

Characterizing sustainability aesthetics of buildings and environments: methodological frame and pilot application to the hybrid environments

Aurelija Daugelaite, Huriye Armagan Dogan, Indre Grazuleviciute-Vileniske
Kaunas University of Technology, Kaunas, Lithuania

Abstract. Growing environmental awareness and emerging design and performance requirements related with the implementation of sustainability goals inevitably have an influence on construction, architecture, urban design and the development of our built environment in general. This influence is reflected both in the increasingly efficient ecological performance of built structures and the growing array of related technologies, and in the aesthetic expression of these environmentally conscious designs. The aesthetic expression of sustainability concept and values is sometimes referred to as sustainability aesthetics. The aim of this research is to develop and test a methodological framework for characterizing the sustainability aesthetics of the built environments. The elaborated methodological framework integrates biophilic design, sustainability aesthetics, regenerative design and genius loci as the most promising approaches, allowing the integration of human and environmental concerns. To test the framework, we selected historic built environments that reflect long-lasting sustainable co-existence between humans and their environment and represent hybrid characteristics of both architectural and urban space. One of the purposes selecting these environments for the case study was to determine the features of an organically evolved sustainability aesthetics that could become a valuable source of inspiration for architectural design and management of the built environments.

Keywords: sustainability aesthetics, hybrid environments, biophilic design, regenerative design, *genius loci*

Introduction

Relevance of research

Growing environmental awareness has raised new challenges for architecture and urbanism of the 20th and 21st centuries. Currently terms “sustainable”, “green”, “ecological” and many others are used daily in scientific literature and media to characterize contemporary built environments. In some cases the “sustainability” label is used for marketing purposes [8]. Vague definition of what sustainable buildings and environments are, causes many scientific discussions [2]. However, the newest debates [2] consider sustainable development as a way of thinking or the direction rather than a single, strictly defined term. Moreover, as C. Owen and K. Dovey [27] note, “sustainability is not a field with institutional boundaries like architecture”, yet is straddles multiple fields including architecture, engineering, urbanism, ecology etc. Herewith, building or any other structure could be considered as sustainable if it is built in an ecologically oriented way that reduces its impact over the environment [2] or even increases the quality of the environment [29]. The concept of sustainability, that could be considered as the first intentional paradigm shift in human history [13], is constantly revised and expanded. The trends of thought of the last decades [2, 10, 13, 20] reveal the shifts in sustainability paradigm that go beyond the sustaining status quo towards systemic, dynamic, organic, holistic and

non-linear approach [20]. The emerging concepts of restorative, regenerative sustainability [29] illustrate the aspiration to restore the lost connection with the natural world and to move towards harmonious co-existence between humans and nature and human-nature co-creation in the living environments of the future.

These changes in the attitudes towards the environment in essence change the architectural expression as well. C. Cucuzzella [8] raises the question: is it possible that “the environmental imperatives are actually imposing a shift in the textual narratives, the visual expression, and the spatial experience of architectural projects?” Actually contemporary design trends move towards so-called “greening” of architecture and urban environments (for example, Barcelona greenery and biodiversity plan) and implementation of environmentally conscious design strategies (for example, biophilic design, biomimicry, regenerative design, cradle-to-cradle approach) that change the aesthetic expression and image of built environments. The emerging trends of peculiar aesthetics of sustainable environments and environmentally conscious building design call for new approaches for understanding and characterizing the sustainability aesthetics [21; 32] of the living environments.

Research aim

The aim of this research was to analyze the existing experience and possibilities of characterizing the sustainability aesthetics of buildings and built environments and to develop and test the methodological frame for this characterization. In order to reach this aim, the literature review of the existing characterization frameworks applied to the environmentally conscious designs was carried out, the existing research gaps were identified and the characterization framework based on the integration of four approaches - biophilic design, sustainability aesthetics, regenerative design and *genius loci* - was developed and tested using as a case study the hybrid built environments in the historic center of Kaunas city.

Research methods

The type of this research is qualitative descriptive study. The methods of research include: literature analysis, concept mapping (mind mapping), comparison and systematization, on-site observation, photographic survey, map analysis, graphical analysis, descriptive analysis. The novelty of this research consists both of development of the framework for characterizing the sustainability aesthetics of buildings and built environments and its testing but also of the employment of mind mapping technique in the research development process and visualization. Mind mapping can be defined as the technique used in brainstorming and allowing deconstructing complex topics by creating a graphical representation of constituent subtopics and related themes [23]; moreover, it allows easier determining and perceiving links between concepts; it is handy for visual representation as well. C. Tattersall et al [33] discussed the possibilities to use mind mapping in scientific qualitative research for such purposes as transcriptions of qualitative interviews and other types of analysis of qualitative data.

Theoretical background and methodology

The relevance of integrative approach in sustainability assessment

In a previous study [18], we analyzed sustainability assessment frameworks and sustainability certification systems for buildings and built environments. Some authors [36] distinguish separate groups of human and ecological criteria in building sustainability assessment systems. Our analysis of the main certification systems (BREAM, LEED, WELL, Living Building Challenge) demonstrated that the majority of criteria applied are two-dimensional, include, for example, an environmental and an economic dimension or an environmental and a social dimension. It is noted

that BREAM and LEED focus on the environmental dimension, while the WELL system focuses on social issues. Fully sustainable development can only be envisioned if sustainability is attained in all its dimensions: environmental, economic, social, and cultural [9]. In conclusion, on the way to the restorative and the regenerative sustainability and design, to a co-evolution of humanity and environment [2; 13; 20], approaches are needed that integrate in a synergistic way human (social, cultural, economic) and environmental criteria.

Moreover, the psychological significance of the environment for human well-being has been highlighted in various recent studies. The concepts of psychologically sustainable architecture [3; 25; 28] and „neuro-architecture“ by M. Bond, 2017 [3] consider the psychological impact of the built environment. In this study we consider aesthetics as a sensory experience and in this the visual experience, although probably the most powerful, forms only part of the whole. Therefore, the methods of aesthetic research commonly used in the humanities, such as analysis of composition that are focused on visual evaluation do not meet the goals of this study. M. DeKay's study on the levels of aesthetic perception of sustainable design [14] encouraged us to distinguish other sensory aesthetic features that have also been described in biophilic design patterns, the *genius loci concept*, and sustainability aesthetics. Many of these features are intangible, e.g. time and change, interaction of light and shadow, and often involve psychological aspects such as feelings of safety and protection, risk-peril or curiosity. It is thus possible to surpass the limits of the simplest visual understanding towards further sensory levels of perception and aesthetics – phenomenological, process, ecological or evolutionary [14].

As a result, the four approaches - biophilic design, sustainability aesthetics, regenerative design and *genius loci* - were identified as having the potential for both the development of three- and four-dimensional criteria for sustainability assessment and the further development of a particular aesthetic expression of sustainability (Fig. 1), which, is still underdeveloped and lags behind the technological, performance-oriented advances in sustainability [38]. The following is a description of the four approaches mentioned above.

Biophilic design

The biophilia hypothesis, which is the basis of increasingly popular biophilic design approach, was developed in 1984 by biologist and philosopher E. O. Wilson. Biophilia hypothesis can be briefly expressed as “innate emotional affiliation of human beings to other living organisms“ [37]. According to J. Krčmářová [24], the biophilia hypothesis was both the outcome of thorough human-environment

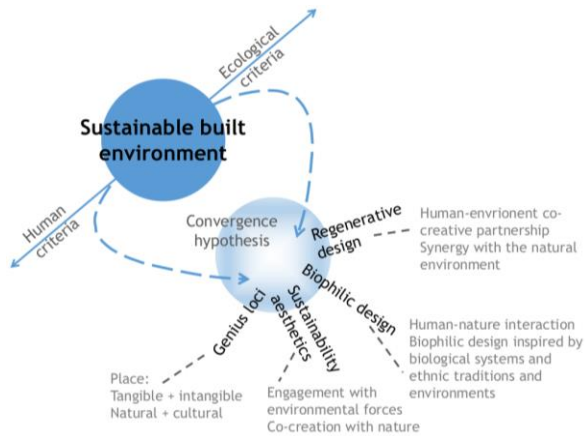


Fig. 1. Concept map of potential synergistic approaches in development and assessment of sustainable built environment [2, 7, 17, 18, 20, 21, 34, 35]

interaction study, but at the same time had an ethical motivation: E. O. Wilson [37] was striving towards “greening” of science and restoring broken human-natural environment connection. Biophilia currently serves as guideline for architectural and urban design [22] but at the same time it is presented as one of biological landscape aesthetics theories [26], stating that our innate affiliation with nature determines aesthetic preferences towards the environments and emphasizes the importance of natural diversity of species and of landscape types. This approach tends to integrate human well-being and healthy physical and psychological development, aesthetic preferences and nature conservation. Several sets of biophilic design guidelines and sets of patterns exist [4, 22]. For example, S. Kellert et al. [22] distinguish six elements of biophilic design - environmental features, natural shapes and forms, natural patterns and processes, light and space, place-based relationships, evolved human-nature relationships - with an array of corresponding attributes. W. Browning et al. 2014 distinguish 14 patterns of biophilic design [4] that are subdivided into three major categories: nature in the space, natural analogues, and nature of the space. Both sets of guidelines correlate highly, although the elements and attributes by S. Kellert et al. [22] are more detailed and the patterns presented by W. Browning et al. [4] are more abstract.

The biophilic design approach distinguishes and discusses aesthetic features encompassing not only visual but also sensory-behavioral (interest, approachability, exportability), cognitive (complexity, organization, modernity, naturalness and beauty) and emotional features, as described in the 2020 study of aesthetic experience by Coburn, et al [6]. The results of their study indicate that „the most salient psychological experiences in the built environment are likely generated by the integration of cognitive, emotional, and sensory information“ [6]. Applying the biophilic design approach to the design of sustainable buildings entails these three major components of aesthetic experience that are not typically considered by

sustainability assessment systems. The complex system of biophilic patterns by W. Browning et al. [4] was too extensive and abstract to briefly and accurately describe aesthetic features. Therefore, the six elements distinguished by S. Kellert et al. [22] were selected as the basis for a concept map describing aesthetic features to characterize sustainable buildings and environments.

Sustainability aesthetics

Even if current implementation of sustainability paradigm is more technologically oriented, the research on the visual culture in the context of sustainability [8] is taking its ground as well. Such authors and researchers are S. J. Zafarmand et al. [39], S. Kagan [21], C. Cucuzzella [8], I. Di Carlo [11]. According to C. Cucuzzella [8], the more complex understanding of the connection between materials and form choices in the sustainable design is needed; moreover, design aesthetics can have re-directive impact towards more environmentally conscious behavior [8, 32]. S. J. Zafarmand et al. [39] distinguish seven attributes relevant to the aesthetics of sustainability: aesthetic durability; aesthetic upgrade-ability and modularity; simplicity and minimalism; logicity and functionality; natural forms and materials; local aesthetic and cultural identity; individuality and diversity. S. Kagan [21] presents the definition of sustainability aesthetics applicable in various contexts: such aesthetics is focused on relations and processes and is based on a “sensibility to patterns that connect at multiple levels and at the same time is attentive to complexity and highlighting the beauty of the complementarity of antagonisms”. He distinguishes such features of sustainability aesthetic as: relation-centered; process-centered; attentive to complexity; combining and contrasting unity; complementarity of antagonisms; open to uncertainties, generativity of chaos, and agitations of disorders.

Regenerative design

Regenerative design is design concept stemming out of regenerative sustainability movement. The field of its application ranges from buildings [2] to landscape management and agricultural practices [17]. According to Ch. du Plessis [13], the regenerative paradigm seeks to “engage with a living world through its emphasis on a co-creative partnership with nature based on strategies of adaptation, resilience and regeneration.” This paradigm bears similarities with sustainability aesthetics approach through its co-creative partnership with nature. Different authors distinguish what regenerative design intervention should be like: according to B. Duarte Dias [12], it should be “highly efficient and low impact” and “integrated with the unique local ecosystems and community, co-creating and developing place to its full potential”; according to A. D. Istiadji et al. [20], such interventions should create “healthier and more resilient living quality and equity of community”;

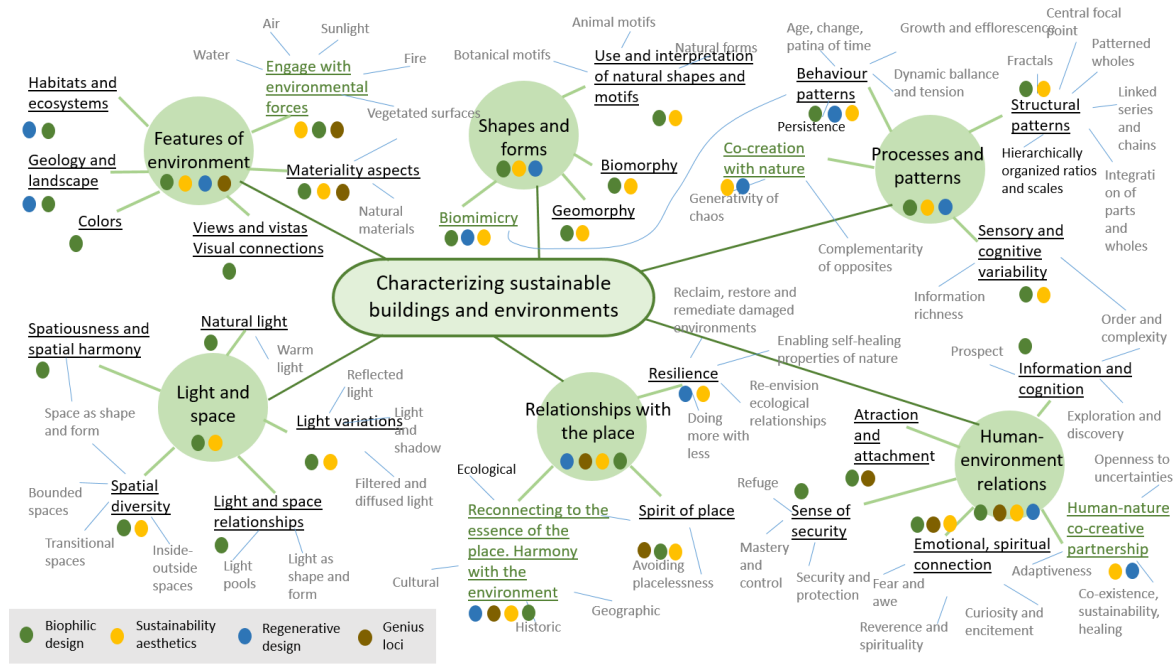


Fig. 2. Concept map demonstrating the interrelations between the above presented approaches and the selected criteria for characterizing sustainable buildings and environments [2, 4, 13, 20, 21, 22, 34, 39]

according to U. Berardi [2], such intervention can become a “live system with dynamic flows with nature”. Even if presented definitions sound like mainly technological challenge, numerous authors [17, 20] argue that the change of the world view is of equal or even greater importance. According to A. D. Istiadji et al. [20] the main challenge in achieving the regenerative paradigm is cultural and human psychological one. This once again reveals the relevance of aesthetic expression in solving what appears a technological challenge from the first glance.

Genius loci

According to V. Stauskas [30], one of the design challenges of the 21st century is to transfer or embody the spirit of place (*genius loci*) in all contemporary architecture. *Genius loci* is usually defined as “as the unity of the tangible and intangible components of the <...> environment, forming the uniqueness of the place” [31] and in the recent years with the advent of the historic urban landscape concept is seen not only as heritage preservation issue but as a resource for urban development [31] and sustainability [34]. *Genius loci*, being the intangible quality of a tangible place, perceived both physically and spiritually [19, 31, 34] links spatial and intangible, natural and cultural aspects of the place and its sustainable development. Empathetic involvement with the place both of designers and users can lead to the phenomenon called *topophilia* – the love of place [26] – the powerful motivator for the environmentally conscious behavior.

The concept map demonstrating the interrelations between the above presented approaches and the selected criteria for characterizing sustainable buildings and environments is presented in the Fig. 2. The criteria

characteristic to these approaches were distinguished in the course of analysis of literature sources: the main sources for biophilic design criteria were S. Kellert et al. [22] and W. Browning et al. [4]; the main sources for sustainability aesthetics were S. Kagan [21] and S. J. Zafarmand et al. [39]; the main sources for regenerative design were Ch. du Plessis [13], U. Berardi [2], A. D. Istiadji et al. [20]; the main source for *genius loci* in the context of sustainability was M. Vecco [34]. Aesthetic features described in sustainability aesthetics, regenerative design and *genius loci* concepts correlated highly with features provided in biophilic patterns, however, there were valuable insights that supplemented the set of criteria. It has also allowed us to distinguish the most important aesthetic features introduced by the four theories and to group them in to the complex system.

All the involved criteria can be subdivided in three groups according to their relation with aesthetic expression and perceptions of the object under consideration: 1-characteristics that define visual expression (for example, colors), 2-characteristics that influence visual expression (for example, behavior patterns), 3-criteria that define aesthetic response (for example, emotional, spiritual connection) (Fig. 4). The *human-environment relation* group includes all the criteria defining aesthetics response. The group *light and space* contains solely the characteristics that directly define visual expression. The group *relationships with the place* contains solely the characteristics that indirectly influence visual expression. The group *features of environment, shapes and forms, processes and patterns* contain both the characteristics that define visual expression and the characteristics that influence visual expression. As the

TABLE 1

Questions for the assessment of aesthetic expression of sustainable buildings and environments
[2, 4, 13, 20, 21, 22, 34, 39]

Features of environment	<ul style="list-style-type: none"> - Are there visual connections between the object and its environment present? - Does the object involve variety of colors characteristic to the environment of locality? - Does the object adapt to local terrain and landscape conditions? - Do the object's design and / or functioning involve landscape restoration? - Does the object express the engagement with environmental forces (water, air, sunlight...) in meaningful and visible way? - Does the object integrate local natural materials? - Does the object integrate ecosystems and habitats in meaningful and visible way?
Shapes and forms	<ul style="list-style-type: none"> - Does the object's design integrate / interpret natural (botanical, animal...) forms and motifs? - Is the object's design based on biomorphic shapes? - Is the object's design based on geomorphic shapes? - Does the object's design mimic nature's forms in functional way?
Light and space	<ul style="list-style-type: none"> - Does the object integrate / provide natural light? - Are light qualities variations, such as diffused, filtered light, light and shadow, reflections present in the object? - Is the interplay between light and space integrated in the object's design in meaningful way? - Is the spatial diversity / variability integrated in the object? - Are the meaningful connections between spaces present in the object? - Does the object create the feeling (image) of spaciousness and harmony?
Relationships with the place	<ul style="list-style-type: none"> - Does the object maintain / contribute to the spirit of place? - Does the object involve restoration of the damaged environment in meaningful and visible way? - Does the object contribute to ecological relationships of the locality in meaningful and visible way? - Does the object employ / demonstrate self-healing qualities of nature? - Does the object connect to the essence of the place in ecological, cultural, historic, geographic dimensions? - Is the object harmoniously integrated in landscape / cityscape?
Processes and patterns	<ul style="list-style-type: none"> - Does the object create sensitive and cognitive variability and / or richness? - Does the object express the process of co-creation with nature? - Does the object express the structural patterns related with fractality, centrality, part-whole integration? - Does the object express in meaningful and visible way the behavior patterns characteristic to natural systems and organisms?
Human environment relations	<ul style="list-style-type: none"> - Does the object stimulate exploration and cognition? - Does the object stimulate the sense of security in users and viewers perception? - Does the object stimulate the sense of attraction / and attachment in users and viewers perception? - Does the object stimulate emotional, spiritual connection with it and its place in users and viewers perception? - Does the object evoke the feeling of continuous human-nature co-creative partnership?

aesthetic perception of ecological environments goes beyond what is immediately visible [14], these criteria, that involve both the appearance, its causes and the aspects of perception can be valuable in constructing the tools for design and better understanding of sustainable environments. Table 2 presents a series of questions formulated in this research aimed at guiding the interpretation of sustainable building or built environment.

Application: case of courtyards as hybrid environments

Definition of courtyards and their relevance.

According to the definition of the courtyard in Cambridge Dictionary [5], the word describes a flat ground area outside, which is partly or entirely surrounded by the walls of a building, with a hard or grass surface depending on the culture and the region. Most of the time, courtyards can be associated with warm climates due to the need for an



Fig. 3. The scheme demonstrating the solid and void space analysis of the segment of the New town of Kaunas and two courtyard spaces selected for further analysis [from authors private archive]

outdoor seating area with shade and water elements. However, courtyards can have other usages as well. According to Edwards et al. [15], courtyards were used as primary meeting places with various functions such as gardening, cooking, working, resting. Therefore, they can provide semi-private spaces for the inhabitants with the specified borders in the cities' urban fabric. However, when the courtyards are in between the block of apartments rather than part of an architectural element of private houses, the management of these spaces can become problematic. Nowadays, most of the courtyards do not contain a lot of function rather than being a parking lot. However, as it is stated by Almhafdy et al., 2013 [1], courtyards can be commonly applied as an element in architectural design in the environment due to their social, environmental, and therapeutic potentials. In that regard, it is possible to evaluate them as hybrid environments that can administrate various functions that support sustainable development. Furthermore, these spaces provide the possibility to their inhabitants regarding the coexistence of different functions and different people, which makes them open to diversity.

As it is presented by the United Nations Sustainable development goals, goal 11 recognizes universal access to green and public spaces for the people [16]. Furthermore, due to the recent developments in the world, that were caused by the Covid-19 pandemic, the requirement for open spaces, where people can spend time, increased. Therefore, it is essential for people to have access to these courtyards as well as green spaces where they can linger. However, the motivation for spending time in these areas can be various and different from individual to individual. Examining the characteristics and the reasons for visiting courtyard spaces can help to understand their usage potential, and furthermore, it can help to offer

relevant functions for supporting sustainability and distinctive aesthetics of these environments. In that regard, a case study area was selected in the New town of Kaunas, Lithuania, which accommodates variously sized and shaped courtyards.

Research process

The research process can be subdivided into several steps. In the first step, the borders of the case study area were decided by the analysis on the map of Kaunas. The segment which was selected for the research is around Nepriklausomybė Square with St. Michael the Archangel's Church, which is located on the main axis of the New town area. In the second step, the courtyards in the selected area were analyzed by the solid and void space analysis to understand the size and shape of them in the two-dimensional plane (Fig. 3.). After this step, the selected area was investigated by visiting the sites to evaluate the spatial configuration of these courtyards; therefore, the analysis at the site involved taking photographs and making sketches of the space. In the investigation process, the courtyards were visited in two different seasons. The first visit was in autumn (October 2020), and the second visit was in summer (June 2021). After all these three steps, two different courtyards were selected as the case study subjects of this research (Fig. 3). The further analysis of two selected courtyards in order to identify their sustainability aesthetics characteristics included: additional on-site observations and photographic survey, graphical analysis and visualization, and descriptive qualitative analysis attempting to answer the questions presented in the table 1. For the graphical analysis and visualization of sustainability aesthetics characteristics the set of icons was developed and applied (Fig. 4).

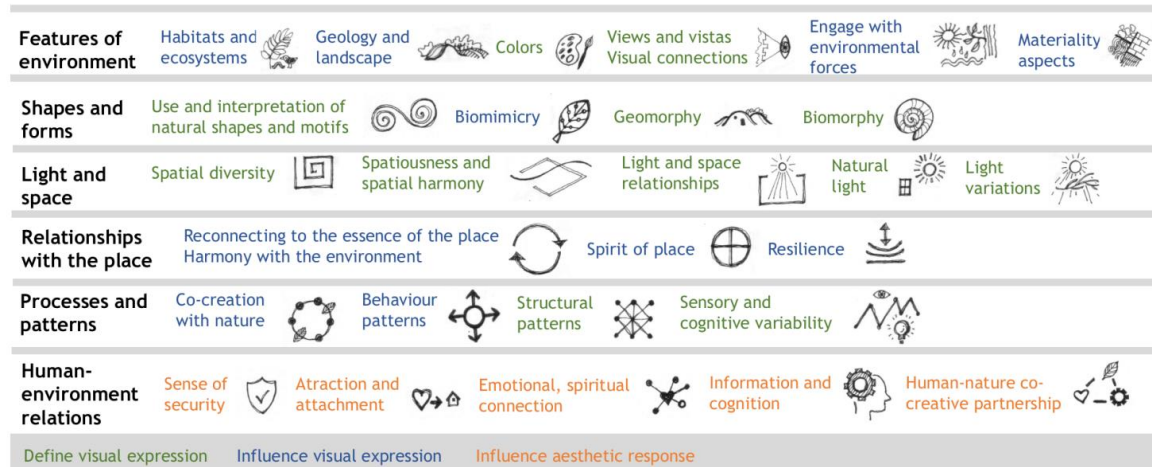


Fig. 4. Icons representing criteria for characterizing sustainable buildings and environments developed in the course of the research and applied in the graphical analysis of the courtyards [from authors private archive]

Research results

The first courtyard (Fig. 5) is at the south-eastern part of the Nepriklausomybē Square, which has a small entrance from the main street. Therefore, the visibility of the courtyard is low and open for surprises for the people who enter it. The courtyard has only one entrance, which makes it a lot more semi-private when it is compared with the other courtyard. In the middle of the courtyard, there is a brick building located that contains geometrical decorations on its façade. When the courtyard is analyzed as a whole, the brick building can be regarded as the centre of the space. The other buildings which are surrounding the courtyard are mostly brick as well, and only one of them contains plaster. Therefore, there is the red brick color dominance in the courtyard.

The building which occupies the central place in the space is closer to one of the edges, which establishes a smaller pathway to the back part of the courtyard and creates a transitional space. Due to the high walls and the spatial composition of this area, there is limited access to the natural light in this area which makes a shaded space both in autumn and summer. Therefore, the light around this place is filtered. The ivy which is covering one of the façades in this pathway gives a vivid colour and a contrast to space. Furthermore, there are small marble art objects located on the windowsills. In that regard, it might be possible to state that this specific part of the courtyard establishes a sense of place, and it is open for emotional connection for the people who are experiencing it. The usage of the courtyard is mainly as a parking lot, however, a small area as a playground is separated at the corner of the space, which gives the impression that this part of the courtyard is more of a living space when it is compared with the other parts. Therefore, the front part of the courtyard evokes the impression which suggests that it is more commonly used by the

inhabitants, while the back of the courtyard seems more discarded. However, the same characteristic of the courtyard also stimulates curiosity and exploration for the people who spend time there.

The storage units which are located at the back part of the courtyard are abandoned and contain considerable decay. The minor part, which is between the border of the courtyard and the storage units, contains trees and weeds, which creates an impression that this part of the courtyard is not actively used and not well maintained by the users. However, due to the massive branches of the trees and the limited area for the movement, this part of the courtyard has an engaging identity. The courtyard as a whole is a hybrid environment which is the result of the human and nature co-creation.

The second courtyard (Fig. 7) is on the opposite side of the first courtyard, and it also has an access point from the main street. However, since it is part of an empty plot rather than being an identified space as a gateway for the courtyard, it does not establish the feeling of an entrance. The courtyard has another opening by an archway from the Nepriklausomybē Square at the side, which contains more of a characteristic of an entrance. Furthermore, the east side of this courtyard also contains the parking lot of the next building, which does not help to have strict borders and establishes an impact that space is not fully identified. As it was detected on the first courtyard as well, this courtyard consists of a building in the middle of it, however, the building divides the courtyard into two different parts rather than being at the centre. The front façade of the central structure has columns which give it an impression of a monumental building. However, when the back façade of the same building is analyzed, it is possible to detect that this part of the structure is quite abandoned, and there is a large amount of decay. Therefore, the sensation which it



Fig. 5. Photographic survey and analysis for the first study area. The particular aesthetic expression of criteria for characterizing sustainable buildings and environments: 1 - sense of place, growth and efflorescence, characteristic brick color, prospect; 2 - sense of security, growth and efflorescence; 3 - sense of security, attraction and attachment, growth and efflorescence; 4 - prospect, openness to uncertainties; 5 - patina of time; 6 - habitats and ecosystems, engagement with environmental forces, openness to uncertainties; 7 - habitats and ecosystems, exploration and discovery, engagement with environmental forces, openness to uncertainties, light variations, inside-outside space

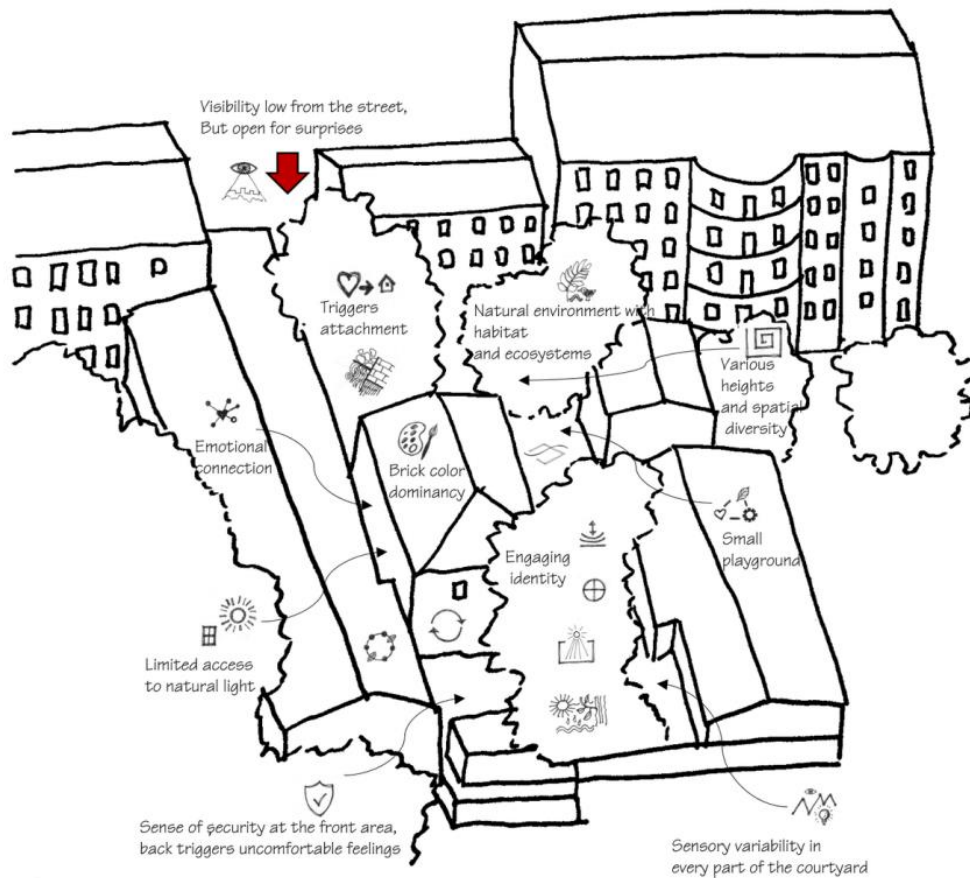


Fig. 6. Graphical representation of sustainability aesthetics features in the first study area

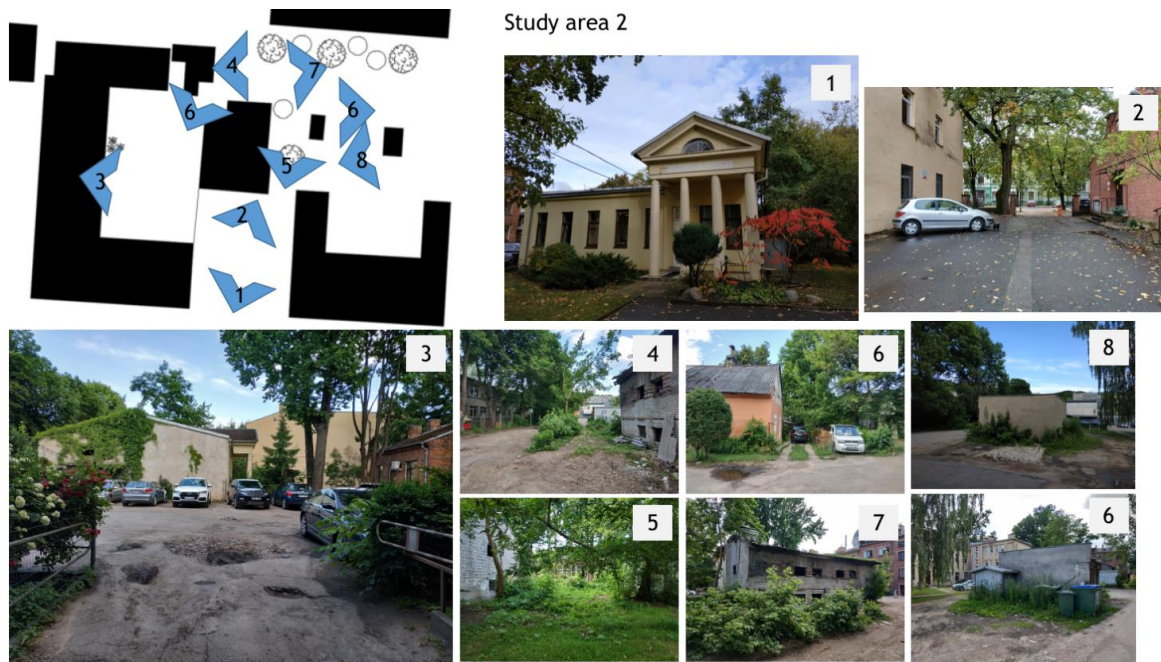


Fig. 7. Photographic survey and analysis for the second study area. The particular aesthetic expression of criteria for characterizing sustainable buildings and environments: 1 - colors, sense of security, sense of place; 2 - prospect, transitional space; 3 - prospect, sense of security; 4 - exploration and discovery, engagement with environmental forces, openness to uncertainties, cognitive variability; 5 - habitats and ecosystems, growth and efflorescence; 6 - resilience, habitats and ecosystems, sense of security, information richness, adaptiveness; 7 - exploration and discovery, engagement with environmental forces, openness to uncertainties; 8 - transitional spaces, habitats and ecosystems, prospect; 9 - transitional spaces, habitats and ecosystems, prospect

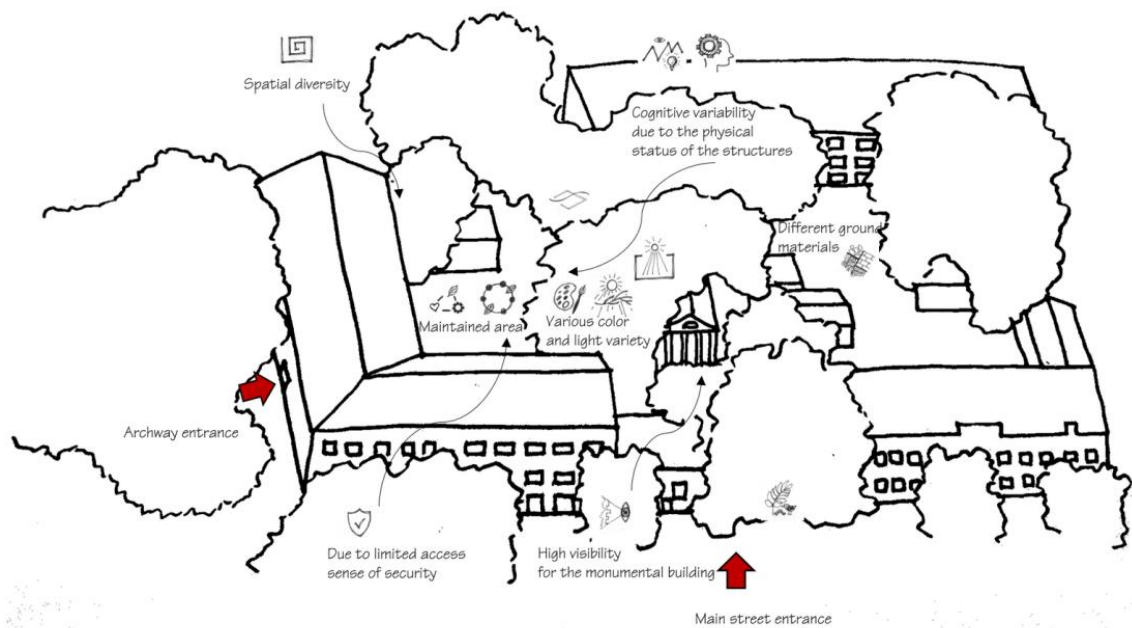


Fig. 8. Graphical representation of sustainability aesthetics features in the second study area

establishes on the observers of the space is different from the other parts of the courtyard. The entrance with the archway has more limited access, and due to the fences at the edges of it, it is more of a private territory when it is compared with the other parts of the space. The fences in this area create a division with the other parts of the courtyard and draw its borders more clearly. The usage of this part of the courtyard is mainly as a parking lot for the buildings which establish the edges of the space. The façades

which are facing this part of the courtyard have various materials and patterns with different spatial compositions.

The second half of the courtyard has a less private identity which establishes the impression that it is more of a public space rather than owned by the buildings nearby. However, the area next to the monumental structure is used by the inhabitants of the building, and it is better maintained. The existence of the fruit trees and the small shed near

the building creates more of a countryside environment rather than an urban fabric. Furthermore, due to the close location of the fruit trees to the structure, they filter the natural light and establish a space that mostly contains shade.

When the courtyard is analyzed as a whole, it is possible to state that it catalyzes different emotions and impressions in each section of it since it has various characteristics. However, it also establishes the sensation that even though it is a hybrid environment, the different parts of the space are not well integrated to each other and they contain different stories both physically and emotionally.

Discussion and Conclusions

The intentional paradigm shift towards sustainability in the last decades of the 20th century and continuous development and application in various fields of sustainability concept change the predominant attitudes towards environment and the design expression and aesthetic perception as well. Besides the increasing ecological performance of buildings and related technological advancements the notion of particular aesthetic expression of sustainability ideas in our living environments is unfolding as well and it is sometimes referred as sustainability aesthetics. However, the qualitative aesthetic side of sustainability paradigm is much less explored compared to quantitative performance side and it is possible to conclude that sustainability aesthetics of the built environments still lacks its own vocabulary.

As it was mentioned above, the concept of sustainability is evolving towards restorative and regenerative and towards the goal of co-evolution of humanity and environment. Such development will require the integrative approaches towards the living environment that integrate environmental, economic, social, and cultural sustainability dimensions in a synergistic way. Biophilic design, sustainability aesthetics, regenerative design and *genius loci* were distinguished as such integrative approaches and applied in the elaboration of methodological frame for characterizing sustainability aesthetics. The concept map approach was selected for developing and visualizing the methodological frame, which was organized around six elements - features of environment, shapes and forms, light and space, processes and patterns, relationships with the place, and human-environment relations - adapted from S.

Kellert et al. [22]. The distinguished criteria grouped around these elements can be subdivided into: defining visual expression (for example, colors), influencing visual expression (for example, behavior patterns), defining aesthetic response (for example, emotional, spiritual connection). These criteria that involve the appearance of the building or environment, its causes and the perceptual aspects were further developed into a series of questions to evaluate the particular space or design.

For testing the developed methodological frame, the courtyards in the historic environment of New Town of Kaunas reflecting long-lasting sustainable co-existence between humans and their environment and representing characteristics of both architectural and urban space were selected. The analysis process involved map analysis, on-site observations and photographic survey, graphical analysis and visualization, and descriptive qualitative analysis attempting to answer the sustainability aesthetics related questions developed in the methodological section.

The analysis of the courtyards has demonstrated that these spaces of quite simple layout create the impression of complex, dynamic, emotionally involving environments from the human eye level. The majority of distinguished characteristics, except ones requiring intentional sustainability oriented design (such as biomimicry), were identified in the analyzed courtyards. It was determined that some sustainability aesthetics characteristics have evolved organically, for example, ecosystems are present in courtyard spaces in unintentional way. Even the supposedly negative environmental features, for example, decaying buildings, can trigger sustainability aesthetics responses. The research has confirmed the importance of new vocabulary for sustainability aesthetics: new language applied for description helps to see the environment differently and to develop empathetic relation with the place. Such sustainability aesthetics analysis could become a part of elaborating maintenance and development guidelines in order not to lose valuable qualities that may lie in such from the first glance undesirable features as re-naturalization and decay in the urban fabric. Moreover, such analysis would allow employing heritage environments that are often partially organically developed, as a source of inspiration for architects and planners.

References

1. **Almhafdy, A., Ibrahim, N., Ahmad, S. S., Yahya, J.** *Analysis of the courtyard functions and its design variants in the Malaysian hospitals.* Procedia - Social and Behavioral Sciences. 2013, 105, p. 171 – 182.
2. **Berardi, U.** *Clarifying the new interpretations of the concept of sustainable building.* Sustainable Cities and Society. 2013, 8, p. 72–78.
3. **Bond, M.** *The hidden ways that architecture affects how you feel.* BBC Futures. 2017. [online 07.07.2021] <https://www.bbc.com/future/article/20170605-the-psychology-behind-your-citys-design>
4. **Browning, W., Ryan, C. and Clancy, J.** *14 patterns of biophilic design: Improving health & well-being in the built environment.* 2014. [online 07.07.2021] <https://www.terrapinbrightgreen.com/wp-content/uploads/2014/09/14-Patterns-of-Biophilic-Design-Terrapin-2014p.pdf>

5. **Cambridge Online Dictionary.** Cambridge, Cambridge University Press. [online 07.07.2021] <https://dictionary.cambridge.org/dictionary/english/courtyard>.
6. **Coburn, A., Vartanian, O., Kenett, Y., Nadal, M., Hartung, F., Hayn-Leichsenring, G., Navarrete, G., González-Mora, J., Chatterjee, A.** *Psychological and neural responses to architectural interiors.* Cortex. 2020, 126. [online 07.07.2021] DOI:10.1016/j.cortex.2020.01.009.
7. **Cole, R. J.** *Building Environmental Assessment Methods: Clarifying Intentions.* Building Research & Information. 1999, vol. 27, No. 4-5, p. 230-246. [online 07.07.2021] DOI:10.1080/096132199369354
8. **Cucuzzella C.** *Is Sustainability Reorienting the Visual Expression of Architecture?* RACAR: revue d'art canadienne / Canadian Art Review Vol. 40, No. 2, Design Studies in Canada (and beyond) / Les études du design au Canada (et au-delà). 2015, p. 86-100.
9. **Culture: the Fourth Pillar of Sustainable Development.** United Cities and Local Governemets. 2010.
10. **Delancey, C.** *Architecture can save the world: building and environmental ethics.* The Philosophical Forum. 2004, 35, 147-159. [online 07.07.2021] DOI:10.1111/j.0031-806X.2004.00167.x.
11. **Di Carlo, I.** *The aesthetic of sustainability: systemic thinking in the evolution of cities.* WIT Transactions on Ecology and The Environment. 2014, 191, p. 27-38.
12. **Duarte Dias B.** *Regenerative Design - new role for the built environment.* CITAD - Research Centrefor Territory Architecture and Design, Lisbon, Portugal. 2013.
13. **Du Plessis, Ch.** *Towards a regenerative paradigm for the built environment.* Building Research & Information 1(40). 2012. p. 7-22. [online 07.07.2021] DOI:10.1080/09613218.2012.628548.
14. **Dekay, M.** *Five levels of sustainable design aesthetics. Perceiving and appreciating developmental complexity.* In: 28th International PLEA Conference on Sustainable Architecture + Urban Design: Opportunities, Limits and Needs - Towards an Environmentally Responsible Architecture proceeding. 2012, p. 7-12.
15. **Edwards, B., Sibley, M., Hakmi, M., Land, P.** *Courtyard housing: past, present and future.* Spon Press. 2006.
16. **Fisher, J. C., Bicknell, J.E., Irvine, K.N., Fernandes, D., Mistry, J., Davies, Z.G.** *Exploring how urban nature is associated with human wellbeing in a neotropical city.* Journal of Landscape and Urban Planning. 2021, p. 212.
17. **Hes, D., Rose, N.** *Shifting from farming to tending the earth: A discussion paper.* Journal of Organics. 2019, 6(1), p. 3-21.
18. **Grazulevičute-Vileniske, I., Viliunas, G., Daugelaite, A.** *The Role of Aesthetics in Building Sustainability Assessment.* Spatium. 2021.
19. **Iqbal, T., Rani, W.N.M.W.M. and Wahab M.H.** *Regenerating the Identity in Historic Waterfront: A Case Study of Central Market Waterfront, Kuala Lumpur.* 1st International Conference on Urban Design and Planning IOP science, Indonesia. 2019, p. 1-11. [online 07.07.2021] DOI: 10.1088/1755-1315/409/1/012001
20. **Istiadji, A.D., Hardiman, G., Satwiko, P.** *What is the sustainable method enough for our built environment?* IOP Conference Series: Earth and Environmental Science. 2018, p. 213. [online 07.07.2021] DOI:012016. 10.1088/1755-1315/213/1/012016.
21. **Kagan S.** *Aesthetics of sustainability: a transdisciplinary sensibility for transformative practices.* Transdisciplinary Journal of Engineering & Science. 2011, vol. 2, p. 65-73.
22. **Kellert S., Heerwagen J.H., Mador, M.L.** *Biophilic Design: the theory, science, and practice of bringing buildings to life.* Wiley. 2013, p. 432.
23. **Kernan, W.D., Basch, C. H., Cadorett, V.** 2017. Using Mind Mapping to Identify Research Topics: A Lesson for Teaching Research Methods. Pedagogy in Health Promotion. 2(4) <https://doi.org/10.1177/2373379917719729>
24. **Krčmářová, J.** *The biophilia hypothesis can be perceived as an interesting manifestation of the greening of science.* Klaudyán: Internet Journal of Historical Geography and Environmental History. 2009, vol. 6/2009, No. 1-2, p. 4-17.
25. **Lindal, P. J., Hartig, T.** *Architectural variation, building height, and the restorative quality of urban residential streetscapes.* Journal of Environmental Psychology. 2013, 33, p. 26-36. [online 07.07.2021] DOI: 10.1016/j.jenvp.2012.09.003
26. **Ode, A., M.S. Tveit, G. Fry.** *Capturing landscape visual character using indicators: touching base with landscape aesthetic theory.* Landscape Research. 2008, 33:1, p. 89 - 117.
27. **Owen C., K. Dovey.** *Fields of Sustainable Architecture.* The Journal of Architecture, 2008, 13,1, p. 9-21.
28. **Ramzy, N.** *Sustainable spaces with psychological connotation: Historical architecture as reference book for biomimetic models with biophilic qualities.* International Journal of Architectural Research. 2015, p. 248-267.
29. **Robinson, J., Cole, R.J.** *Theoretical underpinnings of regenerative sustainability.* Building Research & Information. 2015, p. 43, 133-143. [online 07.07.2021] DOI: 10.1080/09613218.2014.979082
30. **Stauskas, V.** *Kai kurie šiuolaikinės architektūrologijos aspektai.* Town Planning and Architecture. 2009, 33, p. 270-278.
31. **Stepanchuk, A., Gafurova, S., Latypova M.** *Genius Loci as a resource for the development of historical areas of the city.* IOP Conf. Series: Materials Science and Engineering 890. IOP Publishing. 2020, 012013. [online 07.07.2021] DOI:10.1088/1757-899X/890/1/012013
32. **Shrivastava, P.** *Enterprise Sustainability 2.0: Aesthetics of Sustainability.* Pratima Bansal and Andrew J. Hoffman (Eds.) The Oxford Handbook of Business and the Natural Environment, 2012. [online 07.07.2021] <https://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199584451.001.0001/oxfordhb-9780199584451-e-35>
33. **Tattersall, C. Watts, A., Vernon, S.** *Mind mapping as a tool in qualitative research.* Nursingtimes. 2007, vol. 103, issue: 26, p. 32-33
34. **Vecco M.** *Genius loci as a meta-concept.* Journal of Cultural Heritage, Volume 41, 2020, p.225-231. [online 07.07.2021] DOI:10.1016/j.culher.2019.07.001.
35. **Viliūnas G., Gražulevičiūtė-Vilniškė, I.** *Darni architektūra: tarp paveldo ir inovacijų.* Student scientific conference, 2021.
36. **Al Waer, H., Sibley, M.** *Building Sustainability Assessment Methods: Indicators, Applications, Limitations and Development Trends.* Proceedings of Conference on Sustainable Building South East Asia, 11-13 April 2005, Malaysia, pp. 530 - 543.

37. **Wilson E. O.** *Biophilia and conservation ethics*. In: Kellert S. and Wilson E. O. (eds.) *The Biophilia hypothesis*. Shearwater Books, Washington, 1993, p. 31.
38. **Wines, J.** *Green Architecture*. Taschen, Koln, 2002, p. 40.
39. **Zafarmand, S. J., Sugiyama, K., Watanabe, M.** *Aesthetic and Sustainability: The Aesthetic Attributes Promoting Product Sustainability*. *The Journal of Sustainable Product Design*, 2003. [online 07.07.2021]. DOI: 173-186. 10.1007/s10970-005-6157-0.

AUTHORS:

Aurelija Daugelaite; PhD student; Kaunas University of Technology, Faculty of Civil Engineering and Architecture, Studentu st. 48, LT-51367 Kaunas, Lithuania. E-mail: aurelijai@gmail.com

Huriye Armagan Dogan; Dr.; scientific researcher; Kaunas University of Technology, Institute of Architecture and Construction, Tunelio st. 60, LT-44405 Kaunas, Lithuania; huriye.dogan@ktu.edu

Indre Grazuleviciute-Vileniske; dr.; associated professor; Kaunas University of Technology, Faculty of Civil Engineering and Architecture, Studentu st. 48, LT-51367 Kaunas, Lithuania. E-mail: indre.grazuleviciute@ktu.lt

Kopsavilkums. Pieaugošā vides apziņa un jaunās dizaina un darbības prasības, kas saistītas ar ilgtspējības mērķu īstenošanu, neizbēgami ietekmē būvniecību, arhitektūru, pilsētībūvniecību un mūsu apbūvētās vides attīstību kopumā. Šī ietekme izpaužas gan arvien efektīvākā būvēto konstrukciju ekoloģiskajā izpildījumā un pieaugošajā saistīto tehnoloģiju klāstā, gan šo videi draudzīgo dizainu estētiskajā izteiksmē. Ilgtspējības koncepcijas un vērtību estētiskā izpausme dažkārt tiek saukta par ilgtspējības estētiku. Pētījuma mērķis ir izstrādāt un pārbaudīt metodisko ietvaru, lai raksturotu apbūvētās vides ilgtspējības estētiku.