

Legibility of Urban Spaces in Kaunas New Town: Research, Strategy, Suggestions

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Abstract – Legibility is urban quality, defining ability to find a way in urban or architectural structure, as well as understanding the identity or function of a certain space. Legible environment could help to comprehend not only the space in which person is in a given situation, but also the whole city. It helps to identify oneself as part of a group or certain community. The article is oriented to better understanding of people's needs in environment, by analyzing the case study of Kaunas New Town. The project is based on observation, analysis of literature and results of research by space syntax methodology. The results show coherence between design rules, based on people's needs, and visibility graph model, which shows the potential of public and private spaces.

Keywords – Identity, Kaunas, legibility, people's needs, research-based design, space syntax.

INTRODUCTION

Legibility as urban quality was primarily introduced and based on the theory of legible environment, and in such a way created a mental map. This theory was created by K. Lynch and is represented as a feature of the city, which helps to find a way in environment by creating the mental model or map and using it while traveling through the city. Mental model is made of five basic elements: paths, nodes, landmarks, edges and districts [1]. W. Benjamin explains the perception of city through the example of London metro map, which hides a lot of intuitive information under its lines. It is not only the map, it is an associative mental model of the city (where people work, where Buckingham palace is located, etc.). All this information is hidden under a simple metro map, but inside people's brain it reveals all main structures, which are important while finding a way or simply remembering and understanding the city [2, 5–12].

According to D. K. Chandler's theory, people perceive the surroundings based on social and semiotic interpretation and codes. That is why architectural spaces and even architecture itself can be taken as interpretational code of everything happening around. By creating architecture people can express themselves, that is why architecture, as art and manner of expression, should be perceived correctly by others. The language of architectural structure can be very various and is dependent on the size of structure, its function, social and psychological environment. This language can be unique in every person's mind, even though it is perceived and interpreted generally [3]. Most of the time there are two basic languages of architecture: language of shapes and language of architectural structure. The latter one can make objects more or less recognizable or even create emotional impact [4]. People perceive the surroundings through five senses. Architecture most of the time not only represents the function and usefulness but also fulfills visual needs, creates aesthetics. In this case, just

like in ecosystem model, the bond between a human and information perceived from surroundings is very important. That is why architectural and urban structure must have acceptable and reasonable visual connections, which should be created not only intuitively. Legibility of urban spaces could create this kind of environmental quality.

I. PEOPLE'S NEEDS IN ENVIRONMENT

People are the most significant part of the city and people's senses are adjusted to perceive the surroundings. Or maybe the surroundings were intuitively based on our senses? The most developed sense of a human is eyesight, which is why it makes the biggest impact on the principles of designing our cities. According to J. Gehl, people can understand body language at a distance of around 100–80 meters. Most of the old European squares are no bigger than 100 meters (around 90–80 meters wide). According to author, this makes public spaces more socially acceptable than those, which are too big to recognize someone's face. Another example – audience watches the games and other events in arenas from distances no greater than 100 meters, too. Gehl notices that 35 meters is a magical distance. This method is used in theaters, where people must feel the emotion and see facial expressions. However, only from 10 meters and closer it is possible to use all human senses. That is why all social situations and interactions happen at this distance [5], [6].

According to W. Benjamin, a person creates his own environment by even making a city his interior, in which spaces are rooms. City is a dream come true, a labyrinth, where a person or the flâneur (traveler) materializes himself without even knowing it [2]. Human forms his environment and wants to feel comfortable in it. Environmental psychology defines the best environment in which a person could feel most comfortable. It should maintain balance between involvement and making sense (or challenge and comfort). It is called preferred environment and should be coherent, complex, mysterious and legible [7]–[9]. Feelings and senses have a great role in this situation as well as environmental psychology, semiotic meaning of the city, identity, and physical view of the city. All these components have a significant influence on readability or legibility of urban and architectural spaces. Although, it is not known that legibility of spaces would be linked to people's needs in the environment yet.

Flâneur is a traveler and he experiences city while wandering around it, looking around, sitting somewhere for a while, talking to people, etc. W. Benjamin's idea connects a lot of aforesaid components and emphasizes 3 of them: **seeing, moving and having activity**. In this case, legibility of urban spaces is also expressed

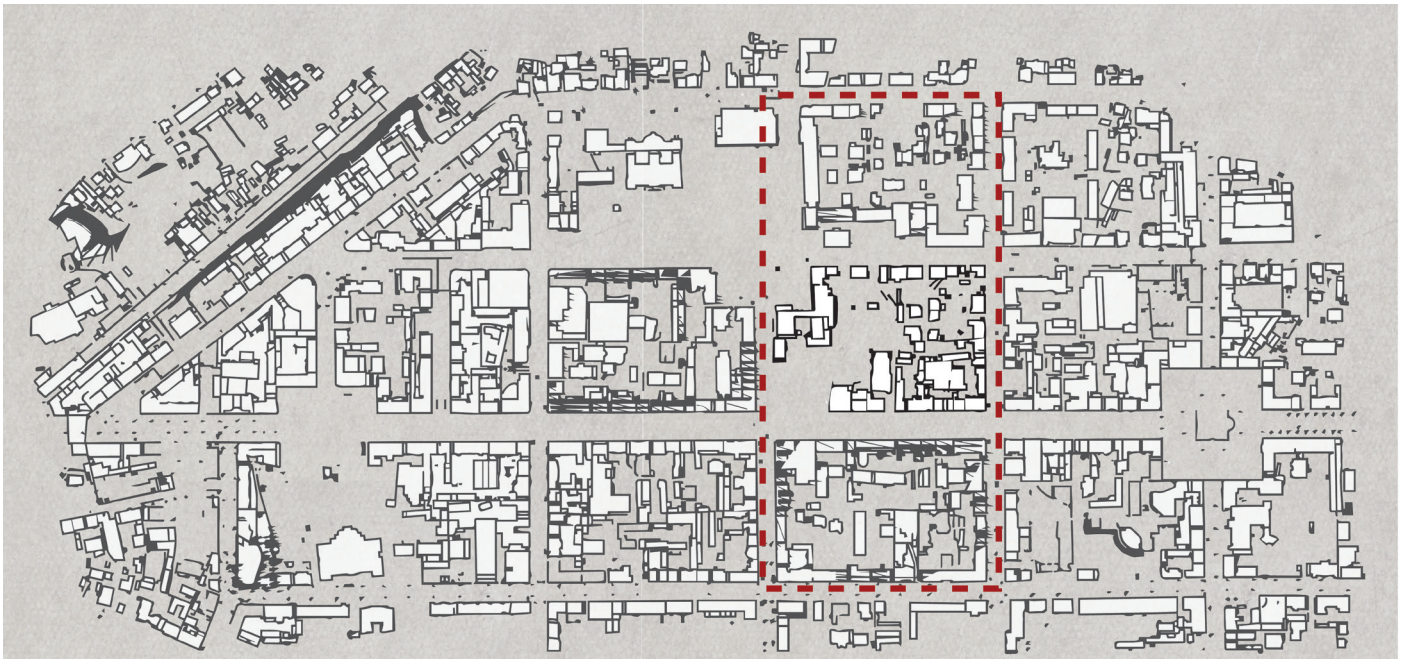


Fig. 1. Structure of Kaunas New Town [Figure: V. Vaitkevičiūtė].

through people's needs. Since human reads his environment, moves and has activities, it is crucial for him to orient himself in a city, to read its function and to understand the connectivity of the area. He can use these qualities later for finding a way in similar environment, which is most of the time near the place where he is right now. This trinomial structure of legibility makes sure that people could understand the structure in the environment, to read the function of it, and it should have easily adoptable connectivity to other spaces. This legibility model with suitable research method would help not only to better understand cities, but also to have a new approach for city structure and public space design. It is important for managing chaotically spreading cities and creating sustainable development.

Space syntax analysis can help to prognose these needs and how they impact the environment. Different types of space syntax analysis are used to predict applicability of urban spaces: person sees surroundings – visual graph space syntax analysis, moves through the city – axial analysis, has activities – convex space analysis (which can predict if certain space could be more private or public).

The aim of this paper is to determine if environment, which is designed by these three needs (**seeing, moving and having activity**), is more legible. The research and project take place in Kaunas New Town and are based on observations and results of research by space syntax methodology. Hypothetical model, based on the analysis of literature and other information sources, was redefined during the research and new concept model of a certain block was established. The area of Kaunas New Town was designed based on the model and new urban scheme strategy was verified by space syntax methodology.

II. HISTORY OVERVIEW AND CHOICE OF RESEARCH AREA

Objects of research are 3 blocks of the Kaunas New Town (Fig. 1). The New Town area has a really strict and clear structure at first sight. Three main streets crossed by secondary perpendicular streets and forming clear rectangular blocks. However, the clear main structure hides a lot of micro changes inside of the blocks. This exact area has been chosen because of the urban revolution, which happened in Kaunas New Town during history. Every town changes during the time and every new layer should be integrated to a solid frame. The structure of a city should stay stable and sustainable, so it could be recognized as a complex. A city is an open space integrating every urban and social layer, however, sometimes it is visible, that there is an unusual and disproportionate relation between action and reaction, when even minor changes in city tissue can cause vivid urban changes. This process could be called the butterfly effect of cityscape or at first sight invisible urban revolution [10]. Transformation of Kaunas New Town can clearly represent the urban revolution effect in Lithuanian urbanism.

A. Tsarist Russia Period

During this time, the plan of Kaunas New Town was of a home-stead type, buildings were oriented and connected to main streets, while in the back plan there were gardens and area of back-yard. The inside of the block was divided into separate lots. That is why there were no trespassing through the block. The center of it was absolutely private (Fig. 2 a).

B. Modernism Period

In this period, perimeteric view of the block started to dominate. Almost all perimeter was built up and more residential buildings started to rise inside of the block. That is why there was a need to form some streets inside of the block, but still, none of them crossed the block from one side to other and there was no transit inside. The block was still private, its structure was orderly and clear (Fig. 2 b).

C. Soviet Period

During Soviet period, the structure of blocks got scattered because of the division of lots. The size of them varies from really small to huge. The central part gets extremely messy because of lots of semi-private spaces. They get separate entrances, inaccurate passages and parking lots, which are dispersed in every undeveloped part of the block (Fig. 2 c).

Thus, it can be clearly seen that instead of steady evolution in urban structure, real revolution happened inside of the New Town blocks. They became chaotic without clearly defined private and public spaces and with a lot of deadlocks and spaces without clear social and visual control. To clean and manage these kind of places is nobody's responsibility. It brings many problems to those, who live in the block and for those who are only visiting, it makes the block less understandable and readable. It is hard to understand its identity, but easy to get lost in it, because at first it is not possible to tell if there is a passageway through the whole block, or it will end in a deadlock. It is only one step from the main pedestrian street to the block but it entirely loses the identity of the city center and cannot be understood as a part of Kaunas New Town.

III. RESEARCH METHODOLOGY AND ANALYSIS OF SPACE SYNTAX. DIMENSION OF SOCIAL DISTANCE.

Urban and spatial structure of the block is analyzed by space syntax software "DepthMap". Visibility analysis is highly connected to the idea of legibility, therefore, it is chosen for the following research. City, as a structure of various types of spaces and connections, accommodates a lot of information. This information is perceived by people and used for better understanding of the city (its structure, identity, connectivity). Space syntax model represents urban structure as a network of spaces and streets and forecasts potential movement in streets or street-network. While performing visual graph analysis, the analyzed spatial structure is divided into the cells of identical sizes, which are based on personal human distances. Each cell is treated as the node of

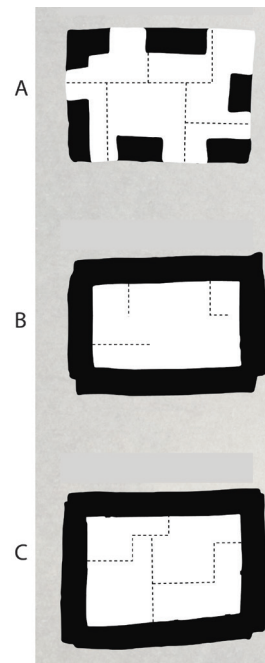


Fig.2. a, b, c. Schemes of block development [Figure: V. Vaitkevičiūtė].

a mathematical graph and all together they make a graph, which represents the analyzed spatial structure. Most of the time it is represented as a dense grid, which is later analyzed mathematically, counting most and least visible parts of the territory and predicting spatial behavior or qualities of the spaces. The mentioned calculations are based on the concept of centrality of importance of the nodes [11]. Even more, it makes it easier to understand and forecast people's movement and possible actions in the environment, to represent places, which are potentially more or less attractive, unsafe, unpopular, etc. The main concepts of this theory are depth and shallowness, integration and controlling, logical symmetry and asymmetry of spaces [12]. This methodology lets analyze not only this network, but also the architectural level of the city. In this case, analysis gets even closer to practice and social level of the city. Urban and architectural changes bring influence on social structure of the city, activity, people actions, that is why it is possible to guess some of the social changes [10], [12]. Previous studies show the reliance between the visibility graph analysis and people's choice of the most visible area [13]. The analysis is performed not only of outdoor spaces, but is also tested with complex indoor structures [14], [15]. This method was used to study the connection and reliance between the usage of streets and mental maps drawn by people [16], [17]. These case studies show strong connection between mathematical and software-based method and people's behavior, which is strongly connected to quality of spaces and later – comfort in surroundings. It clearly indicates that the methodology could be also used to predict and fulfill people's needs in environment.

Visual analysis is performed by two schemes: with an opening in the corner of block of the future project and without it. This change has a great impact on the heritage of New Town and historically. One of the symbols of Kaunas "Merkurijus" supermarket stood there once, but it was demolished because of its unfit façade pointed towards Laisvės avenue. The building on the corner of this block would be the part of perimeteric structure of the New Town blocks, but opening of it may create a potential for a smaller public space inside of the block. Social distance, 80 meters, is also connected to the research. Based on J. Gehl's theory, this distance creates comfortable and social public spaces.

The main idea of this part of analysis was to check the block by 3 components of legibility: seeing (visibility analysis), moving (agent base analysis) and doing (shortest path angle analysis). As it was mentioned before, there are two types of analysis: 1) with "Merkurijus" and without it, and 2) considering the distance of 80 meters and not.

D. Open Corner Case

Visibility analysis has shown that the most visible part of the block would be, of course, the open corner of the block. It forms clear potential for public space. While in the same analysis, but with 80 meters, almost nothing changes at first sight, but it is clear, that inner yards become a bit deeper (dark blue) and bigger visible space appears in the upper crossroad.

Shortest path angle analysis was performed also with and without 80 meters and has shown clear difference this time.

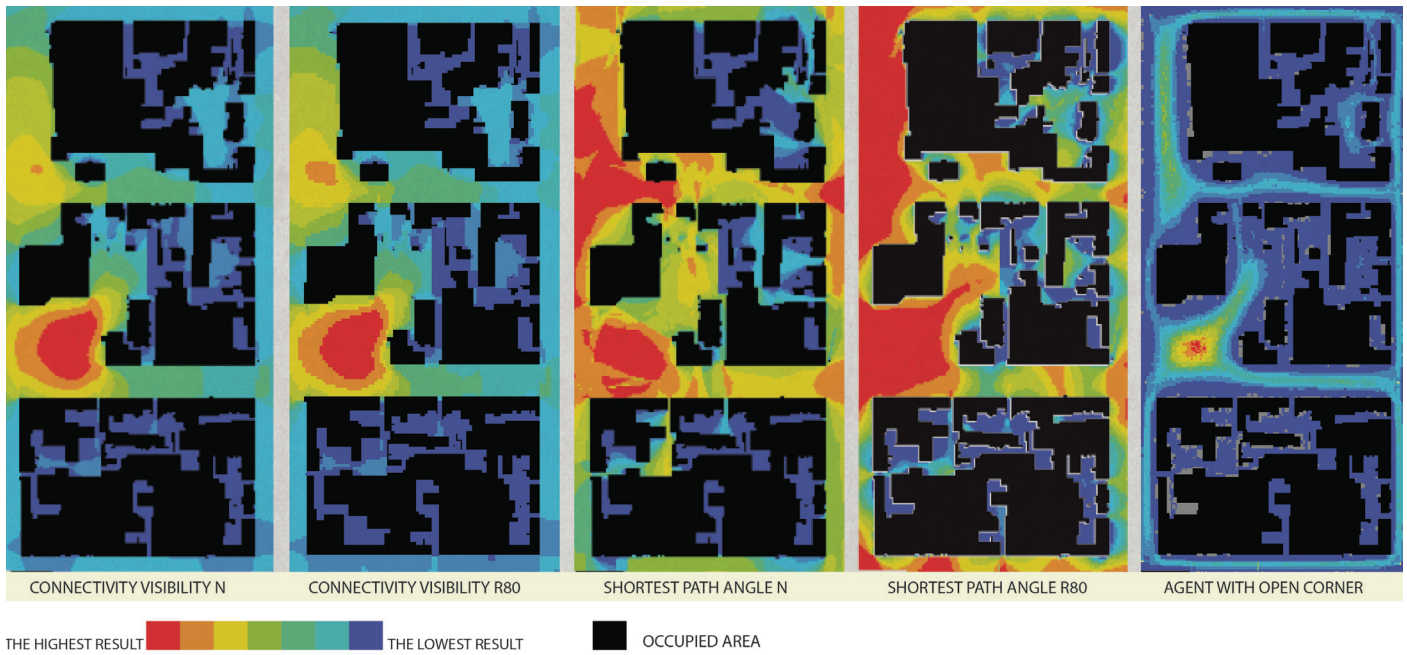


Fig. 3. Open corner case. Space syntax analysis when the corner of the block is open [Figure: V. Vaitkevičiūtė].

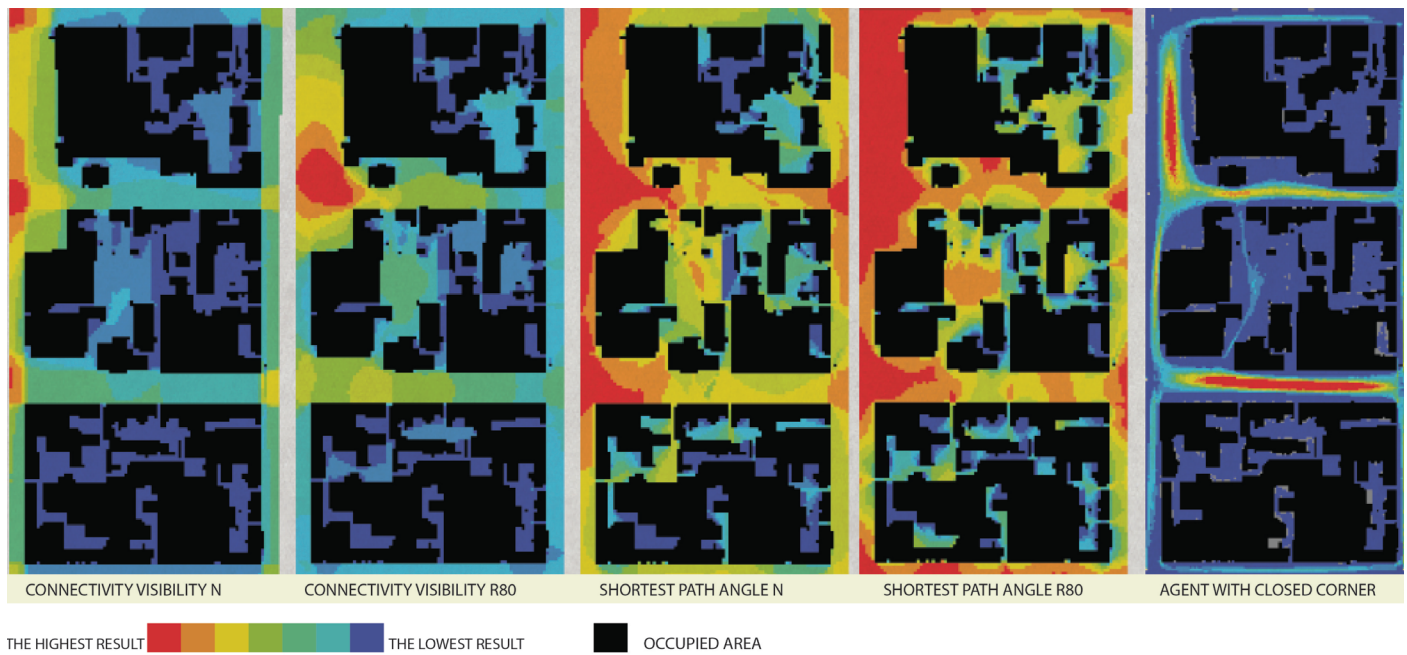


Fig. 4. Closed corner case. Space syntax analysis when the corner of the block is closed [Figure: V. Vaitkevičiūtė].

A smaller public space could appear inside of the block, not only on the obvious corner. 80-meters analysis has shown a bigger potential to connect these two spaces, also, it has highlighted another potential semi-public space inside of the block.

Agent base analysis also has shown clear transition potential through the block and public space in an empty lot. This might be a bit dangerous for the main structure of the New Town, where there are open public streets and there should be clear division,

what is the identity of outside part of the block and what is inside of it (Fig. 3).

E. Closed Corner Case

Visibility analysis with distance n got highlighted almost only intersections of streets. Inside of the block only the space in the back of “Merkurijus” is brighter. However, with 80-meters distance other spaces got brighter: for example, the front side of

“Merkurijus” and bigger space inside of the block. Crossroads got dimmer.

In shortest path angle analysis with distance n , streets and crossroads got highlighted. Inside of the block it can be seen that two different spaces are visible: public (orange, yellow, and green) and private (blue). The pattern seems dispersed and without clear connections. While in the analysis with distance of 80 meters, brighter spots appear and they tend to be connected in one network. Possible paths are connected to potential public space inside of the block.

Agent base analysis has shown that most of the people would choose to walk through the main streets while the corner of the block is closed. But it is visible that there is a potential of small passage way through the center of the block. This kind of block structure would concentrate people’s flows in the main streets and make smaller the flow through the block (Fig.4).

IV. DISCUSSION. STRATEGY OF A LEGIBLE BLOCK

Based on the results of the research, a concept model for a block was created. To create a research-based project while saving the identity of the block, several steps should be taken.

1. Creating an easily recognizable boundary between formal outside and informal inside of the block is essential for keeping the existing margin between main streets and what is inside of the block.
2. Distinguishing two different parts of the inner block – private and public – should be clearly defined to represent one of the needs in legible environment – having clear activity (clearly defined function).
3. Creating a clear division between network of public spaces for locals, living in the block, and visitors reinforces the function (public-private) and makes it easier to understand the network of the block while moving through it.
4. All created public spaces should be no wider than 80 meters. According to Jan Gehl’s theory and research results, it creates more intimate public spaces. This represents one of the three needs – clear visibility.
5. All private yards should be no wider than 35 meters. It could make quiet and cozy spaces for people living in the block.
6. The corner of the block should be partly built up, creating smaller passage to the block, and supporting, but not competing with the main pedestrian street – Laisvės avenue. In this case the street structure would be kept while letting people into the public space of the block.
7. Separating car and pedestrian paths and creating parking system would make moving easier.
8. Creating public program next to Laisvės avenue would supplement the street life and keep public activities in the public space of the block.

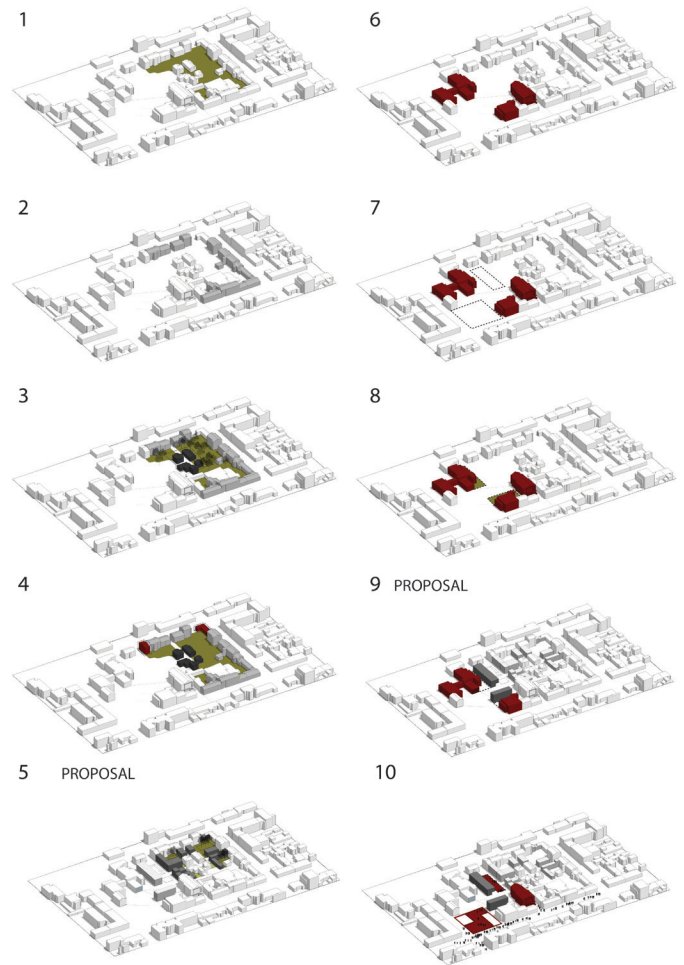


Fig. 5. Existing situation and proposed schemes for private and public parts of the block [Figure: V. Vaitkevičiūtė].

V. DESIGN OF THE BLOCK IN KAUNAS NEW TOWN

Private and public spaces of the block get different strategies based on the existing morphology and function. Problems of existing situation and detailed suggestions to solve them are presented in the schemes in Fig. 5.

1. Yards in the private part of the block are spread and undefined, there is no visible function. Instead, there is undefined parking everywhere.
2. Multi-storey residential buildings form a perimeter.
3. There are private residential buildings inside.
4. There are two small public buildings on the corners.
5. Additional buildings could define private yards of multi-storey buildings (they are no bigger than 35 meters) and create a new quality of living inside of the block.
6. In the public space of the block, 3 free-standing public buildings could be recognized at first.
7. There are two closed and unused lots inside. One of them is a fenced parking, another is a former “Merkurijus” lot,

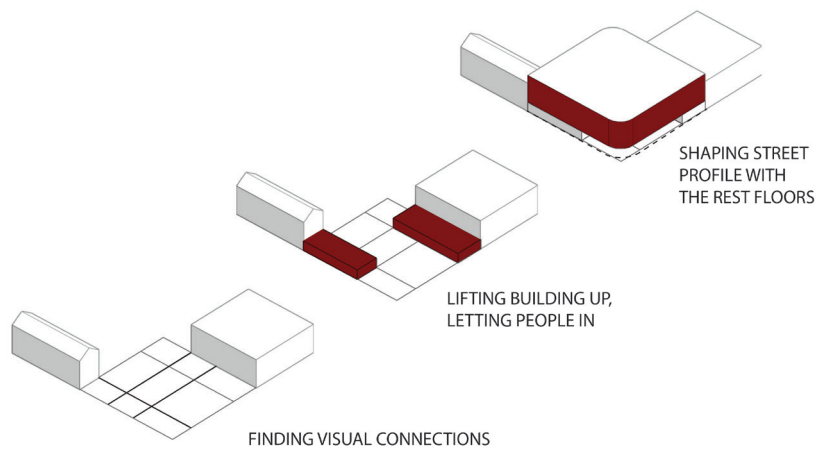


Fig. 6. Shaping of street with the building scheme [Figure: V. Vaitkevičiūtė].

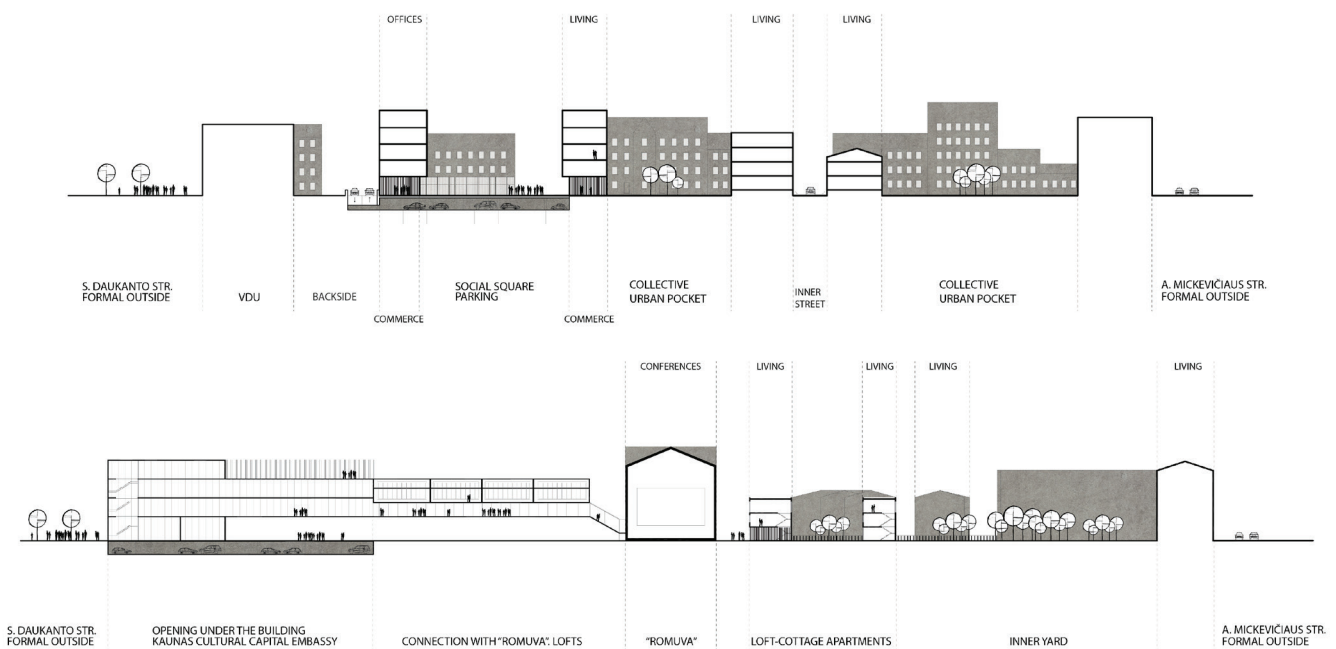


Fig. 7. Division between private and public space shaped by buildings [Figure: V. Vaitkevičiūtė].

which not only closes the block, but also ruins the first row of Laisvės avenue.

8. Some of the backsides of these buildings should be kept due to functionality of the buildings.
9. Additional buildings could keep these backsides functional and form a new quality for the front side, creating some small public spaces (no bigger than 80 meters).
10. A new building could open up the corner of this block and let some people inside, forming a new small public space, which would supplement the function of Laisvės avenue.

The main objective of the building on the corner is to find visual connections and support existing buildings while clearly defining the yards around it, lifting the building up to let people into the block, thus supporting Laisvės avenue and shaping the street profile with the rest of the buildings (Fig. 6).

The division between private/public and back/front sides is clearly visible in the sections (Fig. 7). Private and public spaces of the block and different functions are separated by the buildings. They have front and backsides, which creates easily understandable structure of the block. Multi-function and clear division brings new quality and city center atmosphere to the territory.



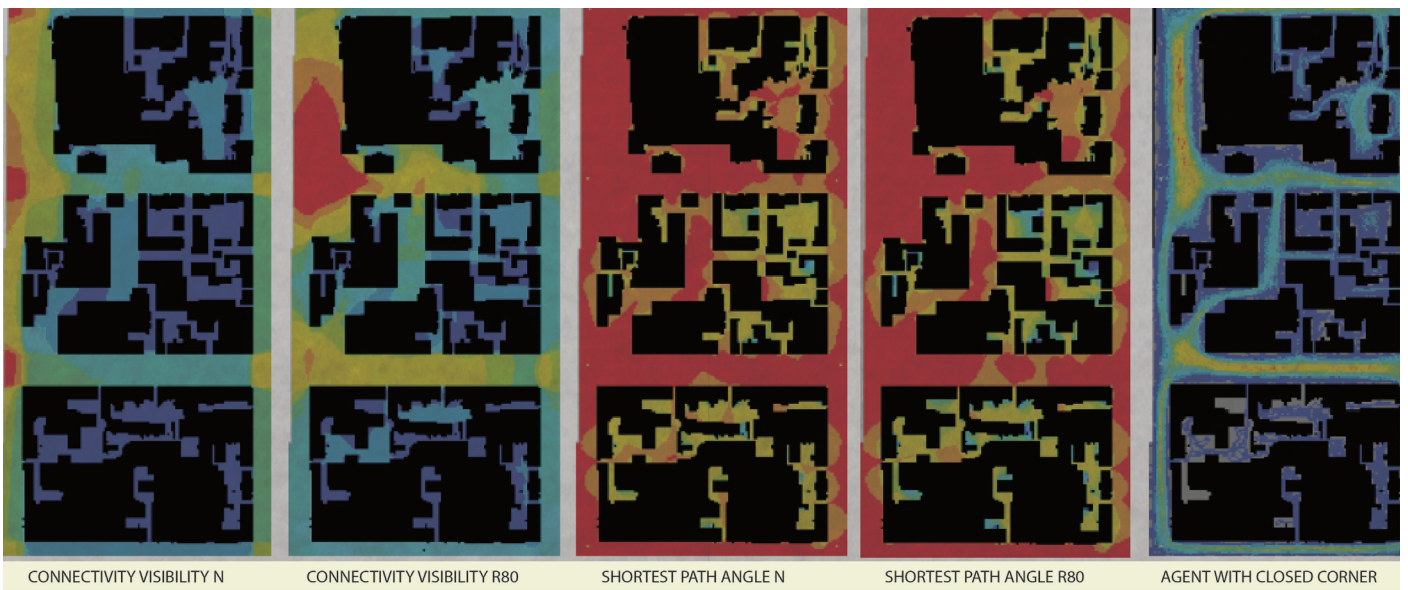
Fig. 8. Axonometric views of situation before and after the design project [Figure: V. Vaitkevičiūtė].

VI. THE BLOCK BEFORE AND AFTER RESHAPING

By using trinomial legibility theory, the whole block was reshaped into a more ordinary place with clear program and function. The difference of the territory before and after the proposal can be seen in axonometric views (Fig. 8). Density of the block and functionality increases, the block is more pedestrian friendly and has clear structure, which is really important for legibility of its urban spaces thus fulfilling 3 needs: **seeing, moving** and **having activity**.

VII. VERIFICATION OF DESIGN AND CONCLUSIONS

The new structure of the block was tested one more time by the DepthMap program, noting visibility and connectivity (with and without social distance). It is recognizable in schemes, that there is a visible depth difference between the created public and private spaces. Agent analysis shows one sharp pedestrian route inside of the block. Other routes and yards stay more private, as it was determined during the strategy phase. Really important aim of this project was to keep the importance of Laisvės avenue.



THE HIGHEST RESULT THE LOWEST RESULT OCCUPIED AREA

Fig. 9. Schemes space syntax analysis of redesigned territory [Figure: V. Vaitkevičiūtė].

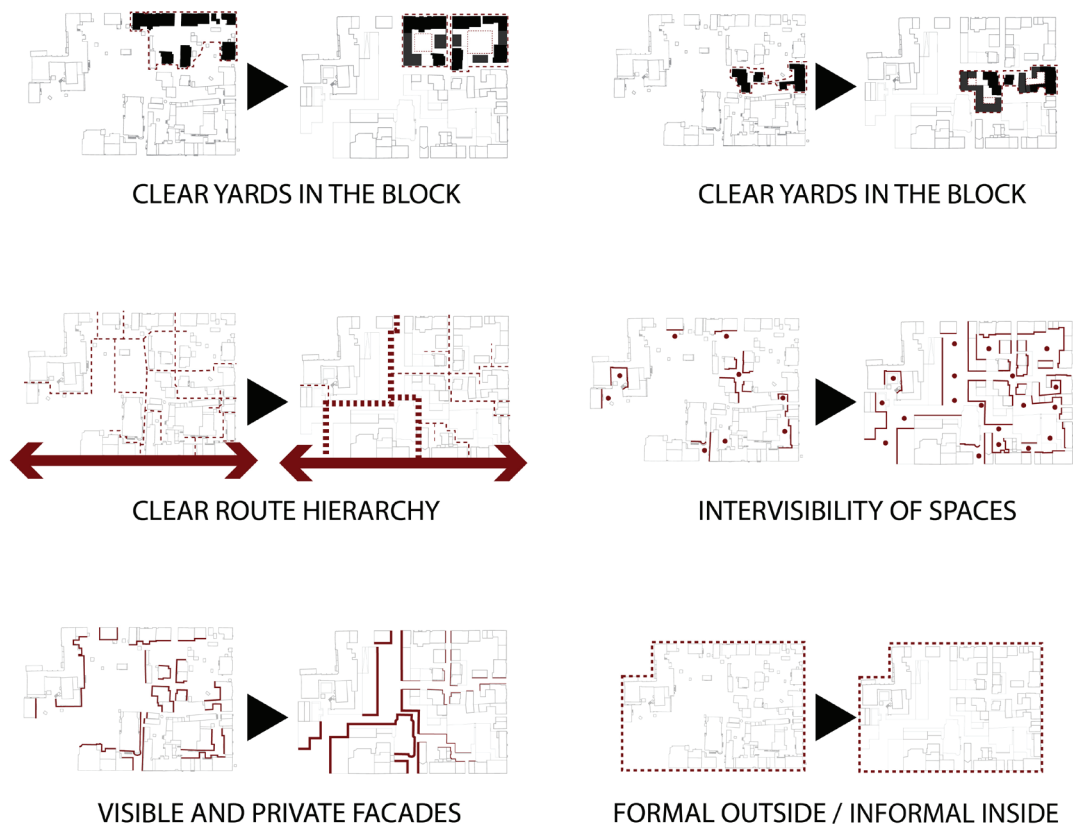


Fig. 10. Concluding schemes [Figure: V. Vaitkevičiūtė].

It is clear that even in small scale analysis Laisvės avenue remains the main route. Therefore, open spaces next to Laisvės avenue will be read as public and inner spaces will stay more closed and private (Fig. 9).

CONCLUSION

The presented network is supplemented by function and fulfills 3 main legibility needs in the environment: **seeing** (theory of 80 meters), **moving** (clear hierarchy of routes), and **activity** (commerce and public function next to the main connections, residential spaces are private, observation of different function facades is different). Summarized conclusions are shown in schemes in Fig. 10:

- Legibility of urban spaces depends on physical environment and perception of it creating mental model of the city. A person experiences environment by wandering in it (flaneur idea). He or she moves, looks around, reads environment. Therefore, all of it can be outlined by 3 main needs in legible environment: moving (good connectivity), seeing (what is public, what is private), and having activity (clear function).
- Network of public spaces continues from Laisvės avenue and has a connection to inner block, where there is a small public space for lunch or shopping. Eastern side of the block remains more private, yards are intimate and people flows are lower than in the western part.
- Primary hypothesis defined legibility of urban spaces as quality of the network, which makes it easier to find way in environment, and had to fulfill people needs. After research, strategy and design phases and verification by space syntax methodology it got clear, that private and public spaces will get potentially separated, the main pedestrian route will be defined, yet residential yards will remain closed. Space syntax has proven that pre-project hypothesis and strategy were right. Fulfilling people's needs in environment makes urban spaces more legible.

The presented block is only a small part of the New Town structure, but transformation of it may cause later changes of the whole neighborhood. Even if every block of this area has its own advantages, problems and identity, it is still a part of fractal structure of the city. Principles of visibility by highlighting people needs, only by changing the strategy, based on exact situation, could be used to develop the whole New Town area. Distinguished public and private spaces, clear pedestrian and car route structure, and clear program of the block could help the city to experience urban evolution instead of chaotic revolution. Space syntax research methods can actually help not only analyze the existing situation, but also forecast the results of urban interventions.

REFERENCES

1. **Lynch, K.** *The Image of the City*. Cambridge: The M.I.T Press, 1960. 208 p.
2. **Benjamin, W.** *The Arcades Project*. Cambridge: Belknap Press, 2002. 1088 p.

3. **Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I., Angel, S.** *Pattern Language: Towns, Buildings, Construction*. New York: Oxford University Press, 1977. 1171 p.
4. **Ostwald, M. J., Vaughan, J.** *Fractal dimension of architecture*. 2016. 423 p. <https://doi.org/10.1007/978-3-319-32426-5>
5. **Carmona, M., Heath, T., Oc, T., Tiesdell, S.** *Public Places – Urban Spaces*. Oxford: Architectural Press, 2003. 394 p.
6. **Gehl, J.** *Cities for People* (1st Edition). Washington: Island Press; 2010. 288 p.
7. **Kaplan, S.** Aesthetics, Affect, and Cognition Environmental Preference from an Evolutionary Perspective. *Environment and Behavior*, 1987, Vol. 19, No. 1, pp. 3–32. <https://doi.org/10.1177/0013916587191001>
8. **Kaplan, R., Kaplan, S., Brown, T.** Environmental Preference: A Comparison of Four Domains of Predictors. *Environment and Behavior*, SAGE Journals, September 1989, Vol. 21, No. 5, pp. 509–530. <https://doi.org/10.1177/0013916589215001>
9. **Csikszentmihalyi, M.** *Flow: The Psychology of Optimal Experience*. New York: Harper and Row, 1990. 336 p.
10. **Zaleckis, K., Matijošaitienė, I.** Hidden urban revolution in Kaunas downtown area: 1935–1988–2011. Proceedings: *Eighth International Space Syntax Symposium*. Edited by M. Greene, J. Reyes and A. Castro. Santiago de Chile: PUC 87. 2012. pp. 8227:1–8227:16.
11. **Turner A., Doxa M., O'Sullivan D., Penn A.** From isovists to visibility graphs: a methodology for the analysis of architectural space. *Environment and Planning B: Planning and Design*, 2001, Vol. 28, pp. 103–121. <https://doi.org/10.1068/b2684>
12. **Tahar, B., Brown, F.** The visibility graph: An approach for the analysis of traditional domestic M'zabite spaces. Proceedings: *4th International Space Syntax Symposium*, London, 2003. Held at UCL, Vol. II, p. 56.
13. **Zaleckis, K.** Role of the urban green structure in creation of preferred urban environment. COST C 11 *Green structures and urban planning*, 2003, pp. 249–255.
14. **Wiener J. M., Franz G., Rossmanith N., Reichelt A., Mallot H. A., Bulthoff H. H.** Isovist analysis captures properties of space relevant for locomotion and experience. ISSN 1468-4233, *Perception*, 2007, Vol. 36, pp. 1066–1083. <https://doi.org/10.1068/p5587>
15. **Hölscher, C., Meilinger, T., Vrachliotis, G., Brösamle, M., & Knauff, M.** Finding the Way Inside: Linking Architectural Design Analysis and Cognitive Processes. (Editors: C. Freksa, M. Knauff, B. Krieg-Brückner, B. Nebel, & T. Barkowsky), *Spatial Cognition IV - Reasoning, Action, Interaction*. International Conference Spatial Cognition 2004, Vol. 3343 of Lecture Notes in Computer Science. Berlin: Springer. pp. 1–23.
16. **Shokouhi, M.** Legible cities: The role of visual clues and pathway configuration in legibility of cities. *4th International Space Syntax Symposium*, London, 2003, pp. 71.1–71.14.
17. **Kim, Y. O., & Penn, A.** Linking the Spatial Syntax of Cognitive Maps To the Spatial Syntax of the Environment. *Environment & Behavior*, 2004, Vol. 36, Issue 4, pp. 483–507. <https://doi.org/10.1177/0013916503261384>



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