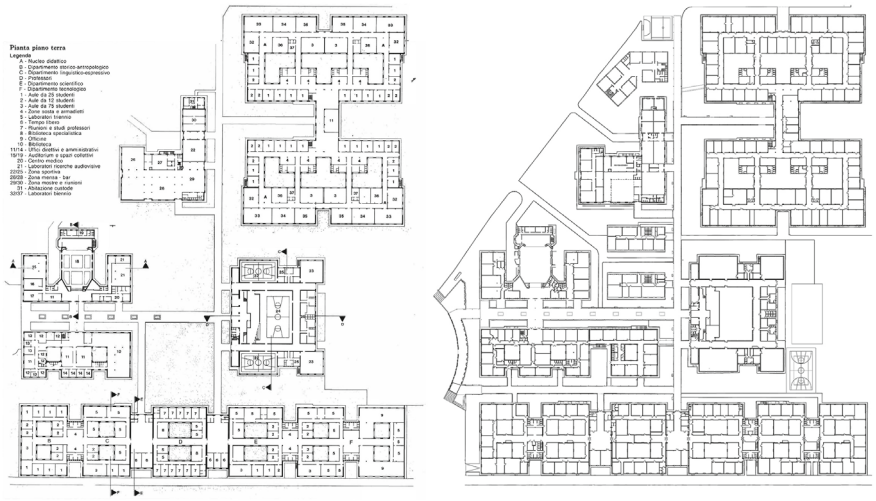


Fig. 32.3 The Omnicomprensivo's High Schools Campus layout in 1975 and in 2022 (drawn by the authors)

Fig. 32.4 Contrast between the urban form, scale, structure and morphology shaped by historic courtyard types in the centre of Vimercate and those produced by the Onmicomprensivo Campus (drawn by the authors)

Mapping highlighted the contrast in urban form, scale and composition between the rich composite urban morphology organised by the Vimercate historic courtyard types along the Roman axes and the rigid layout of the Campus produced by the unrelated serial patio buildings and stiffened by the covered canopies (Fig. 32.4).

Besides, the erosion of originally shared facilities (library, canteen, meeting rooms, ateliers) caused by the increased number of schools and classrooms, the usage of hallways and patios merely limited to circulation and lighting respectively,

discourage any social interaction (Figs. 32.9, 32.10, 32.12a). There is a limited sense that students are valued or that in turn, they should value the school environment.

Besides, the absence of a welcoming multifunctional hall for each school makes it impossible to guard the only entrance (Fig. 32.12a). Consequently, illegal activities and vandalism take place during school hours.

Moreover, the single school spaces are dispersed and fragmented throughout the complex. The identity of each school is confused and none of them takes care of outdoor spaces with the consequence that their usage is admittedly prevented.

Today, the Omnicomprensivo suffers from both a quantitative and a qualitative point of view, especially in terms of collective facilities, design of spaces, non-standard components, inefficient systems and energy saving.

Compared to the original project, in fact, all the shared spaces such as libraries, meeting rooms, cafeteria and canteen, have been dismantled over time and transformed into classrooms. The corridors, holding merely a circulation role, are often dimensionally inadequate (even under the standard) and dark, even for the 1975 Legislation; patios are inaccessible and devoid of character and use; green areas lack fittings and equipment (Figs. 32.9, 32.10).

Students and teachers have no spaces outside the teaching classroom: there are no facilities for study, informal or association activities, no organised and accessible spaces for outdoor activities, no adequate libraries, reference and reading rooms, no meeting spaces other than the rigid structure of the auditorium.

32.3 Design Methodology as a Rewriting Technique

The role of school buildings is no longer confined to the educational function as it provide facilities such as auditorium, library, gyms that are critical to urban design and community needs. The redevelopment study is aimed at verifying the modes of opening the school to the territory, the possibility of expansion and innovation of the educational spaces and the architectural redevelopment of the entire complex in a balance between improvement of existing buildings and transformation of the current layout. In addition, the redevelopment strategy aimed to solve the current fragmentation of the schools, scattered within the campus, and increase the standards and quality of indoor spaces while ensuring educational continuity by partitioning the project in subsequent execution lots.

In a *regenerative architecture* approach, the design tried to stress the resilience of the already built morphology as a primary component of sustainability, making use of circumscribed demolitions in favour of a "rewriting" technique practised in relation to the pre-existing *built text* and order.

Rather than making a tabula rasa and reconstructing, the *rewriting* strategy means writing onto an already-written text, which in this case takes the form of a "re-morphologisation". The design rewriting is therefore defined as a new inscription and stratification of signs connected by formal and sense relationships based on the

reading and interpretation of structures inherited from the previous text and on the overwriting dictated by new plausible principles (Pezzetti 2020).

By rewriting, the project gives shape to the school as a place of relationships that is richly articulated, culturally vibrant and endowed with thematic and equipped *space-places* to be discovered along the pathways and various interconnected shared spaces and patios. The new morphology is defined through operations of collaging, grafting, inserting and partial erasures, which altogether form the rewriting technique. Grafting and collaging worked on the texture of the existing space making it articulated and selectively porous from the outside. The campus thus absorbs energy from the outside, that is, from the city, and from the inside, that is, from the learning community.

By reading jointly the existent settlement structure and school complex layout, the grafting points of the new constructions, the joints and thinning are selected in a way consistent with the existing structure. The proposed interventions reshape the rigid morphology revealing unprecedented spatial potential, capable of co-evolving with the learning community. Besides, the school is shaped in analogy with the places of the city: its neighbourhoods (the clusters of individual schools); its squares, courtyards and gardens (the Green Ring and patios at different scales and hierarchical positions); its urban interiors (the collective spaces); and the more "private" spaces (the home-base classrooms and labs) that stimulate the sense of relationship and belonging.

32.3.1 Reading the Settlement's Structure. From the Isolated Campus to a Learning Landscape

The school campus design was conceived as an "anti-city" and was not meant to be integrated into the urban morphology. Besides the stream, Taro and the PANE Park constituted so far further elements of discontinuity. Yet, for a school complex to be part of the city it must be included in its system of urban landscape relations.

The reading of the settlement's structure indicated some underlying topographical signs and urban facts that could be used to turn the present condition of isolation into a potential. Reactivating some potential historic routes and traces, the school complex in Via Adda could be reconsidered in its potential as a cultural pole, strategically located at the intersection between a "historical urban circuit" and a potential "landscape circuit" (Fig. 32.7).

The "historical urban circuit" (Fig. 32.6) is identified in the old commercial route that connected the *vicus vimercatese* with Trezzo d'Adda, which corresponds to the ancient east–west axis (*decumanus*) of the Roman *castrum* that passed by the Roman bridge (III-IV century AD) on whose stones the San Rocco Bridge was rebuilt in the Middle Ages (Vergani 2005), continuing into the village on the grounds of the current Via Cavour. From the Roman town and along the north–south Roman axis (*cardo*), the urban circuit turns north along the current Via Garibaldi, once the perimeter of the first Medieval Wall (XI-XV century) and then a road (cf. Cadastre of Charles

VI). Bypassing the Molgora stream, the route crosses the Territorial Agricultural Park PANE and finally reaches the Omnicomprensivo, where it reconnects to the southern section of the circuit through the Via Adda. Along this circuit, in particular, its southern section corresponding to the Roman *decumanus,* lies the greatest density of heritage and cultural buildings.

The cartographic elaborations developed within this study show the diachronic and synchronic historical evolution of the city and the countryside (Fig. 32.5), up to the settlement of the campus that today constitutes a possible hinge between these two realities. We can observe the permanencies of ancient Roman and medieval routes as well as the correspondence via Adda to the centuriation trace parallel to the Cardo.

The route that forks into the park corresponds in turn to another old territorial route recorded by the Cadastral Map of Charles VI, and interrupted by the construction of the Omnicomprensivo. The "landscape circuit" corresponds to its continuation through the diagonal axis (*line of force*) introduced by the project intercepting the Agricultural Park PANE and opening the view towards the farmlands and the Pre-Alps. The structure of the farmlands offers a landscape texture of great value. Counterpointed by historic farmhouses, it still bears the structure of the Roman Centuriation and enjoys a tradition of villas and rustic farmhouses dating back to the Roman age and late antiquity (Sacchi 2011).

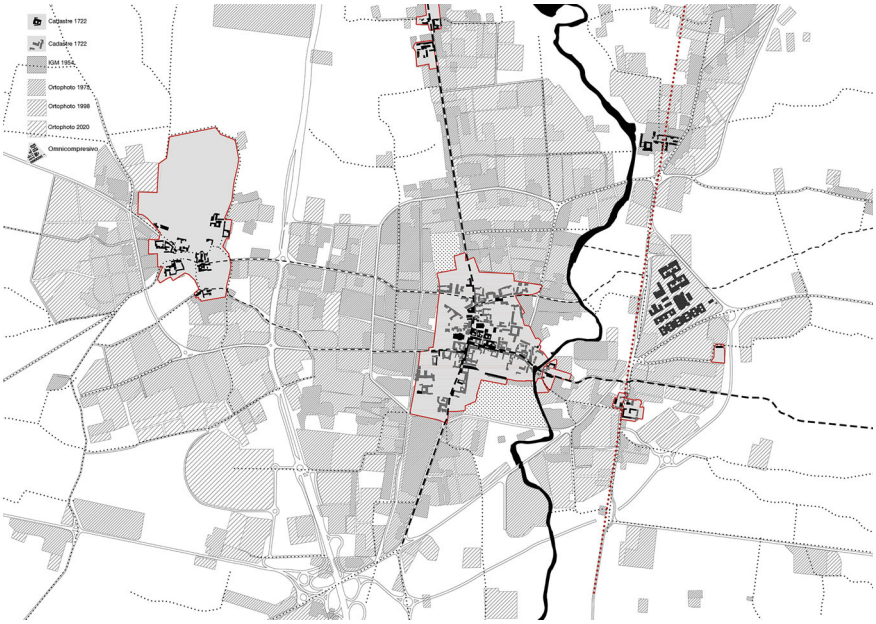


Fig. 32.5 The Omnicomprensivo High Schools Complex in the Vimercate urban development, according to six ascertained historic sections, and main historic axes (Cardo and Decumanus, medieval territorial routes, centuriation trace corresponding to via Adda), (drawn by the authors)

Fig. 32.6 Mapping assets defining the Historic-Cultural Circuit and Landscape Circuit in relation to the urban routes and Omnicomprensivo's inner axes, (drawn by the authors)

The route through the PANE Park integrates the "lines of force" decoded by the design, establishing a connection between the campus and the routes of the Park, the cycle routes and all facilities inside the Omnicomprensivo that could be shared with the local community.

Students reach the school complex from both Vimercate and neighbouring municipalities: the locals commute either by bicycle or by car; the exteriors commute either by public transport or by car. The small scale of the settlement and the presence of the Agricultural Park along the Molgora stream suggest a system of potential Greenways that, through historical pathways and cycle-pedestrian routes, would connect the educational-cultural pole to the town of Vimercate and its territory, thus mitigating the problem of traffic congestion along Via Adda.

32.3.2 Defining Cruxes and Thematic Areas of Intervention

The layout of the campus equals in size the medieval historic centre of Vimercate. Therefore, it represents an autonomous piece of urban morphology, although its schematic uniformity, stiffened by the pervasive system of covered canopies and by the absence of spatial and functional articulation, does not possess the same richness of articulation and *space-places* that we find in the morphology of the city (Fig. 32.4).

In order to redefine the relationship of the campus to its surroundings, its identity within the neighbourhood and to innovate the quality of its learning spaces, it is necessary to act on some main cruxes, which configure as many scales and specific design themes.

The External Space of Relationship Between *Enclosure*, Town and Park

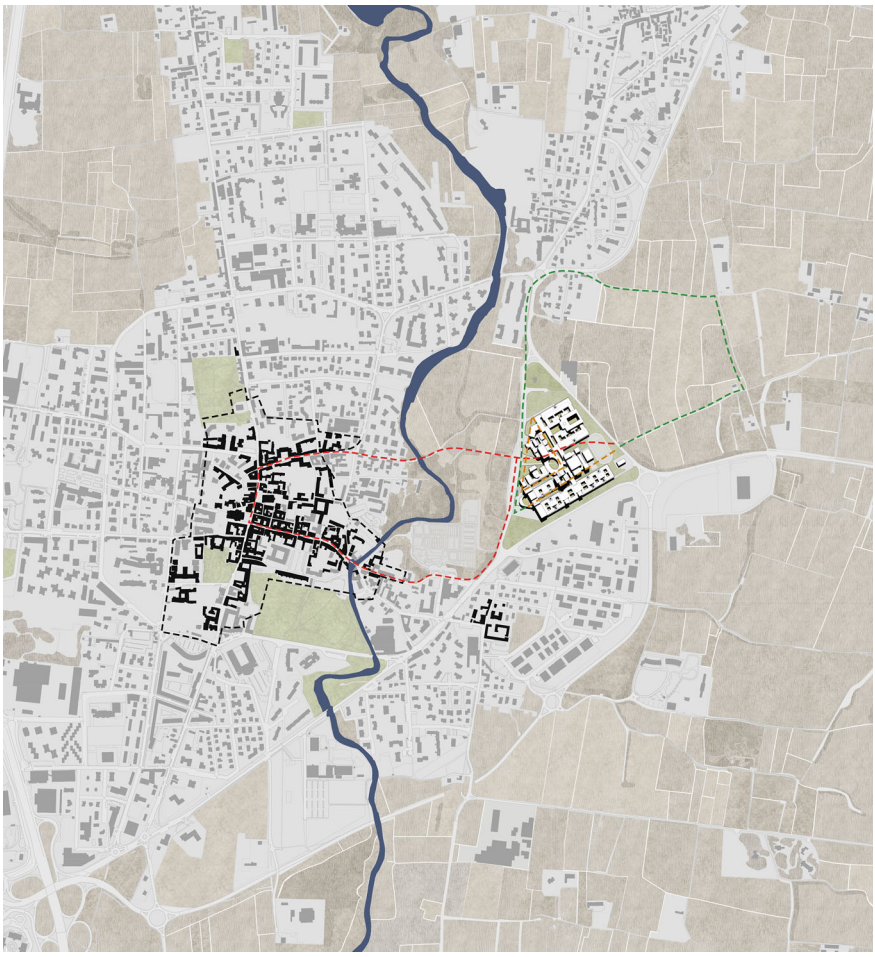


Fig. 32.7 The Omicomprensivo High Schools Campus as an urban hub at the intersection of the "historic urban circuit" and the "landscape circuit" (drawn by the authors)

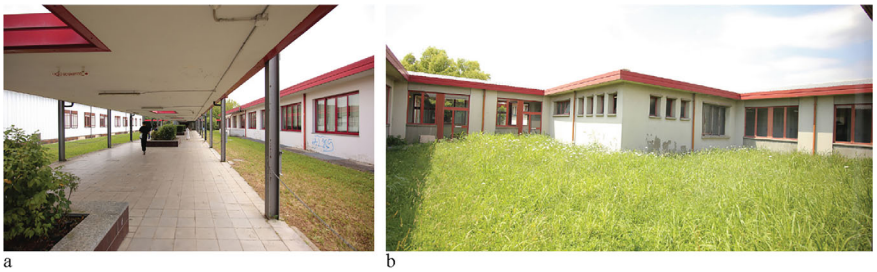
The external space of relationship among the enclosure of the school, the town and the PANE Park does not exist today.

On the one hand, there is the unmediated relation between school and road where the promiscuity of pedestrians, private cars, motorcycles, public transport and parking areas, together with the funnel of the single entrance determined by the bottleneck of the hemicycle, result into conditions of poor safety, exacerbated by the impossibility of guaranteeing adequate distancing today (Fig. 32.8a).

On the other hand, the presence of the incongruous hemicycle-corridor overlooking the parking lot determines a physical and perceptive barrier that lacks transitional spaces between public space and school enclosure as well as a proper relationship among school, city and landscape. Paradoxically, the absence of relationship

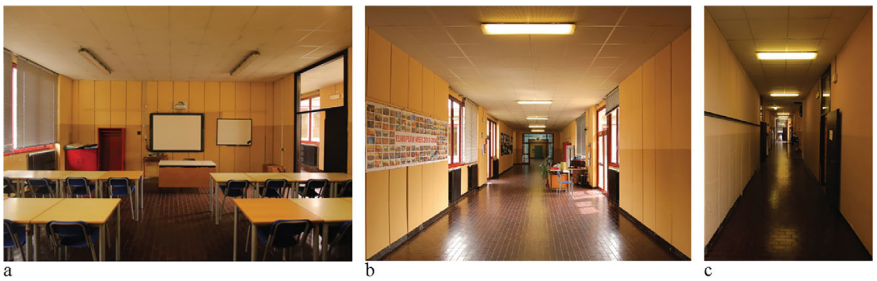
a b

Fig. 32.8 **a** The South entrance; **b** The auditorium on the left side and the gymnasium in the background (by the authors)



a b

Fig. 32.9 **a** Circulation canopies; **b** One of the green patios (pictures by the authors)



a b c

Fig. 32.10 **a** Typical classroom; **b**, **c** Circulation corridors (pictures by the authors)

with the world outside the school corresponds to a total impossibility of controlling access to the campus since the single entrance, directly connected to the hemicycle and from here to the internal canopies, lacks a filter such as the one provided by a manned and controlled hall. The gate remains open and unattended and over time there have been numerous episodes of illegality due to incursions from the outside, resulting in a widespread degradation and lack of safety.

Therefore, two orders of intervention emerge as necessary:

1. diversifying accesses to the four schools so that each corresponds to a multi-functional welcoming hall, which also addresses the request to guarantee a clear identity to each school;
2. locating before the entrances appropriate transitional spaces freed from parking lots and adequate in size (also for anti-pandemic purposes), that can be usefully equipped to offer safe spaces shared with the community.

The relationship with the context also requires site-specific urban design strategies for new hybrid socialisation spaces acting as the interface between the school enclosure, that must be safe and manned, and the new need of openness to the city and the life of the community.

The Hybrid Sharing Space Between the School and the Outside

The hybrid sharing space between the activities inside and outside the school enclosure, that is, with the community, is currently unidentifiable. This hybrid space is necessary to provide public access during extra-school hours to some facilities shared with the town that, in this case, are located deep inside the campus and cannot be used independently (Fig. 32.12b). In order to ensure usability and, at the same time, compartmentalised access from the outside to services such as the gyms, the auditorium and some of the new spaces introduced by the project, it is necessary to identify and structure pathways that selectively intersect the main outdoor and representative spaces of the Centre, which, in turn, must be accessible to the community at set times.

The Transition Space Between Indoor and Outdoor Environments

The transition space between indoor and outdoor environments (Fig. 32.9a) represents a problem that affects different areas: the lack of architectural quality; the solar shading of the façades for internal and external comfort as well as the energy consumption and energy performance of the envelope. Their integrated design solution would also allow imagining a new transitional space between the internal and external spaces of the patios and paths.

Green and Outdoor Spaces

The green and outdoor spaces are represented by the system of patios, courtyards and open spaces between buildings, now totally unused except as circulation areas (Fig. 32.9b). In addition, the absence of supervision at the entrance to the Complex prevents the safe use of open spaces that are, thus, inaccessible to students. Once reshaped, these spaces would become, instead, a decisive resource for redevelopment and spatial innovation also in relation to outdoor learning that helps increasing the perception of psychophysical well-being, the richness of learning experience and safety in times of pandemic.

Interior Spaces

The interior spaces are represented by the rigid system of classrooms and corridors that, over time, has eroded all the spaces of relationship, including the canteen, the

library and the ateliers. The need to increase the number or the size of classrooms has also invaded some portions of corridors (Fig. 32.12a).

The uneven dimensions of the classrooms (Figs. 32.10a, 32.12) due to subsequent functional adjustments make the distribution confused and the flexibility of use difficult. Social distancing has forced the use of laboratories as split classrooms while insufficient or improper size sometimes forces classroom settings with insufficient or back lighting. They also have partition walls in concrete slabs that have long become unstable. Classroom doors directly overlook the corridors (Fig. 32.10b, c), which are mere places of passage.

While the redevelopment must generally include some regulatory compliance (width of some classrooms and corridors, windows performance, solar screens, number of toilets), interior spaces should be reshaped in their connecting spaces and in the external landscape of courtyards, patios and garden, in order to obtain an articulated, varied and rich system of *space-places* suitable for stimulating innovative forms of teaching and learning, including informal spaces as well.

Schools are where students are introduced to the world. There should be no contradiction between the quality of behaviours and life principles that the school inspires and the message that the school environment projects.

"Architectural space is not only an active player in influencing learning and development but is also a constitutive element in the formation of thought and a specific tool of critical, cultural, and imaginative knowledge of reality. Organising learning space means organising the metaphor of knowledge" (Pezzetti 2020: 190).

32.4 The School *in Form of the City*: Rewriting and Innovating the Vimercate High Schools Complex

The "*school in form of the city*" has been postulated by the research as a strategy to renew existing complexes articulating the school layout by a variety of *learning space-places* in analogy to the *loci* of the city and exploring compositional techniques from architectural theories.

By rewriting the order of the existing layout, the design aims at breaking the rigidity of the campus layout while revealing unrealised potential and spatial themes (Figs. 32.11, 32.13). To reshape the campus' morphology the definition of connecting and shared spaces, with their innovative pedagogical role, is fundamental: halls, galleries, corridors, courtyards, patios and gardens, all form an interlaced network of internal and external rooms for recreation and learning. Along both new and renovated sequences of connecting spaces, courtyards and patios, the rewriting shapes a rich and articulated sequence of interior and exterior *space-places* (Fig. 32.13).

Fig. 32.11 Design Diagrams: **a** The design concept as a reinterpretation of the existing order; **b** The Green-Ring; **c** The "lines of force"; **d** The Axis of Ateliers (drawn by the authors)

Fig. 32.12 Functional distribution of interior spaces: **a** Current state; **b** Modifications introduced by the design (drawn by the authors)

32.4.1 Re-Centring, Re-Connecting, Re-Morphologising: Shaping Space-Places

The rewriting of a school complex of 4,500 peoples is a matter of re-morphologisation.

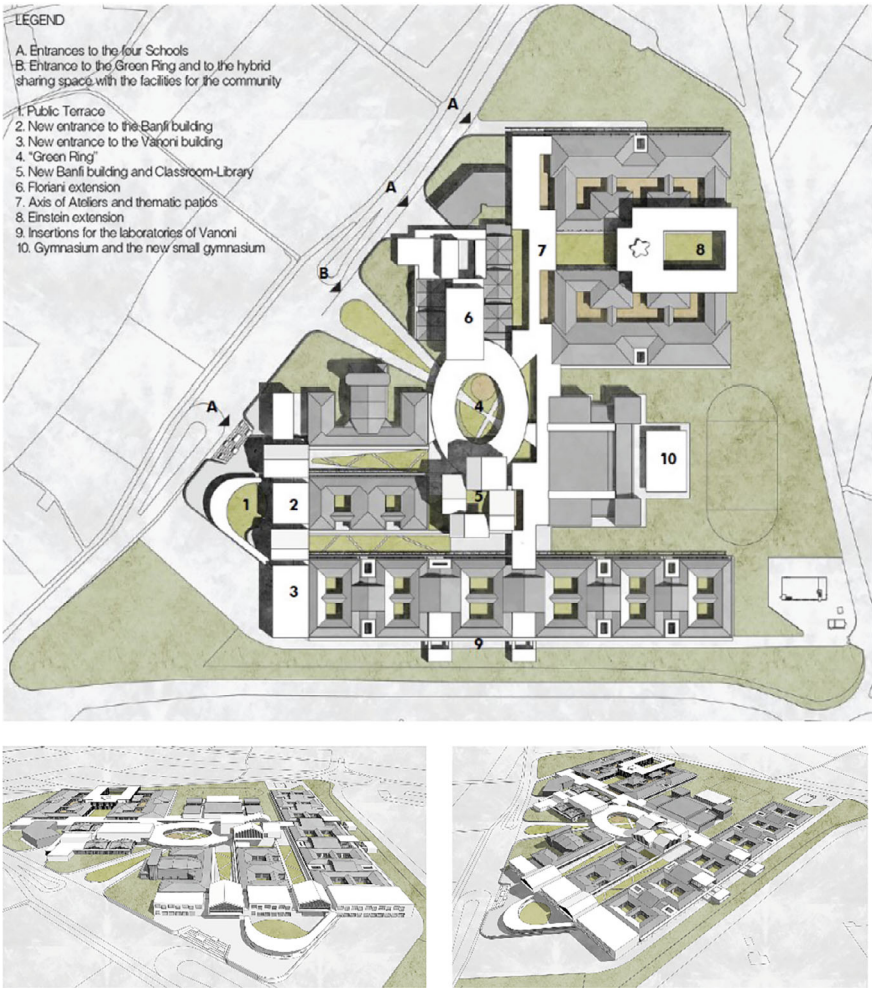


Fig. 32.13 Site plan and aerial views of the regeneration of the schools complex where the new buildings are marked in white (drawn by the authors)

The design worked first on the texture of the existing space, making it articulated and selectively porous, with respect to the outside. The campus thus absorbs energy from the outside, that is, from the town, and from the inside, that is, from the school community.

Regenerative architecture interprets the potential of the existing layout with respect to the place and its founding rules while identifying new "epicentres", *lines of force*, grafting or thinning points. By selecting the grafting points for the new buildings, the junctions between old and new, and the thinning of the fabric consistently with the existing structure, the design strategy reshapes the rigid morphology

of the Omnicomprensivo while revealing unprecedented spatial potential capable of co-evolving with the innovations required by the learning community.

Structured by pathways, courtyards and patios, the school becomes the pivot of relationships between the learning community and the city, culturally dynamic and rich in thematic *space-places*, both indoor and outdoor. Besides, the school complex is shaped in analogy with the places of the city: its neighbourhoods (the clusters of individual schools); its squares, courtyards and gardens (the patios at different scales and hierarchical positions); its urban interiors (the collective spaces); and private spaces (the classrooms) that stimulate the sense of relationship and belonging (Figs. 32.12, 32.13, 32.14, 32.15, 32.16).

In order to respond to the cruxes and the five main thematic areas of intervention, the design concept starts from the existing text and three founding principles.

Re-Centring the Layout—the Green Ring

The Green Ring is a neo-type. It corresponds to the principle of identifying a common centrality to the four clusters formed by the reorganisation of the schools into well-identified buildings and at the same time maintaining this centre as a green void, free from built elements (Fig. 32.11b). It frees the centre occupied by the temporary

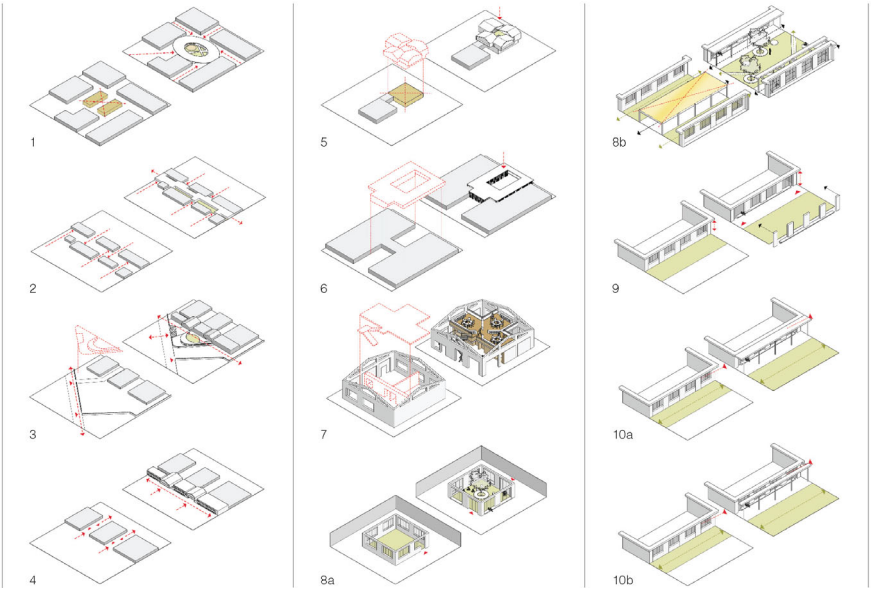


Fig. 32.14 Diagrams of the Rewriting Strategies: 1. Centralisation of the layout; 2. Interconnection of buildings; 3. School-city connection; 4. Addition of buildings; 5. Grafting of solids; 6. Overlaps; 7. Insertion; 8a. Reactivation of patios; 8b. Reactivation of outdoor spaces; 9. Redevelopment and retrofitting of the façade; 10a, 10b. Diaphragms and shading devices according to orientation (drawn by the authors)

a b

Fig. 32.15 The Green Ring, or the epicentre of pathways and relationships, onto which the classroom-library projects. Flexible classrooms, spaces for civic associations and a cafeteria are placed around this green heart (by the authors); **a** Main entrance to the Schools Complex raised on a public terrace; **b** The main "historic" axis leads to the auditorium, the Green Ring and the gym (drawn by the authors)

containers and rediscovers in a certain way the centrality envisaged by the first project (1974).

The Green Ring identifies the elliptical epicentre from which the relationships and energies of the campus unfold. It is the beating heart of school life and the representative place of the whole school complex where all the connecting paths converge, the two new buildings overlook and give access to the deck on its walkable roof and to the classroom-library, and where the connection with the Axis of Ateliers is established (Fig. 32.15). Moreover, it offers a cafeteria connected to the auditorium and various rooms that, through movable walls, can be shaped according to the required activities and capacity. These spaces are shared by the four Schools as well as by the city associations in order to guard the areas accessible to the public while extending the life of the campus beyond school hours (Fig. 32.15a, b).

Re-Connecting and Identifying the Parts—the "Lines of Force"

The Green Ring radiates a field of relationships towards all parts of the complex that, through the proposed design rewriting, acquire a strong identity while, at the same time, participating in the new cohesion of the whole complex.

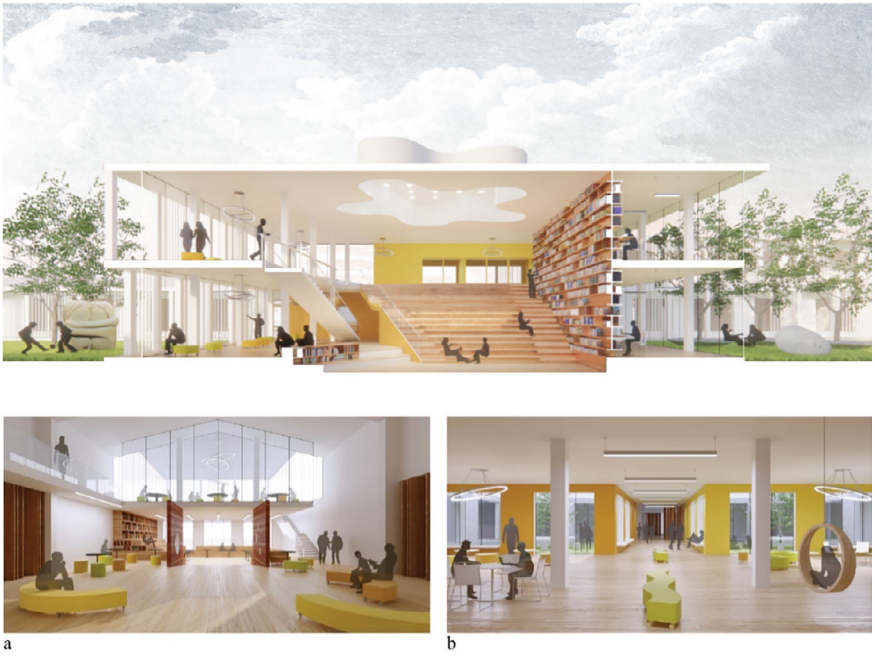


Fig. 32.16 The widespread library and multifunctional spaces for exhibitions and informal learning (Einstein School); **a**, **b** Enhancement of green patios and formation of fluid spaces in Vanoni School (drawn by the authors)

These "lines of force" (Fig. 32.11c) extend the historic routes coming from the town and the Park (Figs. 32.5, 32.6) and the system of new outdoor spaces that strengthen the historic tracing of via Adda and connect to the hybrid sharing spaces in the schools complex (gyms, auditorium, classrooms for associations, cafeteria). A system of partitions integrated into the architecture of the Green Ring adjusts the degrees of porosity of the campus depending on the schedules and activities.

The diagonal line is the main *line of force* connecting the Green Ring to the Park and town. It continues the historical pathway interrupted by the construction of the Omnicomprensivo. This diagonal introduces a new sign that dynamises the rigidity of the Cartesian structure and reconnects it with the historical structure of the ground.

The demolition of the covered canopies solves the fragmentation of outdoor green spaces and the visual perception of the campus. By moving the covered pathways to the sides, a large green area is provided at the centre, planted and equipped with desks, seats and greenery in relation to the role played within the school layout (Fig. 32.11b).

Vertebrating the Patio System—the Axis of Ateliers

The existing patios are a positive ordering principle of great potential, although the pre-existing system is rigid and totally neglects the quality and design of the

outdoor spaces. The compositional principle of the excavation represented by the patios is the theme echoed by the Axis of Ateliers, or the new backbone of the entire complex (Fig. 32.11d). Tangent to the centre, the Axis structures a system of patios and views on which old and new classrooms overlook. Through the interior route and the exterior system of the patios, the Axis connects the four schools while expanding the entrance to the gym and redesigning its façade. The patios are always equipped with seats, desks and installations to allow outdoor education.

32.4.2 Spaces Shared with the Community

Integrating the need to oversee the entrance to the school complex with the need to provide recognition and identity to each school, the design overcomes the current fragmentation through a rational reorganisation of the four schools' spaces into *clusters*. They are all equally connected to the Green Ring, to the Axis of Ateliers and to the system of hybrid sharing spaces (Figs. 32.11, 32.12, 32.13).

The need for a reception and welcoming space filtering the entrances to the school complex while acting as an interface between the schools and the town intersects with the need for expansion of two schools (Banfi and Vanoni). A new head building defines the school's interface overlooking a new raised public space via Adda, which hides a semi-underground covered parking (Fig. 32.13). Strengthening the border, the terrace also provides an outdoor meeting space, with a green area and a shading curved canopy, facing the park and open to the whole community (Fig. 32.15a, b).

The design rewriting permits to define an area inside the schools complex around which both old and new hybrid spaces for sharing with the community gravitate.

The "lines of force", in fact, also identify two preferential access routes from the main entrances in Via Adda: one leads to the existing auditorium and gyms, the other to the new Green Ring, Cafeteria, Classroom-Library and, again, to the Gyms (Fig. 32.15b). This shared area is designed to easily communicate with the rest of the complex or be secluded, depending on the case. In addition, by designing a terrace between the street, the parking lot and the new entrance building from via Adda, the difference in level in the topography forms a public space separated from the parking lot that distributes the flows safely and avoids the current gatherings (Figs. 32.13, 32.15a, b).

Both the raised terrace and the entrance to the Green Ring are designed to be always open to public use so that the school complex can become a vibrant cultural centre, open to civic associations and leisure activities. Beyond class time, gyms, auditorium, Green Ring and Axis of Ateliers are all available to the community and offer spaces for sports, meetings, associations and classrooms-laboratories for lifelong learning.

32.4.3 Rewriting Strategies Derived from the City

The three principles of the regenerative design (re-centring the layout; reconnecting the parts; vertebrating the patio system) have been developed according to ten design strategies that include some techniques of urban rewriting applied to the whole layout composition (centralisation, interconnection, addition, fitting) and architectural rewriting (grafting, overlapping, infill); the enhancement of indoor and outdoor formal and informal learning spaces; and the redesign and retrofitting of façades (Fig. 32.14).

After developing the design proposal, the research has translated the ten design strategies into conceptual diagrams in order to set a benchmark in school redevelopment and help the public administration to visualise the strategies as guidelines for similar situations, although the details of architectural solutions should remain site-specific: 1. Centralisation of the layout; 2. Interconnection of buildings; 3. School-city connection; 4. Addition of buildings; 5. Grafting of solids; 6. Overlapping and Infill; 7. Internal insertion; 8. Activation of outdoor spaces; 9. Rewriting of the façade and retrofitting; 10. Rewriting of the façade by diaphragms and shadings (Fig. 32.14).

(1) Centralisation of the Layout

Centralisation identifies the beating heart of school life and the epicentre from which all relationships and energies of the campus unfold.

(2) Interconnection of Buildings

It identifies a vertebrating element to connect all parts of the existing complex based on the ordering principle of patios. It offers outdoor learning spaces and indoor laboratories-ateliers, vivifying and completing the cognitive dimension. It conveys the ideas of a place of making, of the corporeal dimension and physical activity, of manual and artistic actions.

(3) School-City Connection

It identifies a transition space between the road and the school entrances, which are set back from the chaotic road to offer an external public space of encounter and relation among the "enclosure" of the school, the city and, in this case, the Park.

(4–7) Addition of Buildings, Grafting of Solids, Overlaps and Infills

They identify various principles for the reorganisation of the complex into recognisable spatial units, expressing the sense of unity and at the same time guaranteeing the identity of the individual schools or structures. The design research identifies the focal points for addition or grafting of buildings, for the punctual infill or overlapping of individual solids, or for the insertion of spaces from the inside. These insertions provide additional rooms that allow the renewal of the congested existing spaces creating altogether a new learning landscape.

(8) Activation of Outdoor Spaces: Open-Air Schools

The pandemic has relaunched the importance of outdoor and green spaces, so far almost forgotten by contemporary pedagogy. Patios and outdoor spaces can be used in continuity with the classrooms and informal learning spaces. Open spaces and greenery also represent a specific resource that should be articulated into a plurality of learning places and leisure possibilities: educational gardens, gardens or structured spaces for open-air education, groves, playgrounds, green sports, quiet spaces and orchards.

(9–10) Redevelopment of the Façade with Retrofitting and Shading Devices

The redevelopment of façades identifies integrated strategies that should intervene both on architectural quality and on the performance of the building envelope. It is thus a matter of acting jointly on the architecture of the façade, the windows and cladding typologies and the shading and shielding devices.

Besides, the addition of new layers of materials and superposition of façade diaphragms creates a shallow mediation space between inside and outside, the depth and characteristics of which may vary in relation to the façade orientation. Additional components of the strategy may be added to this transition space: paths, openings giving direct entrance to the classrooms and lowering of windowsills to be replaced with linear benches.

32.4.4 Space-Places: Innovation and Redevelopment of Interior Spaces

The Vimercate Campus' school buildings present several problems related to the quality of their indoor and outdoor spaces, the lack of shared spaces and facilities and the performance and decay of construction materials.

The triggering of new relationships between classrooms and corridors, corridors and halls, halls and patios, is the starting point for reorganising the existing learning spaces. The modification of the existent is aimed at transforming corridors and halls from mere circulation routes into shared spaces of encounter, relaxation and informal learning; reimagining the role and character of open spaces; and changing the lighting and wellness conditions through the new spatial arrangement.

The proposed interventions re-structure the indoor and outdoor spaces as a plurality of *space-places*, or recognisable architectural units proposing various centres of attention and stimulating aesthetic qualities, as well as allowing forms of innovative learning for small teaching groups (Figs. 32.14, 32.15, 32.16).

Through the remodelling proposed by the design, conventional spaces are reshaped into vibrant places for encounters, creation and communication between the schools and the external community, being pedagogically innovative, architecturally qualified but sufficiently flexible to respond to future changes in education.

In association with the classrooms, the communal spaces form a continuous tissue that has the complexity of a small town or landscape, characterised by different depths of field and heights, degrees of partition and sharing; halls, habitable recesses, multifunctional squares or agoras; shaded patios, ramps, paths and gardens.

Therefore, students can experience the internal and external architectural space in the full richness of *space-places* and meanings, symbols, metaphors and metonymies attributed to forms; in the game of different scales, heights and layouts that encourage and stimulate different types of behaviour; and in the expression of tactile, olfactory and aesthetic-perceptual values (Pezzetti 2019).

Informal Learning Spaces to Foster Interaction and Inclusion

By transforming some classrooms and expanding and reorganising shared places, the patios and corridors will offer multifunctional *space-places* for innovative education, socialisation and informal learning (Fig. 32.16a, b).

Spaces for informal learning widen the scope of circulation spaces and halls to develop unstructured activities for small groups and relaxation.

The common areas become a hybrid laboratory of learning and an extension of the classroom. Equipped with multimedia, desks, swings and comfortable seats and in continuity with the widespread library and relaxation corners, they offer a place to interact informally or settle conflicts.

These spaces are of primary importance. Their configuration cannot be serial but, like in a city, should be identifiable and characterising through a variety of themes and spatial configurations. They are also spaces of inclusion where students with difficulties or disabilities can carry out specific individual tasks.

Besides, the pandemic requirements of separating the flow of people are addressed by architectural solutions that reinvent the layout and use of common spaces.

Widespread Library and Classroom-Library

Since a civic library already exists in Vimercate, the campus library is not interpreted as a single specialised place but as a dynamic landscape widespread in the common areas of all the four Schools, in conjunction with the informal spaces and relaxation areas. In the design interpretation, the widespread libraries strengthen the identity of the various schools. They are located in correspondence to the amphi-seatings and socialising spaces, configuring hybrid spaces dedicated to consultation, reading, listening, meetings and other activities (Fig. 32.16a).

The design project also envisions a new type: a classroom-library overlooking the Green Ring, which offers a multifunctional study space shared by all the schools, and is also suitable for seminars and conferences.

Spaces for Teachers

Teachers are the soul of the school and need, in turn, appropriate, welcoming and stimulating spaces to develop their professionalism, culture and relationships. Such areas for the specific work and sharing of teachers are located in correspondence with the socialising informal spaces.

32.5 Conclusions

Through research by design, the paper has investigated school buildings no longer as a specialised functional type determined by pedagogical issues only but rather as a qualifying *learning architecture* and an essential *urban unit* in regenerative processes.

Aiming to set a benchmark in the redevelopment of large school campuses, the redesign of the Vimercate High Schools Complex adopts a set of *rewriting* techniques to shape an innovative *morphological text* and *learning architecture*, expressing typological and syntactic constitutive principles in relation to the context, landscape and existing courtyard-patio system. Through the study of the deep structure of the urban–rural form, long-duration *lines of forces* were revealed, which set the principles to reshape the interface between the schools and the town. Instead of adopting generic models of innovation in learning environments, *regenerative architecture* investigates the problems and potentials of the existing structure as an urban part and *re-morphologises* it through some *rewriting techniques* detecting urban *lines of force*, new epicentres as primary elements, grafting and thinning points, and upgrade of the "ordinary fabric", like in a city in miniature.

Besides, going beyond the concept of *learning environment*, the research postulates a *learning architecture* that envisions spatial innovation in analogy with ateliers and museums, stimulating active learning by a plurality of *space-places*, each one responsible for proposing centres of attention and aesthetic experience of architectural space while allowing forms of self-learning outside the traditional classroom.

Opening school spaces to the community by establishing different degrees of porosity and partition, the new Omnicomprensivo inverts the traditional idea of the school campus as a self-contained citadel and becomes a catalyst providing the scenarios of constant dialogue and interaction within the framework of city-community-school relationships.

Acknowledgements The ongoing research and design project have been commissioned and funded by the Provincial Government of Monza e Brianza, Italy, within the framework of a partnership agreement between the Province and Politecnico di Milano, ABC Department of Architecture Built Environment and Construction Engineering, led by Prof. Laura Anna Pezzetti, with the collaboration of the PhD student Helen Khanamiryan and the participation of the PhD students Alberto Malabarba and Liu Qian.

References

Augé M (2008) Non-places: an Introduction to Supermodernity. Verso, London-New York
Aymonino C (1980) Campus scolastico a Pesaro. Edizioni Kappa, Rome
Aymonino C (1988) Piazze d'Italia. Electa, Milan

Bannister D (2017) Guidelines on exploring and adapting learning spaces in schools. European Schoolnet, Bruxelles, https://www.readkong.com/page/guidelines-on-exploring-and-adapting-7715882. Last accessed 2022/06/20

Borri S (ed) (2018) The classroom has broken: changing school architecture in Europe and across the world. INDIRE, Florence

Canella G (1964) Relazioni tra morfologia, tipologia dell'organismo architettonico e ambiente fisico. In: Rogers EN et al. (eds) L'utopia della realtà: Un esperimento didattico sulla tipologia della Scuola Primaria, 66–81. Leonardo da Vinci, Bari

Franchi G, Gallinella V, Michelangioli S, Ponti G, Selleri R (1985) Una scuola per la Riforma: Quindici anni di architettura per la Scuola Media Superiore (1970–85). Unicopli, Milan

Haar S (2003) School for Cities: Urban Strategies. NEA Series of Design, NFAH, Washington

Health City Institute: Manifesto. La Salute nelle Città: Bene Comune. HCI, Rome (2020), https://issuu.com/raffaelecreativagroupcom/docs/manifesto_la_salute_nelle_citt_bene_comune, Last accessed 2022/07/14

Hertzberger H (2008) Space and learning: lessons in architecture. 010 Publisher, Rotterdam

Malaguzzi L (1995) I cento linguaggi dei bambini. Edizioni Junior, Azzano S. Paolo

MIUR: Linee guida Dicembre 30. Ministero dell'Istruzione, dell'Università e della Ricerca (2018), https://www.miur.gov.it/documents/20182/1306025/Linee+guida+PCTO+con+allegati.pdf, Last accessed 2022/06/17

MIUR: Norme tecniche aggiornate relative all'edilizia scolastica, ivi compresi gli indici di funzionalità didattica, edilizia ed urbanistica, da osservarsi nella esecuzione di opere di edilizia scolastica. Ministero dell'Istruzione, dell'Università e della Ricerca (1975), https://www.indicenormativa.it/sites/default/files/dm_18-12-75.pdf. Last accessed 2022/06/17

MIUR: Nuove line guida per l'edilizia scolastica. Ministero dell'Istruzione, dell'Università e della Ricerca (2013), https://www.indire.it/progetto/architetture-scolastiche/norme-tecniche, Last accessed 2022/06/05.

MIUR: Piano scuola 2020–2021: Documento per la pianificazione delle attività scolastiche, educative e formative in tutte le Istituzioni del Sistema nazionale di Istruzione. Ministero dell'Istruzione, dell'Università e della Ricerca (2020), https://www.miur.gov.it/documents/20182/2467413/Le+linee+guida.pdf/4e4bb411–1f90–9502-f01e-d8841a949429, Last accessed 2022/06/17

OECD: Education at a Glance 2010: OECD Indicators. OECD publishing, Paris (2010). https://doi.org/10.1787/eag-2010-en. Last accessed 2022/06/20

OECD: Designing for Education. Compendium of Exemplary Educational Facilities 2011. OECD Publishing, Paris (2011), https://doi.org/10.1787/9789264112308-en, Last accessed 2020/05/06

Pezzetti LA (2019) Space-Places and Third Teacher. The Issue of Architectural Space in the Age of Knowledge Cities and Schools 3.0. In: Della Torre, S. and others (eds.) Buildings for Education. A Multidisciplinary Overview of the Design of School Buildings, pp. 225–235. Springer, Cham (2019), https://doi.org/10.1007/978-3-030-33687-5_20, Last accessed 2020/01/30

Pezzetti LA, Khanamiryan H (2020) Accelerating Innovations, Wellbeing and Requalification of School Buildings after the Pandemic. Towards a "New Extraordinary". FAMagazine. Research and projects on architecture and the city (52), pp. 189–197 (2020).

Pezzetti LA (2020) Continuare a scrivere nel paesaggio storico. Lettura, interpretazione, figurazione. LetteraVentidue, Siracusa

PNR, Piano Nazionale di Ripresa e Resilienza: Futura: Progettare, Costruire e Abitare la Scuola. MIUR, Milan (2022), https://pnrr.istruzione.it/wp-content/uploads/2022/05/LineeGuida_ScuolaFutura-1.pdf. Last accessed 2022/05/17

Rogers EN (1947) Architettura educatrice. Domus—La Casa dell'uomo (220), 1

Sacchi, F (2011) Vimercate in Età Romana. In Marchesi A, Pesenti M (eds) MUST: Museo del Territorio. Electa, Milan

UNESCO, UNICEF, World Bank, World Food Programme: Framework for reopening schools, https://www.wfp.org/publications/framework-reopening-schools-report-unesco-unicef-world-bank-and-world-food-programme, Last accessed 2020/06/01

Vergani GA (2005) Il complesso del ponte di San Rocco a Vimercate. Identità e storia. Silvana editoriale, Cinisello Balsamo, Milan

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

Chapter 33
Study on a Paradigm of Micro-Regeneration of Urban Community—Taking Three Cases of House Upgrading in Xiaoxihu Traditional Block, Nanjing

Li Bao, Yichang Sun, Han Wang, and Zixuan Liu

Abstract The large-scale urbanisation experienced by Chinese and other Asian cities over the past few decades has fragmented and demolished urban fabric, functional structures, spatial environments, and even social relations. Various urban-associated diseases have emerged consequently, and urban transformation is required to achieve more sustainable development. The micro-regeneration of urban community orientated on residents' demands can be an approach to balance the urban development and preservation, to seek harmony between historical heritage, cultural revitalisation, urban distinctiveness, market profits, and local lives. As a positive intervention during the urban transition, it is argued that the elaborate micro-regeneration has turned into one of the significant subjects for both professional and educational fields of architecture towards future urbanism. This paper takes three research-based projects of housing upgrading in Xiaoxihu Community in the traditional quarter of Nanjing as examples of such micro-regeneration. In the interactive mode of "Learn-Research-Practice", the authors have focussed on value fostering, multilateral cooperation, and an integrated multidisciplinary system, with equal attention to history, culture, space, and social ecology. These projects have further explored inclusive institutions and mechanisms that take both urban regeneration and community revitalisation into account, with nuanced integration of top-down planning and bottom-up self-regulation. Taking a small-scale, incremental approach, it has further investigated the characteristics of diversity and the role of universities, as a producer of knowledge in the urban regeneration process. With a pedagogical and pragmatic paradigm formed, this paper can be a reference to architecture education and practice in other cities facing similar challenges.

L. Bao (✉) · H. Wang · Z. Liu
Southeast University, Nanjing 210096, China
e-mail: baoli@seu.edu.cn

Y. Sun (✉)
University College London, London WC1E 6BT, UK
e-mail: yichang.sun@ucl.ac.uk

© The Author(s) 2025

M. Hanzl et al. (eds.), *Urban Morphology versus Urban Redevelopment and Revitalisation*, The Urban Book Series, https://doi.org/10.1007/978-3-031-77752-3_33

Keywords Housing upgrading · Micro-regeneration · Typo-morphology · Positive intervention · Pedagogical and pragmatic paradigm

33.1 Introduction

The rapid urbanisation process over forty years in Chinese cities has led to the homogenisation of urban fabric and everyday-life spaces, which not only turns city life plain and monotonous but also causes severe urban problems and even poses critical challenges to public health and wellbeing. Along with the National Strategy on "advancing urbanisation" since 2014, the principle of urban development has been changed from incremental planning to inventory regeneration, various cities have explored feasible methods and paradigms of urban regeneration based on their specific contexts. As a traditional settlement located in the southern inner-city of Nanjing, Xiaoxihu is a typical mixed-use neighbourhood mingled with diverse types of residential buildings constructed in various periods. It includes courtyard houses of Ming and Qing eras (1368–1912), detached and terraced houses of Publican China (1912–49), and multi-level collective housing built after 1949 with multiple property rights (public, private, and collective). Prior to regeneration, these residential buildings in Xiaoxihu had fallen into the dilemma of cluttered layout and over-crowded living spaces with poor quality of life, primarily as a result of a lack of maintenance over time and the complex iteration of the intergenerational and rental/selling relationship. Concerning the limits of residents' ability in self-regeneration, house upgrading has been initially listed as one of the most significant issues within the regeneration project.

Based on the authors' continuous "Learning-Research-Practice" experience in Xiaoxihu community, this paper chooses three research-based house upgrading projects as a series of case studies (Fig. 33.1). By reflecting on the corresponding process of the regeneration practice over time, we mainly explore questions as follows: First, how the knowledge and methods of urban morphology can be specifically applied and contributed to the urban practice. Taking the intricate people-land relationship as the focus, the second question asks about the implications of the chaotic Public–Private-Interface on the diversity of urban life, and how they can be recognised and regenerated through "modest and precise interventions" (Barker 2009). Finally, it examines how diversity is constructed and manifested in Xiaoxihu community's micro-regeneration and how the university can in-depth engage in this process, related with a wider range of urban issues.

Fig. 33.1 Three cases of house upgrading along Duicao Lane in Xiaoxihu Block. *Source* Drawn by authors based on the photograph by Bowen Hou

33.2 Methodology

As Trisciuoglio (2021) highlighted, the typo-morphological studies are not only urban analysis itself, but also a powerful tool that can be operated towards the practice of urban regeneration. In the process of research-based practice in Xiaoxihu, the typological map, which is overlapped with the property information of land and buildings in various periods, has been used as an important tool for communication and coordination among diverse groups in community engagement since the early stages (Fig. 33.2). Taken an empirical approach, which is comprised of three case studies, this paper traces back the specific regenerative process to examine the problem and solutions of each type of housing upgrading project in the framework of the micro-regeneration paradigm, and further investigate the diversity in the people-land relationship and the role of universities in urban regeneration.

33.2.1 The Choice of Case Studies

Based on the 127 implementation units of micro-regeneration delineated in the "Detailed Construction Plan for the Historic Area of Xiaoxihu (Dayoufang Lane) in Qinhuai District, Nanjing (2019)", houses upgrading that have been initially implemented are mainly distributed on both sides of Duicao Lane, which is one of the main lanes inside the block. Concerning the diversity of living patterns, three houses

Fig. 33.2 Typological map of Xiaoxihu (2017). *Source* Joint Design Studio "Transitional Morphology: Dayoufang Xiang (2017)" between Southeast University and Politecnico de Torino

located along Duicao Lane (labelled in Fig. 33.2) have been specifically chosen as follows:

(1) The symbiotic courtyard, where the community and residential space are combined,
(2) The integrated courtyard (Long's House), where residential and business spaces are integrated,
(3) The resettlement housing, where collective living and street life are mingled.

33.3 Results

*33.3.1 Case One: The Symbiotic House (*Gongsheng Yuan*)*

The Symbiotic House, located in Duicao Lane No.31, was comprised of two courtyard houses, of which the public directly manages the properties. Before regeneration, multiple tenant families were living there with relatively poor quality. During the discussion period, apart from two families who live along Duicao Lane, most residents express their willingness to relocate. The final regeneration project has been explored through multi-party coordination to respond to the diversified requirements. On the one hand, a corresponding regeneration plan has been tailored for these

Fig. 33.3 The ground floor plan of Symbiotic House after regeneration, and photos of the common aisle before and after regeneration. *Source* Drawn by Song Tang (left), Photographed by Bowen Hou (right)

two households based on their family composition, living conditions, and everyday habits. An independent kitchen and toilet, together with a second-story attic, have been added respectively. On the other hand, the vacated space located in the eastern and northern areas has been transformed into a communal space, which is served as a multi-functional cultural and art place and the office of community designers in Xiaoxihu.

Based on the courtyard house typology, the collective spaces in-between residential and official areas are composed of the courtyard and inner and outdoor corridors. These spaces extend private domestic life in various forms and integrate with public communal life. For instance, the lamps on the wall of the indoor aisle can work as lighting facilities for residents returning home at night and community exhibitions in the daytime. Moreover, the chairs in the front of the two households also serve as shared furniture for residents and visitors. As a supplement to the public and private realm, the collective spaces here constitute a dynamic stage of everyday life through micro-regeneration (Fig. 33.3).

33.3.2 Case Two: The Integrated House (Gongrong Yuan, or Long's House)

As a unique micro-regeneration unit surrounded by non-residential plots in Xiaoxihu block, the Integrated House has a relatively complex land-property relationship. Located in Duicao Lane No.31–18, it consists of the Qinhuai District Real Estate Company's residential land on the east and private residential land on the west, the latter of which consists of Mr Long and his brother and sister (now been inherited by her daughter, namely Mr Long's niece). Concerning the building property, this unit includes individual private buildings on the west and industrial-commercial buildings on the east. Before regeneration, the eastern area was rented by migrant workers, and Mr and Mrs Long were living in the western area. Following the residents' aspiration,

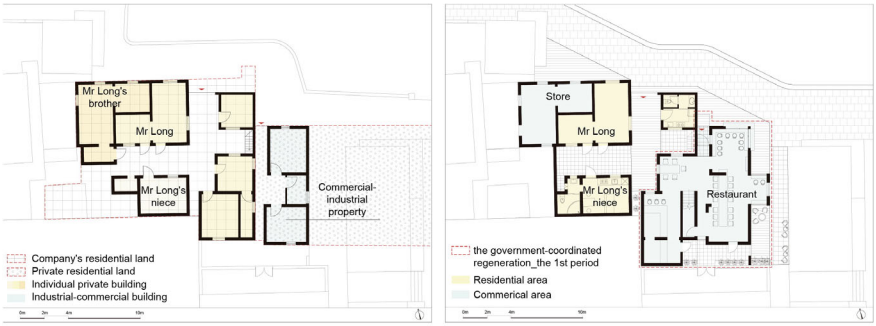


Fig. 33.4 The Integrated House before and after regeneration. *Source* Drawn by authors

these adjacent small-property land plots and buildings have been transformed into a commercial-residential integrated system by vacating public houses and renting private ones (Fig. 33.4).

With the changing demands of multiple stakeholders, the upgrading process can be generalised into three periods (Fig. 33.5). At first, two public bungalows on the east and two two-floor houses from Mr Long's family have been rented by NHCPC (Nanjing Historical City Protection & Construction Group CO., LTD.), with 93 square metres in total. As a part of the governmental-coordinated regeneration, the community designers are initially entrusted as project designers to transform this rented unit into a restaurant. Two issues are mainly concerned in this phase. For the outdoor area, the delicate independence and interaction between a small business and Long's residential area are carefully considered, when regenerating the public space and reshaping people's movement in Duicao Lane and the eastern alley. In terms of the inner area, especially the buildings themselves, the three independent buildings have been transformed into one free-flowing space to meet the requirement of commerce, making the most of the original load-bearing walls and their opening holes. Moreover, the typo-morphology of this regenerated unit needs to be coordinated with the Xiaoxihu block.

As the design and construction of the eastern restaurant go, Mr and Mrs Long have gradually established their trust in the urban regeneration team and expressed the request to renovate their kitchen, bathroom, and courtyard. Later, their niece also put forward the need for uploading her two-storey house, to which she and her husband planned to move back after retirement. During the latter two periods, the community designers have also gone through the role transition, from the initial project designers to the designer consultants for public–private joint regeneration, and quality controllers of residents' self-regeneration. Through close communication and cooperation with residents, the in situ regeneration design can be constantly and timely revised based on their needs and the on-site construction. Alleys, courtyards, outdoor staircases, and the first-floor balcony, as the collective spaces that integrate commercial and residential areas, have also been regenerated as one thing. Therefore, Mr Long's family and the restaurant's guests can interact with each other inside the

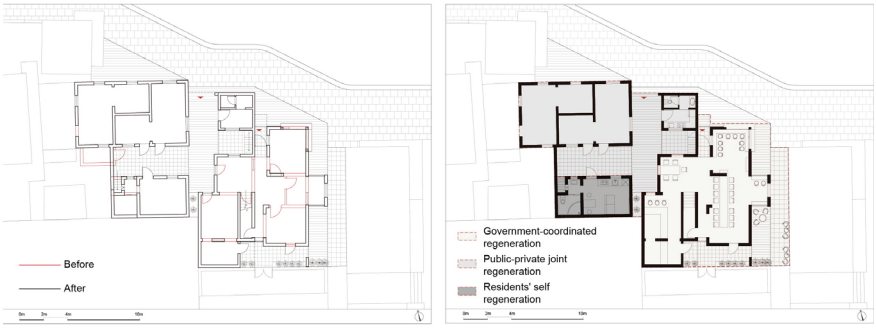


Fig. 33.5 The Integrated House before and after regeneration (left) and three modes of regeneration (right). *Source* Drawn by authors

courtyard. Based on a long-term micro-regeneration, this unit has been transformed into a dynamic commercial-residential complex, with the living quality significantly improved and diverse groups of people engaged (Fig. 33.6).

Fig. 33.6 The integrated house after generation: (1) the street perspective from east side; (2) the street perspective from north side; (3) the restaurant; (4) the courtyard of Mr Long's family; (6) the two-storey house of Mr Long's niece. *Source* Photographed by Bowen Hou and NHCPC

33.3.3 *Case Three: The Collective Housing (Resettlement Housing)*

The collective housing at Duicao Lane No. 8–9 is adjacent to the south gate of Xiaoxihu Primary School in the north, opposite the courtyard houses in the east, and connected to the Qinhuai District Market Supervision and Administration Bureau in the south and west. The land use of its corresponding plot is the residential land of the district real estate management company. Through regeneration, the original three-floor building directly managed by the public has been reinforced and transformed into a four-floor one. As an innovative method for vacating several courtyards into complete units, within the overall framework of regeneration, it is used for the in situ resettlement of residents in Xiaoxihu block to upgrade their living quality. Based on the limitations of the plot size and the masonry structure of residential buildings, the form, structure, space organisation, and elevations of the collective housing have been regenerated. Taking elements of sight and light into consideration, this regeneration design has been achieved mainly through a detailed analysis of the surrounding urban form and building typologies. Through the integrated approach of "reconstruction and expansion + top-floor addition", the complete set of kitchen and bathroom with full brightness is realised. To maximise the quality of life and land use value for residents who are settled, mezzanine spaces under the sloping roof are specifically designed following the roof structure, with skylights introduced into the domestic spaces (Fig. 33.7).

Apart from the optimisation and improvement of apartments and staircases inside the collective housing, the entry platform from the eastern side of the building has

Fig. 33.7 The collective housing before and after regeneration. *Source* Drawn and photographed by authors (left and middle), photographed by Bowen Hou (right)

Fig. 33.8 The entry platform of the eastern side of the building, before and after regeneration. *Source* Photographed by authors

been refined through space and material design. Taking people's sitting and leaning behaviour, the conversion and succession of the stairs, and the continuity and rhythm of the physical boundary into consideration, a neighbourhood-friendly entry space has been created (Fig. 33.8). Moreover, to empower the collective housing in the community's every day and public life, the renovated apartment at the north-eastern corner, together with the outdoor leisure space, has been redesigned and transformed into a community-oriented public place.

Concerning the neighbours on the east side who were worried about the loss of privacy inside their courtyard after the additional floor, the design project of the main façade on the top level has been revised from the open roof balcony to the enclosed one with translucent sunlight panels added in the edge. Their horizontal inclination angle is set to avoid sight towards the private courtyard, forming a changeable texture. In this way, the uninterred visual effect with a view to see, and light to penetrate can be achieved. Although this revised design based on the neighbours' demands has changed the original idea of setting back the added volume, it has satisfied the actual needs of residents from all parties to "see and not to be seen" in an unexpected decent way (Fig. 33.9). As a large-volume housing of Xiaoxihu, the regeneration design and construction can only be implemented effectively with the understanding and cooperation of the neighbours. The back-and-forth revision the community designers have been engaged in proved to be valuable at last.

33.4 Discussion

33.4.1 The Characteristics of Diversity

Through a long-term research and practice of micro-regeneration since 2015, residents' living quality has been significantly improved, reshaping Xiaoxihu into a diversified community. Although it has not been set as an initial target for regeneration, the aspect of diversity that has been touched upon in this research-based practice

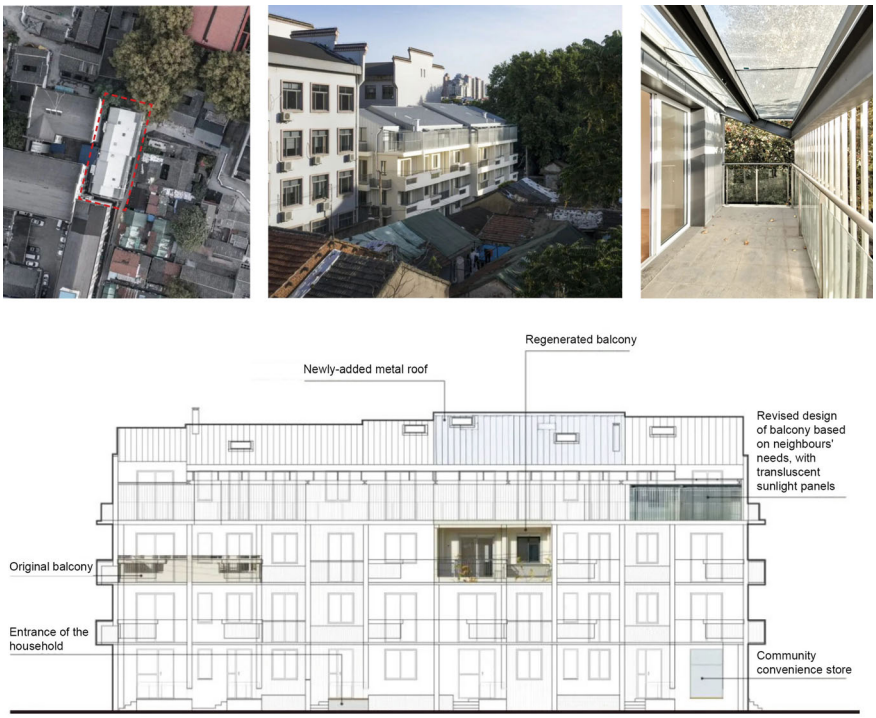


Fig. 33.9 The revised design of the added top-floor and the south-eastern elevation, based on the needs of diverse stakeholders. *Source*: Photographed and drawn by authors

can be interpreted from three dimensions: collaboration mechanism, land-property system, and community network.

For the mechanism itself, which is the initial issue in urban historical areas' regeneration, the principle of multi-role participation and multi-mode parallelism has been proposed from the very beginning. Three specific regeneration modes are taken as follows: self-regeneration, resettlement, and co-construction and sharing. In the process of community engagement and co-production, diverse stakeholders, including government, NHCPC (as the local development and construction company), households, tenants, merchants, multi-directional design teams, construction teams and other parties have been closely cooperated and coordinated together. This gradually promotes the formation of a reliable team made of acquaintance, based on which, a flexible and effective multi-party cooperation platform has been established (Table 33.1).

The complex land-building system of Xiaoxihu block can be mainly shed light through the ownership of three types of residential plots and four types of residential buildings. Based on each plot's characteristics and residents' wishes, the implementation units of micro-regeneration in Xiaoxihu have transcended the boundary of plots and buildings, which shows a diversified land-building relationship. For the

Table 33.1 Three cases of house upgrading with diversified regeneration modes and participants

Case	Time Period	Regeneration mode	Participants
The symbiotic house	2019.03–2020.11	Co-construction and sharing	Government, NHCPC, households, tenants, community designers from Southeast University (also as new users of the community zone), construction team
The integrated house	2019.11–2020.11	Co-construction and sharing + Self-regeneration	Government, NHCPC, households (Mr Long and his brother and niece), tenants, business owners (of the restaurant), design teams (community designers from Southeast University + interior design team employed by the business owners), construction team
The collective housing	2018.12–2021.01	Resettlement	Government, NHCPC, households, tenants, community designers from Southeast University, construction team

three cases mentioned above, this relationship includes "one house in one plot – the Collective Housing", and "two houses in two plots – the Symbiotic House and the Integrated House" (Fig. 33.10).

In terms of the community network, residents of Xiaoxihu have been consciously cared and gradually enriched into a group of multi-identity, multi-age, and multi-interest population, including original residents, new residents, and tourists who live in the community for a short time. Among them, the new residents are mainly composed of tenants and business owners. This community network of diversified residents has further triggered a significant transformation in interpersonal relationships among intergenerational families, neighbours, and wider communities (Bao and Sun 2022).

33.4.2 The Role of Universities in Urban Regeneration

Universities have played significant and diverse roles in the transformation of urban regeneration narratives. Not only as the team of community designers who provide professional knowledge and skills, as well as coordinators among multi-stakeholders (Fig. 33.11), but the university is also served as an urban laboratory for creative and experimental thoughts, and a producer of urban knowledge that can be instrumentalised and mobilised progressively (Melhuish 2022).

Different from professional practice in general, teachers, bachelor, master and doctoral students from Southeast University have deeply engaged in the regeneration

Fig. 33.10 The complex land-building relationship in each implementation unit. *Source* Drawn by authors and the Xiaoxihu research and design team of Southeast University

of Xiaoxihu. Within this team, most major designers have dual identities as professional architects and teachers from the School of Architecture. During the process of exploring the practice of Xiaoxihu, it is accompanied by a series of teaching-based research, including the summer voluntary activity in 2015, design studios, and related studies for master and doctoral dissertations (Fig. 33.12).

The three case studies specifically investigate how the university participates in urban regeneration and community revitalisation (Table 33.2), forming an integrated pedagogical and programmatic paradigm, mainly through three approaches as follows: a multidisciplinary methodology for investigation and research, an inclusive and interactive mode of "L–R–P" (Learn–Research–Practice), and an integrated system for knowledge production and design practice (Fig. 33.13).

Firstly, multidisciplinary theories and tools from architecture, urban studies, history, sociology, and anthropology… have been combined in the investigation and research at multi-levels. Besides the built environment itself, residents' everyday behaviours, living needs and networks are investigated through detailed mapping and data analysis (Dong et al. 2022). This learning process of abstract or figurative thinking creates a rich toolkit for students to in-depth experience, understand

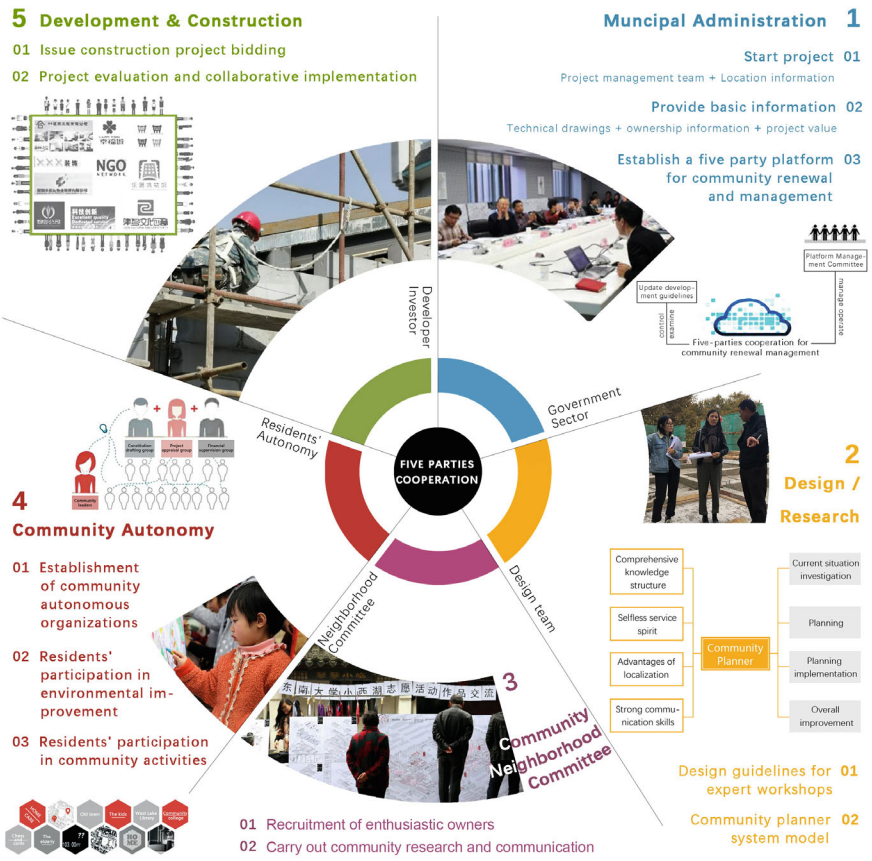


Fig. 33.11 Five-parties cooperation platform among multi-stakeholders. *Source* The Xiaoxihu research and design team of Southeast University

Fig. 33.12 Teaching-based research in Xiaoxihu: the summer voluntary activity (left), the joint design studio of Xiaoxihu between Politecnico di Torino and Southeast University in 2017 and 2019 (middle and right). *Source* Photographed by authors and the Xiaoxihu research and design team of Southeast University

Table 33.2 The role of university in urban regeneration and community revitalisation

Phases	Cases	The role of university
Preceding Study and urban planning (2015–2018)		The teaching-based research team (2015 – now), and constructive-detailed planning team (joint with Architecture and Engineering Co., Ltd. of southeast University) in Xiaoxihu
Design and Construction Phase (2018–2020)	The symbiotic house	The community design team and new users of the community office area
	The integrated house	The community design team, from project designer for governmental-coordinated regeneration, design consultants for public–private joint regeneration, to quality controllers of residents' self-regeneration
	The collective housing	The design team for public managed resettlement
After Design and Construction Phase (2020 –)		The community design team with long-term support and companionship for Xiaoxihu neighbourhood, together with ongoing new micro-regeneration projects

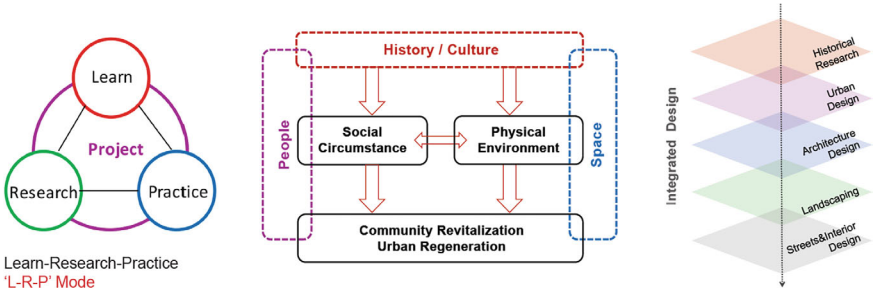


Fig. 33.13 A pedagogical and pragmatic paradigm based on "L-R-P" mode. *Source* The Xiaoxihu research and design team of Southeast University

and engage in the existing urban environment, trying to respond to the urban issues creatively.

Secondly, based on the inclusive and interactive mode of "Learn–Research–Practice", the boundary between academics and the world beyond has been transcribed, through both teachers' and students' continuous community engagement and close collaboration with other stakeholders in situ. This process prepares students for better coordination across disciplines and organisations during urban regeneration, with a sense of social-environmental responsibility and a nuanced understanding of socio-spatial justice. It also contributes to the formation of a new generation of professionals, who are capable of fostering the sustainability and resilience of the urban community.

Thirdly, multidisciplinary knowledge has been combined into one system, with design acting as the central component connecting humanities and technologies.

This knowledge includes urban history, architecture, landscape, infrastructure, etc. As Li (2022) points out, the regeneration of Xiaoxihu not only makes renovation of related institutions and mechanisms but also advocates knowledge formation mainly based on the relationship between people and land (property and circumstance). These series of teaching activities and research have expanded the understandings of real-world conditions, updated the regeneration models, and renovated the tools and methods of design practice from multiple dimensions (Bao and Trisciuoglio 2018). This integrated system for knowledge production and design practice has better accommodated residents' requirements and precisely intervened in urban transformation, shaping Xiaoxihu into a diverse and vitalised community.

33.5 Conclusions

The conservation and regeneration of residential buildings in Xiaoxihu are still in progress. Based on the long-term "Learn–Research–Practice" approach in situ, the three house upgrading projects are taken as examples to specifically explore how the typo-morphological approach can be applied in practice. Through cross-cultural use and expression, the typological map overlapped with complex land-property information has functioned as an important tool for community engagement, which promotes the formation of a robust and professional team among multiple subjects. Taking the city itself as a complex and diversified system, the micro-regeneration of residential buildings has been positively and precisely intervened based on the understanding of the relationship between people-land (property). Accordingly, the diversified Public–Private-Interfaces are formed through the modest integration of diverse people's movements in an incremental and small-scale approach. During the process of community engagement and positive intervention, the role of community designers has been transitioned from project designers to coordinators among multi-stakeholders. The diversity of the Xiaoxihu block has been manifested through the exploration of an inclusive collaboration mechanism, the land-property system, and the broader community network. It also highlights that the university, as an integrated institution and a producer of urban knowledge, can play a unique role in the reconstruction of community value in urban regeneration processes. As a pedagogical and pragmatic paradigm of the micro-regeneration of the urban community, this paper aims to provide a reference for architectural practice and education in cities facing similar urban challenges.

Acknowledgements We are grateful to colleagues and students in the Xiaoxihu research and design team of Southeast University, whose earlier contributions fed into the research reported in this paper. We would also like to thank the editors and reviewers for their insightful comments, helping us improve the quality of the paper.

Funding Research for this paper was supported by the National Natural Science Foundation of China, for the project "Study on the Upgrading Strategies Based on Multi-dimensional Sense of Place towards Urban Healthy Community" (Program No. 52278012).

References

Bao L, Sun Y (2022) Diversified regeneration of residential buildings at the traditional xiaoxihu block within the context of man-geographical co-constitution. Arch J, Beijing: Arch Soc China, No. 638(01):22–27

Bao L, Trisciuoglio M (2018) Capire le città cinesi. Ri-disegnare gli strumenti italiani | Understanding Chinese cities. Redesigning Italian methods, AGATHÓN | International Journal of Architecture. Art Des 3:123–132

Barker P (2009) The Freedoms of Suburbia, 1st edn. Frances Lincoln, London

Chen Y, Qu L (2020) Emerging participative approaches for urban regeneration in Chinese megacities. J Urban Plan Dev 146(1):04019029

Dong Y, Han D, Huang J (2021) (2021) The process-ness and participation of urban design in the small-scale and gradual conservation and regeneration of the Xiaoxihu historic area in Nanjing, Time+Architecture, Shanghai: Tongji University. No 177(01):51–55

Dong Y, Han D, Trisciuoglio M (2022) A graphical method of presenting property rights, building types, and residential behaviours: A case study of Xiaoxihu historic area, Nanjing, Frontiers of Architectural Research [Preprint]

Li H (2022) (2022) Problematizing the "Xiaoxihu Practice." Arch J, Beijing: Arch Soc China, No. 638(01):41–46

Melhuish C (ed.) (2022) Co-curating the City: Universities and urban heritage past and future. UCL Press

Roberts P, Sykes H (2000) Urban Regeneration: A Handbook. London

Trisciuoglio M et al (2021) Transitional morphologies and urban forms: generation and regeneration processes—an agenda. Sustain 13(11):6233

Verdini G (2015) Is the incipient Chinese civil society playing a role in regenerating historic urban areas? Evid Nanjing, Suzhou Shanghai, Habitat Int 50:366–372

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.