

Editorial

Wissem Gallala

Architecture is at the crossroads of multidisciplinary fields; it is obvious for it to integrate new concepts and encourage new interpretations in all architectural projects in order to create a synergy that must exist in projects which combine other disciplines, e.g., the historical context, the surrounding environment, urbanism, design, occupation of spaces and their components, social dynamics, engineering... All of these factors influence architecture and will be influenced by architecture. In fact, there is a cause-effect reciprocal influence.

The articles in this issue revolve around types of rural architecture in relation to landscape and history. Rural landscapes are always attractive for their beauty and variety. Actually, this is true of the whole rural world. It is through vernacular architecture or mountain huts that the identity of a territory is expressed and perpetuated, a precious element that constitutes our heritage. Beyond its aesthetic value, buildings offer a unique and irreplaceable glimpse of an aspect of intangible heritage: a response to local living conditions and the organization of social life.

Access to nature is not only evident in rural areas. In the urban environment, some people have an instinctive connection with nature, they seek out spaces that reflect the characteristics of the outdoor environment or that offer views and even access to beautiful landscaping, plants and/or landscaping water. Architects use several techniques incorporating biophilic design principles. In fact, the integration of elements of nature and especially water in the built environment improves people's well-being. Water with the hydraulic structures are considered as the core of the urban structures and the various concepts have been proposed since ages. These facilities are part of the heritage and can be valued among tourists.

In the present issue, the first paper "Investigating privacy principles' formation in vernacular architecture of arid and semi-arid parts of Iran" by Aida Shayegani and Viera Joklová focuses on the principle of privacy in the vernacular architecture based on the Iranian or formerly Persian culture, climate, and security conditions. It discusses the role of geopolitical and cultural conditions in the 20th century giving rise to new forms of architectural residential morphology, which do not take into consideration and thus change the principle of intimacy and influence native architectural culture.

The second paper by Damla Katuk and Emine Köseoğlu, entitled "Bibliometric analysis of water at the intersection of environmental psychology and biophilic design", puts emphasis on identifying the current research gaps and key author-concepts by analyzing Scopus and Web of Science databases and using technical mapping when investigating water-related research with the interference of environmental psychology and biophilic design. Bibliometric analysis led the authors to the conclusion that biophilic design is a more recent field than environmental psychology. Furthermore, the new combinations of identified concepts and biophilic architecture approach allow for the creation of new research topics.

In "Traces of former mill races in Krnov: Possibilities of revitalization and interpretation", Juraj Illéš, Viera Joklová, and Agnieszka Jaszczak, carried out an investigation based on different types of documentation (historical maps, cadastral registers, etc.) and field research in order to identify the remains and traces of the old mill races. Despite their commonly seen disappearance from the urban tissue, mill races surely constitute historical and cultural heritage and can contribute significantly to sustainable tourism in urban public spaces.

Mária Novotná contributed with the paper "Alpine huts: Architectural innovations and development in the High Tatras in the second half of the 20th century" which highlights the architectural quality of buildings in the mountain environment and their evolution from post-war modernism to high-tech architecture and postmodernism thanks to new technologies based on several case studies.

Investigating privacy principles' formation in vernacular architecture of arid and semi-arid parts of Iran

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Abstract:

Traditional Iranian architecture principles have deep roots in this region's culture, thoughts, and climatic conditions. Privacy, as one of these principles, which has ever regulated all aspects of life, has been beautifully embodied in the vernacular residential architecture of Iran. It proved to have profound effects which resulted in a specific spatial organization of the house and the placement of various functions, either private or semi-private. Many research studies have claimed that privacy was an attribute of Islamic rules in Iranian architecture. Based on historical and phenomenological analyses of vernacular Iranian architecture this paper strives to confront the privacy principle also according to Iranian (or former Persian) culture, climate, and security conditions. Changed geopolitical and cultural conditions in the 20th century raised new forms of architectural residential morphology almost completely negating the principle of privacy. The question is whether the vernacular principle of privacy should be embodied in the new design of Iranian residential houses or be preserved merely as an expression of former culture increasing the quality of the image of the city and its attractiveness. The research completed by qualitative morphological and analytical methods clarifies the mentioned principles and identifies the definition of privacy, the factors affecting it, the roots of its formation, its influence on the physical-spatial organization of traditional residential architecture in Iran, and its continuation in modern residential architecture in Iran.

Keywords:

privacy, climatic architecture, Iran, Islamic rules, vernacular residential architecture

INTRODUCTION

Throughout the history of humankind, vernacular residential architecture has been constructed with regard to security issues and local sources; its shapes and dispositions have been strongly determined by the utilization of local building materials, the climate, and by the social and cultural conditions. "Vernacular architecture is a good example of intuitive building effectiveness" so as many variables – climate, materials, living styles, are effectively integrated in the architectural morphology (Joklová, Bacoová, 2013). Weather in the major part of the Iranian central plateau is hot and arid (Fig. 1), and many historic cities with valuable architectural designs are located in this hot and arid region (Keshtkaran, 2011). Residential structures in these conditions were characterized by narrow streets and dwelling units turned inward. Narrow streets provided shade from the scorching sun as well as greater protection from the expanding desert and enemy raids. From the 7th century onwards, Iranian architecture was vastly influenced by the principles of Islamic rules, which shaped buildings and the cities' architecture. Besides, Iranian hot and cold climatic regions require a significant amount of energy for heating, cooling, and ventilation. However, with the same climatic conditions in the past, multiple effective strategies have been used in vernacular

residences to confront harsh circumstances (Khalili, Amineldar, 2014). Generally, structures in this region have been logically affected by nature and culture. As a result, unlike many modern facilities, the traditional buildings in Iran are compatible with and have a harmonious relationship with the natural and cultural conditions (Keshtkaran, 2011).

Even in the pre-Islam era, Iranian architecture has paid particular attention to preserving privacy in buildings, this can be perceived in ancient Persepolis city structures or the Apadana principle. This phenomenon, in turn, has led many researchers to consider cultural-religious approaches and climate issues in their design process (Mahdavinejad, 2004). Therefore, traditional architecture can be viewed as a treasure full of concepts and human methods that have worked to pay attention to the security and comfort of the users of the building (Mahdavinejad, 2002). In general, "buildings built by human hands are manifestations of his attitude towards the universe, which is based on the intellectual and social-cultural structure of the people of that society" (Emami, 2011). One of the essential principles that have been paid attention to in the traditional architecture of Iran is the principle of privacy, which is best used in all buildings, from vast and large public buildings to residential houses, and from urban public

spaces to semi-public spaces, which have been used more privately (Seyfian, Mahmudi, 2007). *"The architecture of the past relied on the dignity of man, honouring the position of a man who was the caliph of God on earth"* (Hujjat, 2008).

Indigenous housing in Iranian hot and dry climate has constantly provided thermal comfort for its residents, followed by the coordination of the construction principles according to climatic conditions, environmental mitigation, and energy-saving solutions. The microclimate of the area in which the building is constructed affects the indoor climate of a closed or architectural space. Climate and environmental conditions are critical parameters in a building design. Buildings are designed to achieve or create a suitable atmosphere for human comfort (Givoni, 1976). They provide essential protection against the outdoor climate. Furthermore, they create an artificial indoor environment based on the surrounding microclimate. Architectural elements forming the thermal envelope, such as walls, windows, roofs, and floors,

separate the microclimate and indoor climate and thus influence the indoor climate significantly (Nasrollahi, 2009).

The desire for privacy is a general requirement but relates to variables such as culture, age, gender, personality, and situated factors (Hall, 1966; Altman, Chemers, 1980). This article explores how different conditions affect privacy formation, especially in residential design. It is vital to recognize what privacy is and how it can affect the architecture, especially the layout of the plans, and placement of windows and doors. The research aims to survey the principle of privacy, its historical and phenomenological aspects and the manifestation in the vernacular residential architecture in Iran. The study defines the influence of cultural and religious backgrounds as well as climatic conditions on Iranian architectural style. It raises the questions about the sustainability of this principle in modern architectural design in Iran.

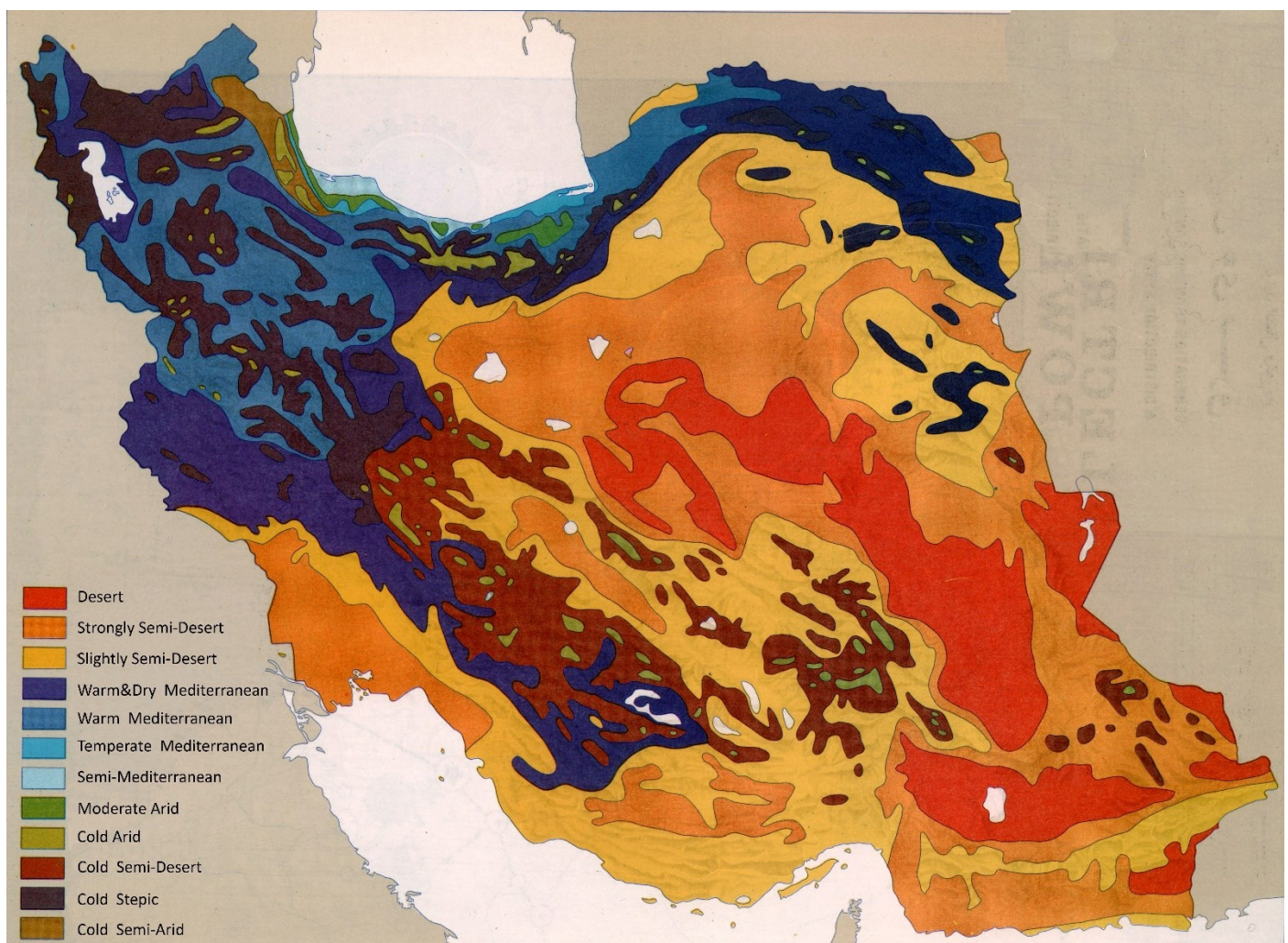


Fig. 1. Bioclimatic map of Iran. (Source: Muassasah i Jughrafiay i va Kartugrafi i Sahab, 1972; modified by authors)

BACKGROUND

In general, we can state that privacy is the right to be let alone. It is one of the main principles of residential architecture and one of the essential rights of the individual. The layout of the apartment or house has to offer spaces for the separation and socialization of an individual, family member or community. *"Privacy is a conventional process by that a person or group of people exposes themselves to others"* (Niay Gharaei, Rafeian, Jalalkamali, 2012).

Altman (1975) defines it as a process to justify the borders among people by a person who supervises their relationship. According to Altman, privacy is a dialectic process built on two powers: "being with others" and "avoiding being with others." According to Gifford's (2002) definition, *"privacy means selective control of access to self, either in person or in terms of information about oneself"* (Niay Gharaei, Rafeian, Jalalkamali, 2012). It can be considered a preference, expectation, value, need, or behaviour. Differences in privacy behaviour originate in personal char-

acteristics, social situations, physical settings, and culture. "Some people, because of their culture, personality, or other characteristics, require more privacy or express privacy needs differently from others. Certain social situations or physical settings, regardless of who is in them, engender different privacy needs" (Gifford, 2002; Altman, 1975; Hall, 1959). In other words, the person or the group chooses mechanisms based on the basis of age, gender, personality, cultural-social background, and situated factors to achieve desired privacy (Altman, Chemers, 1980; Lang, 1987; Niay Gharaei, Rafieian, Jalalkamali, 2012).

Cultural influences on privacy

The desire for privacy varies from one culture to another. Some cultures need more privacy than others (Altman, Chemers, 1980). According to this fact, Hall (1966) classified cultures into two different classes: contact and non-contact. Based on his studies, the spatial behaviour of Mediterranean and northern European people is significantly distinguishable; Mediterranean societies prefer relatively interactive distances, while north European institutions prefer greater interactive lengths. Hall's studies became the basis of subsequent research on the cultural effects on unique behaviour and the personal space of the citizenry. Researchers, working based on Hall's classification, indicating Mediterranean (contact groups) and northern European (non-contact groups) characteristics, supported his results and ideas through surveys they had undertaken (Watson, Graves 1966; Forston, Larson, 1968; Little, Henderson, 1968; Sommer, 1968; Engebretson, Fullmer, 1970; Evans, Howard, 1973; Hayduk, 1994; Sanders, Hakky, Brizzolara; 1985; Remland, Jones, Brinkman, 1995). Consistent with these studies, we can assume that the inhabitants of the northern parts of Iran, where the climate is mild and humid, and the dwellers of central parts of Iran, where the weather is harsher and dryer, would differ in their privacy regulations. According to the participants' cultural background, the people who lived in the central parts of Iran with arid and semi-arid climate conditions would have higher privacy needs in their daily lives than the northern dwellers of Iran (Niay Gharaei, Rafieian, Jalalkamali, 2012).

Privacy in Iranian traditional housing architecture

The meaning of privacy in architectural space and urban planning is to embody the space in such a way that it has privacy from both physical and semantic aspects. Privacy in Iranian architecture comprises security and respect for others' rights (Seyfian, Mahmudi, 2007). Having privacy in the area of the space is more focused on the principles that shape the security of the space and in the semantic area that brings dignity and value to the architectural space in such a way that a person can relax in it (Mahdovinejad, Mashayikhi, 2010). According to the title, a space that physically has privacy, immunity, and security for the user can be considered confidential. Its spatial qualities are such that it provides peace and comfort to the person. It is clear that visual security in this space is only part of its features, and the concept of comfort and relaxation includes a much larger scope. When a person chooses a person as their confidant, they consider the latter trustworthy, secretive, and an insider (Besim Selim, 2002). Therefore, we can state that privacy creates intimacy. The spatial configuration of a traditional residential house in Iran consists of public, semi-public, and private spaces – layers. Semi-public layers are further divided into men's and women's social layers (Fig. 2).

A simple application of two different types of knockers on the entrance door allowed the house's residents to recognize whether the visitor was male or female. "The slot with low pitched sound

was for men, and the one with high pitched sound was for women. This difference helped the house members and the one who opened the door know the gender of the guests from the sound of the slot and be prepared to see them" (Nayyeri Fallah, Khalili, Rasdi, 2014).

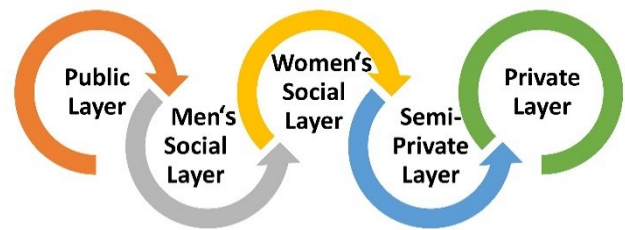


Fig. 2. Scheme of the spatial configuration of a traditional residential house in Iran. (Source: Authors)

The public layer as a boundary space with the public space of the street shows the spatial system of privacy from outside to inside the house. The public space of the house does not allow a view into the internal semi-public or private spaces. Thus the privacy of the dwellers is not disturbed. The Iranian house cannot be seen at once; the spaces organized in these houses are not visible in one picture. One should enter the house, move inside it, and access its various areas (Haeri Mazandarani, 2008) (Fig. 3).

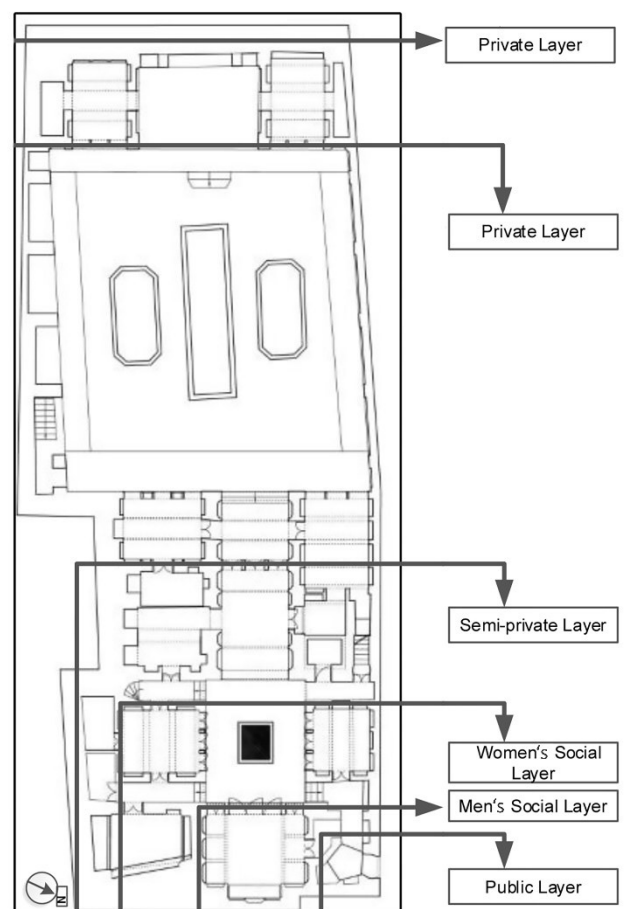


Fig. 3. Interpreted privacy layers within traditional Iranian housing. Boroujerdi House, Kashan, Iran. (Source: Nayyeri Fallah, Khalili, Rasdi, 2014)

The following analyses show the principle of privacy application in traditional Iranian houses; it is necessary to mention that these

are originally the houses of middle-class Iranians. "The entrance space is a place to stay, wait and converse. In some cases, there are some platforms at the sides for sitting, which are used to welcome or companion the guests. In this regard, the entrance was built so that people would not directly and immediately enter the building. Thus, after entering the vestibule, they would enter a corridor placed on the sides of the vestibule and then enter the yard and other internal spaces of the building" (Nayyeri Fallah, Khalili, Tajjuddin, Rasdi, 2015) (Fig. 4). The second house privacy layer is a men's social layer located after the public area. This part is mainly for men's social communication. As such, based on observation and plan layout analysis, the corridor which connects the entrance to this space does not enable the view into the inside of the house. This part of the house usually includes two spaces for the prominent guests and their servants (this area's name is Gholam Gozar in Iranian architectural elements). This way, the hierarchy principle based on social differences is strengthened (Nayyeri Fallah, Khalili, Rasdi, 2014).

The men's social layer is followed by the women's social layer around the house's outdoor yard. This layer of the house has a few sight limitations because of the users' gender. Outdoor service spaces like an outdoor kitchen, sanitary areas, and food storage are inaccessible to men and women coming to the house's social layers. Iranian culture has tried to make desirable social parts

of the house for guests to show the importance of guests for Iranians and their hospitality rooted within them through the linkage of architecture and nature. Based on analyzing the data collected from experts' we can consider the next layer a semi-private zone of the house, which includes a guest bedroom and men's workroom. This part of the house is a border between women's social and private layers (Nayyeri Fallah, Khalili, Amp; Rasdi, 2014). Thus, this border must be crossed to reach the house's personal layer. A traditional Iranian housing space then continues with private layers (the innermost and completely confidential). Based on existing research, these layers are entirely for family life, and strangers' entering without permission into these areas is forbidden. According to the plan layout analysis of the selected traditional case studies, the private layer involves three levels (first floor, ground-, and underground floor) connected by private stairs (Nayyeri Fallah, Khalili, Rasdi, 2014) (Fig. 5). These parts of the house are not only the most distant from the outside, but through using water, flowers, and trees in the inner courtyard, they represent symbolic heaven for the family part and help a family to enjoy a more desirable environment and climate (Nayyeri Fallah, Khalili, Rasdi, 2014).

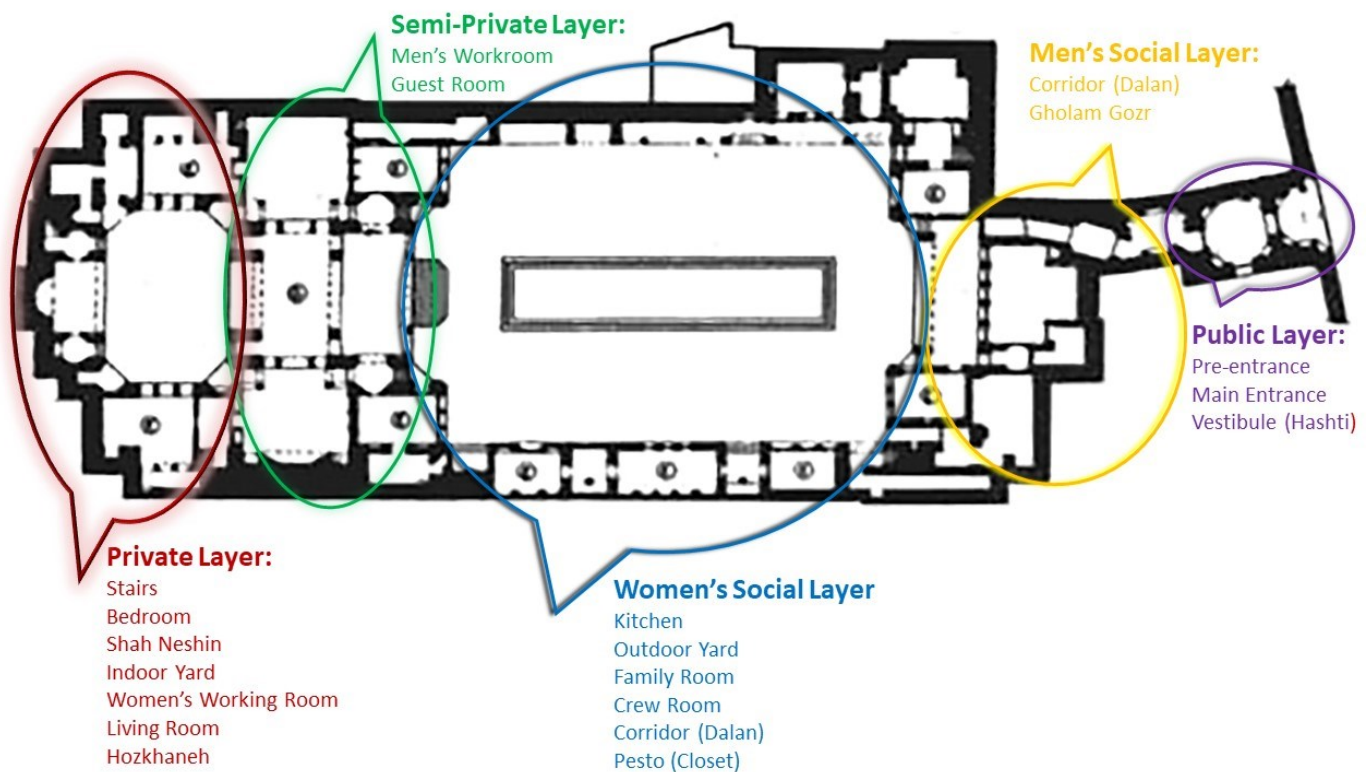


Fig. 4. Analyzing the houses' ground floor layers according to privacy. Borujerdi House, Kashan, Iran. (Source: Authors)

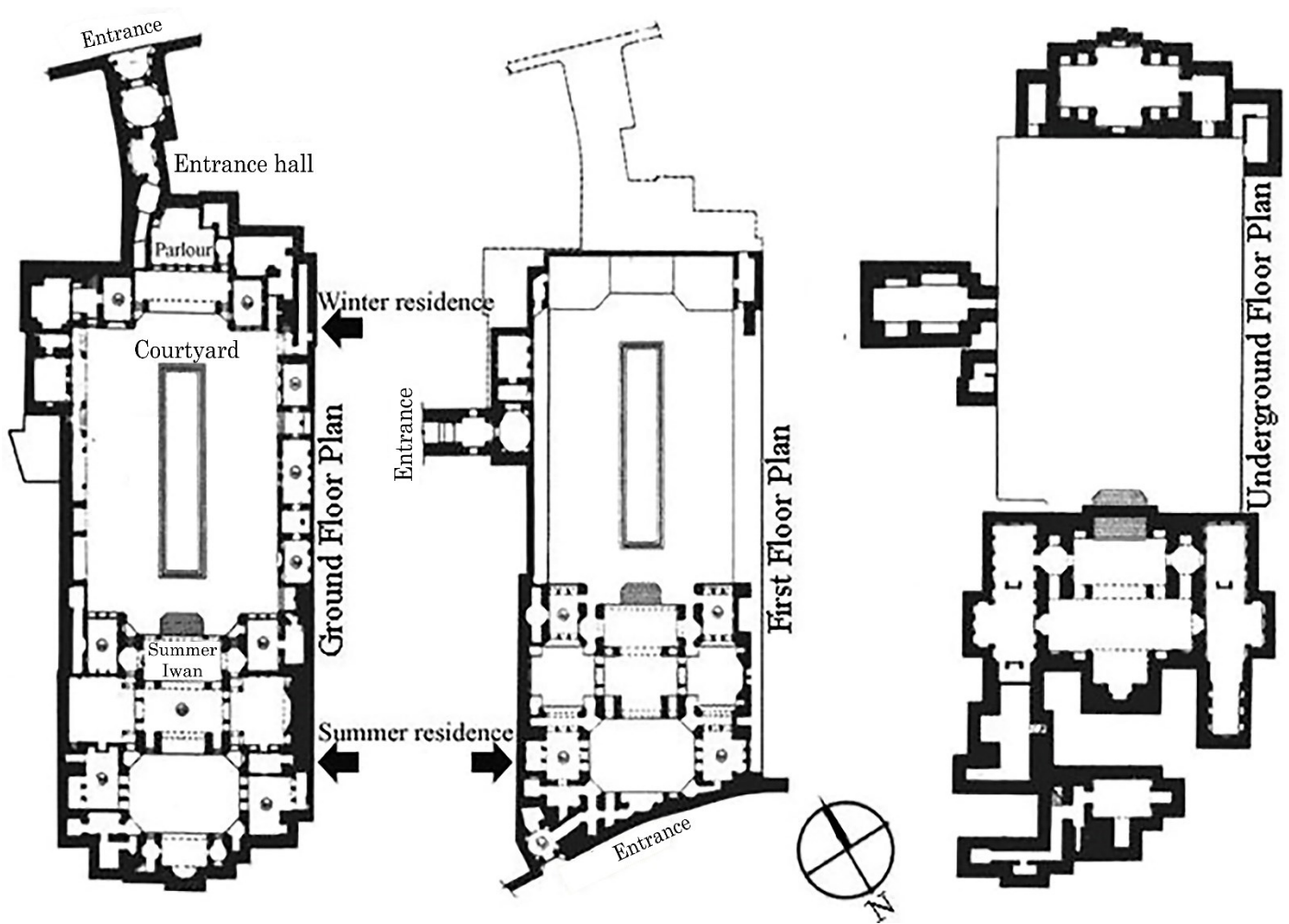


Fig. 5. Borujerdi House, the ground floor, first floor, and underground floor layouts, Kashan, Iran. (Source: Nosratpour, 2012)

MATERIALS, DATA AND METHODS

This research aims to identify the cultural values of traditional Iranian housing in terms of privacy features. The data is a comparison of literary sources and is illustrated through a mixed historical and qualitative research method, document studies, and observation. Based on historical and phenomenological analyses of Iranian vernacular architecture, this paper furthermore strives to confront the privacy principle according to Iranian (or former Persian) culture, climate, and security conditions. Changed geopolitical and cultural conditions in the 20th century helped raise new forms of architectural residential morphology, almost completely negating the principle of privacy. The question is whether the vernacular principle of privacy should be embodied in the new design of Iranian residential houses or just be preserved as an expression of previous cultures and thus increasing the quality of the image of the city and its attractiveness. The research completed by the qualitative morphological and analytical methods seeks to clarify the mentioned principles to identify the definition of privacy, the factors affecting it, the roots of its formation, its influence on the physical-spatial organization of traditional residential architecture in Iran, and its continuation in modern residential architecture in Iran.

Main privacy principles in Iranian housing formation

A. Introversion principle

Phenomenological analysis vindicated this principle as a concept that has existed in Iranian architecture as a specific value. It is

morphologically visible and understandable in different forms that have deep roots in Iranian cultural attitudes. It was strengthened after the new philosophy of Islam and its formation of privacy (Omer, 2010). Regardless, it should be mentioned that the principle of introversion has also been applied in ancient architecture and has survived in residential architecture all over the world to the present days. In the spatial configuration, it is manifested by a central courtyard to which the spaces of family life are oriented (Nayyeri Fallah, Khalili, Rasdi, 2014) (Fig. 6).



Fig. 6. The morphology of a central courtyard, Borujerdi House, Kashan, Iran. Interpretation of introverted architecture. (Source: Hosseini, Nik Etteghad, Uson, Armesto, 2015)

B. Hierarchy principle

Hierarchy (from Greek: hierarkhia) is a way of organizing a system in which every element, except for the highest one, is subordinate to a single superior element. The principle of hierarchy causes the formation of spatial territories with a different function, meaning and importance, and morphology within spatial boundaries. The hierarchy in architecture is most often established through the use of unique shape, size, colour, strategic location, or placement, which define the importance of the specific space (Shah, 2017). It is essential to apply the principle of hierarchy in spatial urban and architectural systems and distinguish public spaces from private ones (Nayyeri Fallah, Khalili, Rasdi, 2014) (Fig. 7). In this regard, when the elements of a building are divided into different parts with distinguishable frameworks and

processes, transferring from one territory to another immediately and without preparing the necessary conditions is undesirable (Ardalan, Bakhtiar, 2000). Privacy limitations are the distance between the most private solitude of the resident in the house and the most public gathering of residents and relatives in the house in the form of intermediate and consecutive spaces. This criterion shapes the spatial hierarchy of the house (Haeri Mazandarani, 2008). We can observe that Iranian traditional architecture has been significantly influenced by "the Design Value of Hierarchy as one of the main principles in the world" (Seyfian, Mahmudi, 2007). Furthermore, "any universe object in the Islamic worldview has a particular place and status whose value and the characteristics of its hierarchy determine the status" (Naghizadeh, 2000).

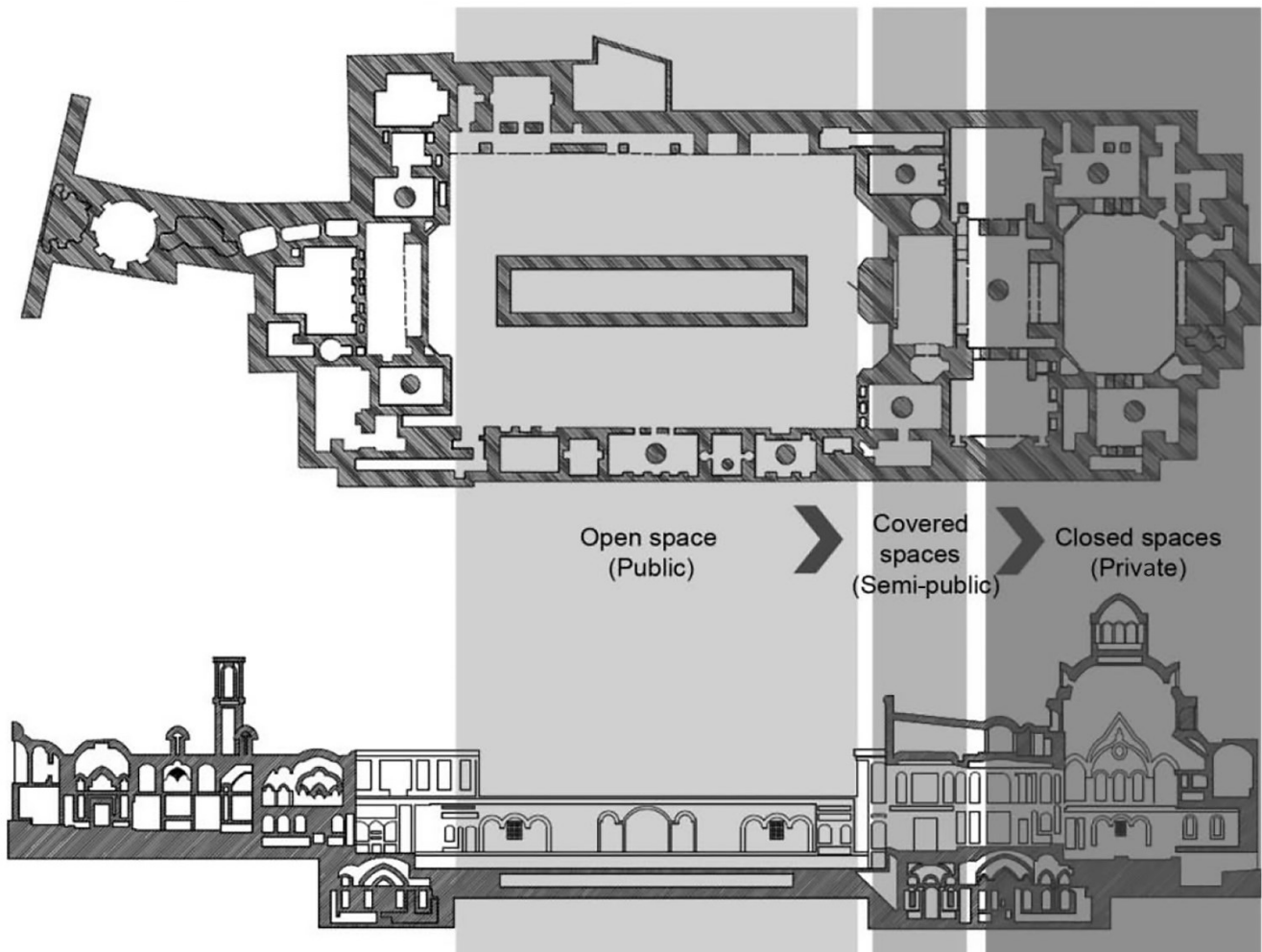


Fig. 7. Interpretation of hierarchical system of privacy in plan and section of Borujerdi house, Kashan, Iran. (Source: Eskandari, 2011, modified by authors)

Formation of privacy factors in Iranian historical houses

Based on the morphological survey of traditional Iranian residential architecture, we can consider two main elements affecting privacy in Iranian vernacular architecture as indicated below: (i) Privacy principles according to culture and religion, (ii) Privacy principles according to climatic conditions. Another point worth mentioning is the issue of security and freedom in the home environment. A person in their private territory achieves a kind of freedom and a sense of security. Vernacular Iranian architecture carries traces of protection against numerous invasions, as well

as protection against the expansion of the desert. The houses possess an innate system of protection. They all have enclosed gardens with maximum privacy, preventing any view into the home from the outside world (Fig. 8).

Privacy principles according to Islamic rules

The culture, religion, and art in Iran mixed with new factors after the rise of Islam. The Islamization of Iran occurred due to the Muslim conquest of Persia in 633–654 AD. Traditional Iranian housing has been merged with religious rituals, principles,

the spirit of thinking, traditions, characteristics, and the attitude of generations. Privacy, as an Islamic principle governing all aspects of life, has formed traditional Iranian housing and has had profound impacts on and outcomes in its spatial organization and function. In this regard, looking at the related verses of the Quran, the features of privacy from the Islamic perspective are understood as the most vital source of learning the principles which explain different behaviours according to respecting other people's privacy. According to Besim Selim (2002), Islamic principles state some points on how to enter a house and ask for permission. Furthermore, they rule the intimate behavioural and verbal manners of people living together in the same house, and thus manage approaches to consider the design of the spaces and house morphology (Nayyeri Fallah, Khalili, Rasdi, 2014). The religion of Islam has clear instructions in this regard as well, and many holy principles have been narrated from Islam's prophet and his siblings, where even the most minor points are mentioned about how to knock on the door, how to get permission, and how to enter them. It is quite evident that the relevant Iranian Muslim architect has also tried the best way to embody these points.

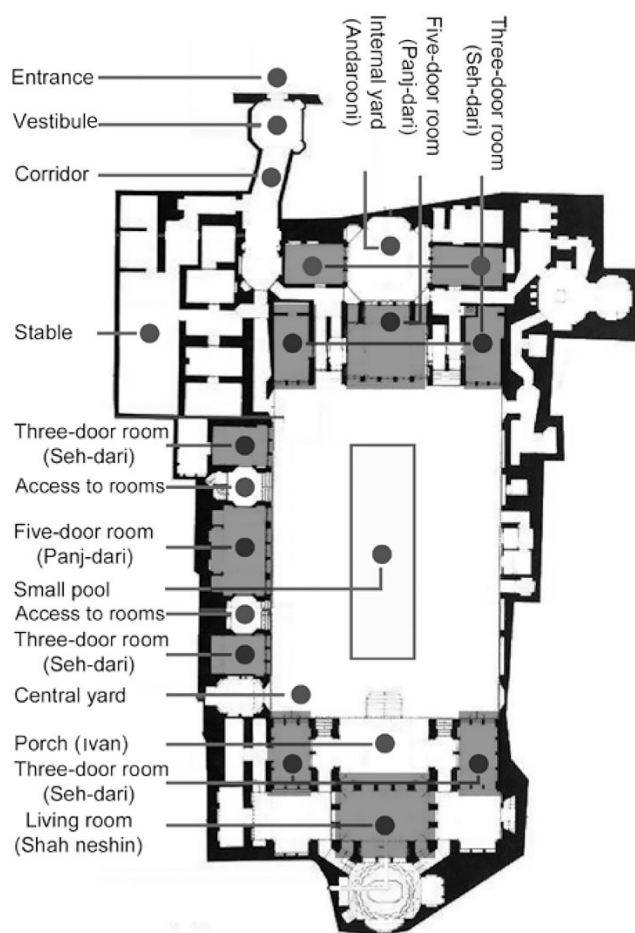


Fig. 8. Spatial arrangement in Sharifian House, Kashan, Iran. (Source: Eskandari, 2011, modified by authors)

Privacy principles according to climatic conditions

Iran lies in a warm climatic district between 25° and 40° latitude. The deserts of northern Africa and Saudi Arabia extend from the Atlantic Ocean in western Africa across Iran and end in Afghanistan and Turkmenistan (Keshtkaran, 2011). Iran has eight different kinds of climatic regions, as follows (Khalili, Amindeldar, 2014):

1. Regions with 'approximately hot summers' and 'nearly cold winters' accompanied by an incredible amount of humidity.
2. High mountainous regions with 'mild summers' and 'frigid winters'.
3. Nearly high mountainous regions, with 'approximately hot summers' and 'almost cold winters'.
4. Low mountainous regions, with warmer summers and winters, compared to the third group.
5. Regions primarily located in central Iran, with 'arid-hot summers' and 'cold winters'.
6. The borders of the Central Desert (Dasht-e Kavir) with extreme hot-arid summers and 'nearly cold winters'. In these areas, achieving human comfort, especially in the hot season, could be very difficult.
7. Regions with very hot and semi-dry summers and moderate winters.
8. Coastlines and islands of the Persian Gulf and Oman Sea, which are very hot and humid in summer and moderate in winter. In this climatic area, hot and humid weather condition makes it challenging to achieve thermal human comfort (Haghparast, Niroumand, 2007).

Two regions from groups 5 and 6 were selected for this study. The air temperature in these regions ranges between 40–45°C and a minimum of 0–5 °C. Total precipitation is meagre, relative humidity is under 30%, with a clear sky during the summer days. In addition, the dusty wind is an essential factor in these unstable regions (Khalili, Amindeldar, 2014).

Climatic issues have always posed serious problems for residents of these regions. Over thousands of years, people were driven to find astonishing solutions to reduce the disturbing aspects of the climate and make use of its convenient aspects, in passive design approaches for dry and hot regions. Such efforts engendered constructional patterns which interact with the nature rather than conflict with it, bringing the benefit of minimized amount of artificial lighting and required cooling. Hence, constructional patterns taking advantage of climatic elements and the environment to produce traditional architecture providing quality and comfort, play a significant role in eliminating the need of high energy consumption. (Khalili, Amindeldar, 2014)

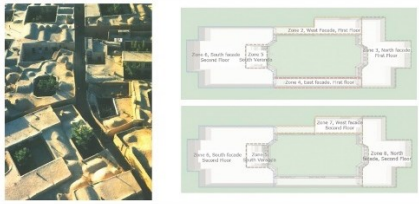
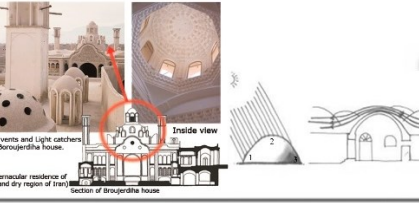
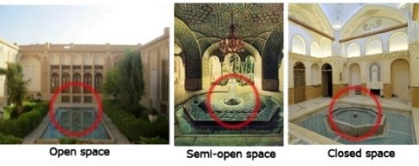

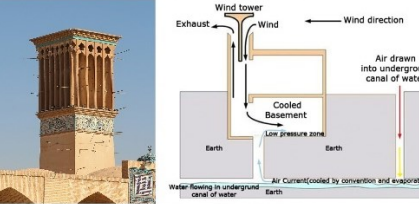
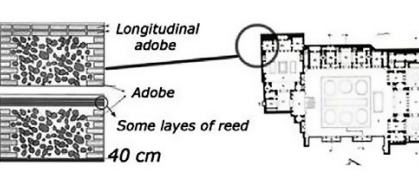
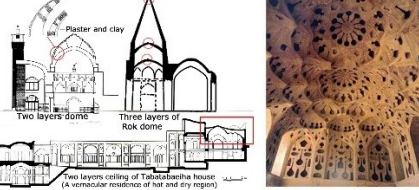
We can observe brilliant morphological solutions developed in such difficult climatic conditions to provide thermal comfort in Iranian vernacular architecture. Building orientation, methods of communication with the ground and underground, introversion and closure, wall thickness, the height of rooms, and applied materials confirm the maturity of the traditional builder's respect to and semiotics with the environment (Khalili, Amindeldar, 2014). Some research studies have proved that spatial proportions, the dimensions of the main structures, and even construction details are based on very precise methods and calculations (Afshar-Naderi, 2003). The most important of them providing residential comfort conditions are:

- Enclosed yard;
- Vaults, domes, and air vents;
- Using water and vegetation;
- Semi-open spaces (veranda or Ivan);
- Wind tower (Badgir);
- Wall thickness, height, and material;

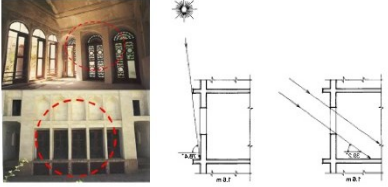
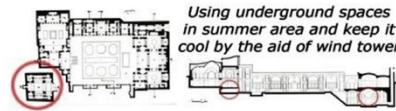


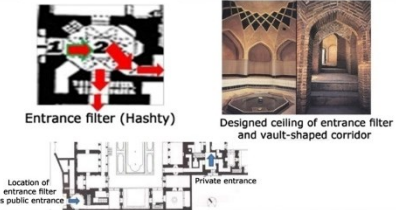
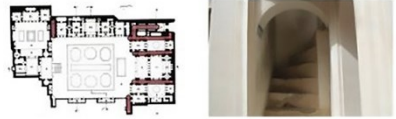
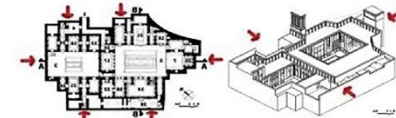
- Multiple-layer ceiling;
- Openings;
- Using underground spaces for cooling;
- Using natural light to the greatest extent;
- Using service areas as temperature filters;
- Using entrance filter.

Tab. 1, 2, and Fig. 9 show the variable strategies of climatic approaches in Iranian vernacular architecture in the mentioned parts of Iran. As evident, the strategies used in plan design and supported climatic architectural approaches act in harmony with introversion and hierarchy in reaching the house's private zone and separating it from the public area.

Tab. 1. Summary of 7 climatic strategies: summary of climatic approaches in Iranian vernacular residential architecture that were used in hot and dry regions. (Source: Saljoughinejad, Rashidi Sharifabad, 2015, modified by authors)

Climatic strategies		Abstract	Diagrams and details
1	Enclosed yard	A central yard, which protected the micro-climate of the yard against the harsh macro-climate of the hot and dry climate outside.	
2	Vaults, domes and air vents	Arched shape of roofs, using adobe and mud. Since they were constantly exposed to the flow of air caused by the wind, it was a useful way to reduce the heat of the roof. They were also combined with air vents.	
3	Using water and vegetation	To humidify and reduce the environmental heat, allowing evaporation and more cooling to the airflows coming through wind towers, air vents and light catchers.	
4	Semi-open spaces	To create more shadow to protect users from direct sun, using high walls and narrow alleys covered by vaults and enclosed spaces.	
5	Wind tower	A tower which made the cool summer breezes drawn into them and penetrate into the buildings, where cooling could be achieved by cross ventilation.	
6	Walls thickness, height, and material	Providing thick walls and roofs, which delay the heat flow within the thermal mass in order to diminish its effect on the indoor environment.	
7	Multiple layers ceiling	Ceilings that were made of multiple layers to minimize heat exchange between inside and the roof.	

Tab. 2. Summary of 7 climatic strategies: summary of climatic approaches in Iranian vernacular residential architecture that were used in hot and dry regions. (Source: Saljoughinejad, Rashidi Sharifabad, 2015, modified by authors)

Climatic strategies		Abstract	Diagrams and details
8	Openings	Openings, with their location, orientation, colour, material, size, and shading, influenced the inside environmental comfort and natural light.	
9	Using underground spaces	Considering the heat capacity of soil and the grounds' minimal temperature exchange which can cause thermal comfort for the residents, underground are perfect places to be utilized as living areas.	
10	Using natural light as possible	Openings, located on the walls and roofs were all considered in a way that all spaces including second-storey rooms and underground spaces received natural light.	
11	Using service areas as filters	Usually service areas were placed around the main living rooms, so they could be a temperature filter between outside and inside spaces.	
12	Entrance filter	An architectural octagonal space designed for the guests in front of the entrance which was utilized as thermal filter.	
13	Corridors	Corridors usually played a role of canal for air flows. The moving air speed gradually increased mainly because of the corridors shape and entered the enclosed yard.	
14	Introversion	The reasons such as getting rid of the dusty weather outside, creating a comfortable micro-climate through the enclosed yard, and cultural issues had made the residences form introverted.	

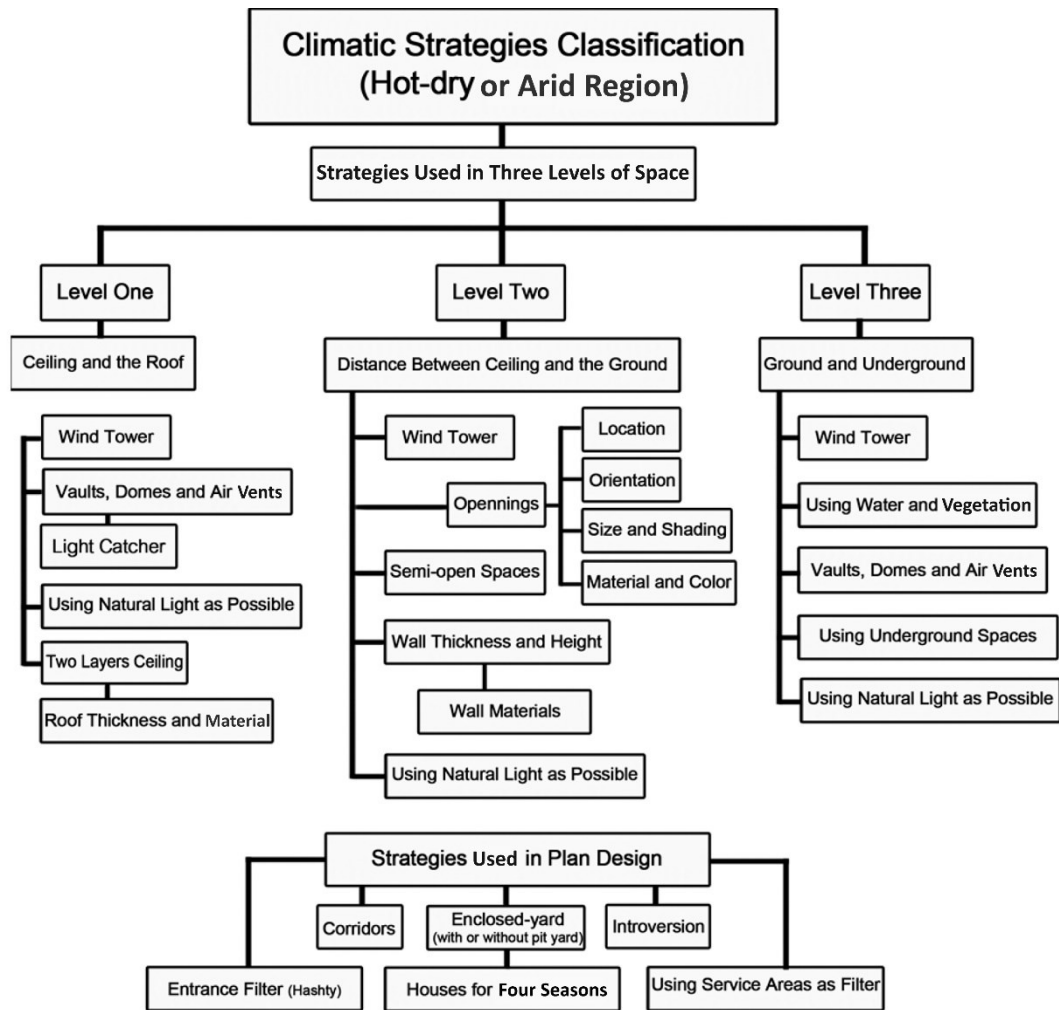


Fig. 9. Climatic strategies classification in the hot and dry region. (Source: Saljoughinejad, Rashidi Sharifabad, 2015)

BASIC MORPHOLOGICAL ELEMENTS OF IRANIAN HOUSE

Among the basic morphological elements of the public and social layers in the traditional Iranian house for middle class residents are:

Entrance and main door

The territory of an Iranian house starts at the outside of the house; the public gradually turns into privacy. Until reaching the inside of the house (courtyard), successive spaces of 'pause and passage' are created. A dedicated space is designed to enter the house, and the concept of privacy and public is reflected in this space; different paths are provided to enter each of these territories from within this space. The house's entrance uses architecture to fit the purpose and preserve relevant traditions. The entrance space is part of a sequence of interconnected and related areas of the whole house. When entering the building in front of the house, they are both an 'obstacle' to entering the non-public premises in house and a place to welcome semi-familiar guests. The greetings are exchanged here, and passers-by may sometimes take a short stop to relieve fatigue and use its shade. The entrance is still a bridge between the privacy of the house, the street, and the neighbourhood (Kateb, 2005) (Fig. 10).



Fig. 10. Gender differentiation by the type of door knockers in traditional Iranian houses. (Source: Raviz, Eteghad, Guardiola, Aira, 2015)

Vestibule

After passing through the entrance, upon entering the house, the visitor should stop in a space offering the possibility of pausing. The entrance sections are dimmed and cooler compared to the passage space. It has a welcoming and relaxing atmosphere; people can stay and talk if needed. The area usually comes in a square, rectangular, or octagonal shape. The door takes a different height. The vestibule is the first space of the Iranian houses that anyone enters; intended to help reduce fatigue and rest until we know which room to go to. There are one or more doors, one or more routes in or from the vestibule; one path goes to the upper house. This way is for those who will not enter the house and the courtyards. One track goes to the yard through the hallway (Haeri Mazandarani, 2008) (Fig. 11).

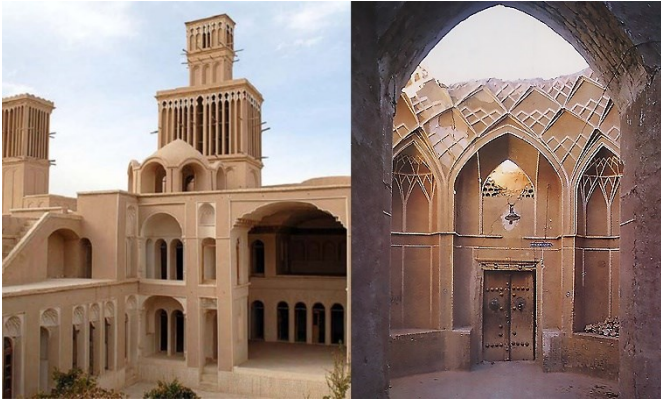


Fig. 11. Aghazadeh Historical House, Yazd, Iran. (Source: left – Hosseini, Nik Eteghad, Uson, Armesto, 2015, right – Reza Haeri, 2012)

Dalan (Corridor)

The hallway is the most straightforward part of the entrance space, which provides communication and access between two places; a corridor indirectly leads to the courtyard. Typically, corridors are physically narrow. Of course, their width is determined according to the function of the building and the number of users. The width of the corridors of mosques and large schools is, on average, between 2 and 3.5 meters, and the width of the corridors of tiny houses is, on average, about one meter (Mahdavinejad, Mansour Pour, Qeiderlou, 2013) (Fig. 12).



Fig. 12. Corridors of traditional houses in Iran. (Source: Authors)

Courtyard

After entering the vestibule, on the way to the corridor, follows the courtyard. The hallway that connects the vestibule to the courtyard is half-dark. The space gradually brightens. A courtyard is a space without a roof with specific bodies, the fronts of the courtyard are formed by the facades of buildings and covered areas, and in the parts where there is no building, the wall plays an active role in defining the courtyard. Almost all the routes, stairs, steps, rooms, and cellars are connected to it (Haeri Mazandarani, 2008). The yard composition in traditional houses is consistent with the variety of physical and spiritual needs. These needs also explain the relationship between the private and public sectors (Fig. 13).



Fig. 13. Ameriha Historical House, Kashan, Iran. (Source: Sarihi, 2015)

DISCUSSION

Identifying the influence of cultural, social, and climatic impacts clarifies the changes in Iranian historical architectural style. The analysis of them through key information instruments revealed that privacy is an inseparable principle in vernacular designing of residential buildings in arid and semi-arid parts of Iran. Furthermore, analyzing the effect of climatic approaches to bring along ventilation and passive cooling, which in turn could minimize the use of fossil energy in the historical architecture of Iran, shows the undeniable effect on the composition of privacy in designing plans. The mentioned approaches play a major role in the privacy shaping of traditional Iranian houses. Considering these two factors behind achieving privacy, the role of architectural elements in creating the required privacy effect in traditional Iranian houses is worth mentioning.

The physical environment of traditional Iranian housing played an important part in achieving desired privacy for settled families. It means that in this context, the ability of architecture is one of the most focal parameters to enhance the quality of residents' life. These parameters, like hierarchy and introversion, shape human values, which are under the cultural understandings of residents about housing and its quality in terms of privacy. Additionally, the research findings show that the spatial organization of the house is a complex mechanism to support residents' familiar life through very exact space differentiation, allowing people to have their personal and interpersonal territories. As a result, these territories created opportunities for residents to have better housing environments.

Based on the plan layout analysis and interpretation, the findings indicate that middle-class Iranian traditional house consists of six different layers in terms of privacy. These layers are public, men's social, women's social, semi-private, private, and personal private (Fig. 14). Such spatial organization is the solution to answer

residents' higher needs based on their cultural values. (Nayyeri Fallah, Khalili, Tajjuddin, Rasdi, 2015)

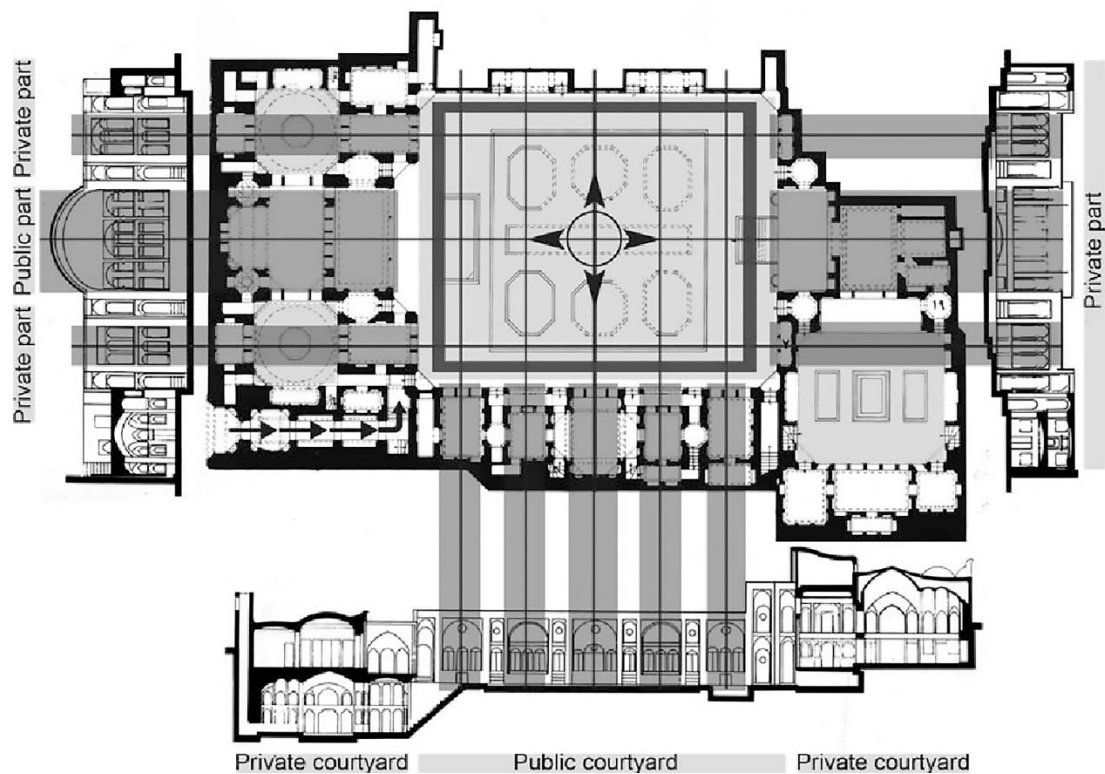


Fig. 14. Spatial organization and privacy hierarchy in Tabatabaei House – Kashan, Iran. (Source: Eskandari, 2011, modified by authors)

Among all the constituting features of privacy, religious or climatic, a specific architectural morphology can be observed, developed and blessed by both these compelling reasons. Changed geopolitical and cultural conditions in the 20th century raised new forms of architectural residential morphology, almost completely negating the principle of privacy. There are ongoing discussions (Masoud, 2020) whether the vernacular principle of privacy should be embodied in the new design of Iranian residential houses or just be preserved as an expression of ancient culture, and thus increasing the quality of the image of the city and its attractiveness. Many modern Iranian architects (Apcar, Forughi, Sadeq, Vartan...) promote modernist principles in their designs of residential architecture with the application of new materials, structures, and layouts; with the principle of privacy being significantly limited.

The contemporary residential architecture of Iran extensively adopts the features of global modern architecture without considering the roots of ancestors' deep creative attitudes. It experiences mass construction mainly because of the population explosion. Based on analyzed data, housing spaces consist of the pre-entrance area, entrance space, kitchen, living room, sanitary space and bathroom, and bedroom(s) (Fig. 15, 16). In most cases, there are no men's social layers. The residents of modern middle-class housing no longer have such a range of privacy like in the past. The modern housing layout reflects the social, cultural, and economic changes in the life of the inhabitants of Iranian cities and neglects traditional cultural values.

CONCLUSION

It can be stated that the climatic approaches and striving for sustainable design, together with cultural background, family lifestyle, the pattern of social relations, and behavioural criteria of Iranians, have been essential and practical principles for ensuring privacy in traditional Iranian homes. Based on many pieces of research, the origin of privacy principles in Iranian vernacular residential architecture was attributed to Islamic rules, but as we investigated in this paper, not only is privacy caused by religion but also by security reasons and climatic design measures. Though it is undeniable that after Islam, privacy rules have been considered more than before. However, changes in the way of life, social, and cultural spheres led to the need to reassess the sustainability of the privacy principle being strictly applied in residential architecture in Iran.

State policies that supported women's education and employment in the last century freed women from households and supported their aspirations for modern housing. We can observe that contemporary people desire to reveal, express, and expose themselves to others. It is as if people no longer have many things to hide that require high walls and fences in the house, and that they will only worry about the loss of property and material assets inside the house, and not about social relations, privacy, or human values. This is because a "global citizen" is born in one place, studies in another, and works in different lands. Therefore, the concept of home, paternal home, ancestral land, homeland, and pri-

vate home will no longer evoke that traditional concept in them. Due to the emergence of a kind of uniformity and homogenization in the culture of houses, “global citizens” will probably forget the native architectural cultures. At the same time, one should know and respect the local styles of architecture and house building.

Knowing that the relationship between housing and culture will never be the same as in the past, a new logic and research should be established on how to preserve and evolve the native architectural culture in different regions of the country by creating a relationship of another kind.



Fig. 15: Analyzing the middle-class modern Iranian housing from the aspect of privacy, Shiraz, Iran, 2009. (Source: Authors)



Fig. 16: Analyzing the middle-class modern Iranian housing from the aspect of privacy, Tehran, Iran, 2014. (Source: Authors)

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Bibliometric analysis of water at the intersection of environmental psychology and biophilic design

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Abstract: Water is the subject of study in many scientific fields. The relationship between water and space in architecture is connected with environmental psychology and biophilic design. Therefore, this study seeks to explore the research related to water at the intersection of environmental psychology and biophilic design, to identify current research gaps and primary authors and concepts. The method applied herein is bibliometric analysis with the science mapping technique, covering the documents held on Scopus and Web of Science Core Collection databases. The keywords *environmental psychology*, *biophilic design*, and *water* are selected for the systematically analysed scan performed in Scopus and Web of Science Core Collection databases. After collecting the bibliometric data of a total of 292 documents from the databases on 1 May 2022, the downloaded .csv and .txt data files were transferred to VOSviewer (1.6.18.0). Firstly, descriptive data was examined on the Scopus and Web of Science Core Collection databases. Secondly, visualizations were created via the science mapping techniques by VOSviewer. The selected bibliometric analysis with science mapping techniques represents co-authorship data by the authors, co-occurrences data by author keywords, citation data by documents, co-citation data by the cited references, and co-citation data by the cited authors. As a result, twelve primary authors and five concepts have been identified. The concepts for the gaps are biophilic design, biophilia, emotional design, perception, and architectural design. The critical result is that in the approach to the relationship between space and water in architecture, biophilic design has been found to be a more recent field than environmental psychology. So, the concepts ascertained in this study – and especially the newly established combinations with the biophilic architecture – are going to have a growing tendency in architecture.

Keywords:

water, biophilic design, environmental psychology, bibliometrics, VOSviewer

INTRODUCTION

Environmental psychology is one of the fields that examine human relationships with nature. Another concept that attempts to describe humans' instinctive connection with the natural world is biophilia. In the present case, biophilic design is an additional field that examines the human-nature relationship. Environmental psychology and biophilic design are the fields that are related to architecture, built environment and natural environment. So, it has been seen that water can be a common intersection point of both environmental psychology and biophilic design with an architectural approach. Within the scope of this study, water –at the intersection of environmental psychology and biophilic design– is the main focus. This work is a part of an ongoing research on perceptual and affective aspects of water in terms of biophilic design.

As a subject matter, water at the intersection of environmental psychology and biophilic design has demonstrated diversity. For instance, some studies of this intersection focused on subjective scales (Boffi, Pola, Fumagalli, Fermani, Senes, Inghilleri, 2021), while others approached the subject by focusing on the spatial scales (Beatley, Newman, 2013). Firstly, subjective scales were related to age and user profile, such as older people (Peters,

Verderber, 2022), young people (students) (Peters, D'Penna, 2020), and children (Zamani, 2017). Secondly, these scales dealt with psychological health and well-being, such as restorative benefits (Gillis, Gatersleben, 2015), attention restoration (Boffi, Pola, Fumagalli, Fermani, Senes, Inghilleri, 2021), dementia and cognitive disorders (Peters, Verderber, 2022), and affective benefits (White, Smith, Humphries, Pahl, Snelling, De-pledge, 2010). Spatial scales, on the other hand, were firstly related to design and space, such as biophilic cities (Beatley, Newman, 2013), sustainable behaviour (Corral-Verdugo, Mireles-Acosta, Tapia-Fonllem, Fraijo-Sing, 2011) and pro-ecological behaviours (Kaiser, 1998). Secondly, spatial scales were used to assess building features, such as interior-exterior space (Nevzati, Demirbaş, Hasırcı, 2021) and function (Peters, D'Penna, 2020). Further, some review studies have discussed subjective and spatial scales and provided additional investigation areas that could be considered for water at the intersection of environmental psychology and biophilic design (Gillis, Gatersleben, 2015; Jo, Song, Miyazaki, 2019; Hung, Chang, 2021).

In terms of subjective scales, the category *older people* was related to the attention restoration theory which was one of the terms that psychological health and well-being included at this intersection. Boffi, Pola, Fumagalli, Fermani, Senes, Inghilleri

(2021) presented this relation as a design method with a biophilic approach by the people's experiences in natural environments. In their study, being in contact with water or water elements –which was recognized as valuable according to the fascination factor– was evaluated positively (Boffi, Pola, Fumagalli, Fermani, Senes, Inghilleri, 2021). Similarly, Peters and Verderber (2022, p. 242) have noted that a need for research on “water feature design attributes in indoor and outdoor environmental” is related to dementia and cognitive disorders. Water and water features have a significant role for children in accessing nature, creating their own play places, imagination, and experiencing their senses (Moore, Wong, 1997; Tranter, Malone, 2004; Zamani, 2017).

In addition to the age and user profile in subjective scales, affective benefits were related to psychological health and well-being. The presence of water in both natural and built environments has a more crucial role for preference, positive affect, and restorativeness than space without water (White, Smith, Humphries, Pahl, Snelling, De-pledge, 2010). A study examined that with a nature-based approach, affective benefits could occur which were increased by “reducing stress and negative affect” and by “increasing positive affect and well-being” (Bratman, Olvera-Alvarez, Gross, 2021, pp. 3-4). In this context, undisturbed natural environments were effective in increasing the affective benefits as they contain water. From the perspective of urban scale, natural green parks with water elements created more positive affect in users' mood as compared to other parks and squares (Rapuano, Ruotolo, Ruggiero, Masullo, Maffei, Galderisi, Palmieri, Iachini, 2022).

In terms of spatial scales, some new concepts were considered, such as biophilic cities developed based on biophilic design that would lead people “to live happy, productive, meaningful lives”. While these cities “provide close and daily contact with nature”, they also serve to develop awareness and care for the nature. In Beatley, Newman's study (2013, p. 3328), water is defined as one of the biophysical and essential services providing resilience benefits to the natural systems around a city. A similar study reported that the concept of sustainable behaviour influenced the happiness factor depending on the pro-ecological, altruistic, frugal, and equitable factors (Corral-Verdugo, Mireles-Acosta, Tapia-Fonllem, Fraijo-Sing, 2011). Water is one of the considered natural resources according to the pro-ecological behaviours approach which include the notions of manifestation in the form of water and power conservation (Kaiser, 1998; Corral-Verdugo, Mireles-Acosta, Tapia-Fonllem, Fraijo-Sing, 2011). A study focused on the building features, such as function and interior space with water, examining the effects of the water element in the interiors of educational buildings and the state of well-being on students, established that the feeling of being connected with nature has improved and stress has decreased thanks to the water element (Nevzati, Demirbaş, Hasırcı, 2021).

When examining review studies in this field by way of a narrative review process, articles about biophilic design and restorative environments were searched according to certain criteria in order to identify key terms. For instance, in Gillis, Gatersleben's study (2015), water is highly restorative in the built environment which emerged from the experiences of nature. The research focusing on the psychological benefits of water indicates that there is a lot of research on the psychological benefits of water, but less on the psychological well-being benefits. In this context, the findings of Gillis, Gatersleben's study (2015) are supported by another review study, which examined 37 articles on the

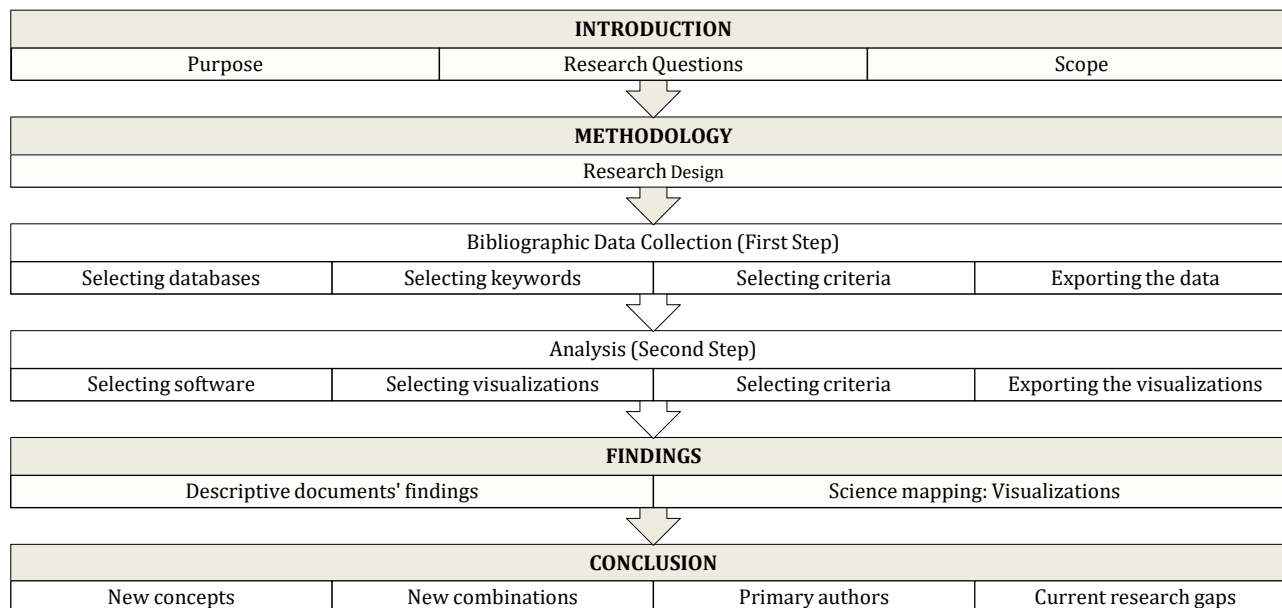
restorative benefits of water in urban and natural environments (Jo, Song, Miyazaki, 2019). A study focused on building features and user profile found no published work on the integration of water elements into university design for the university students' health and restorative benefits, apart from individual water images or sounds according to critical review of literature (Peters, D'Penna, 2020). Yet another review study comparing subjective and spatial scales noted that there is a substantial body of literature in the field of environmental psychology where nature benefits humans, landscapes; and built environments can be designed to connect humans and nature, but there is no distinguished research in the biophilic design area that would review health benefits (Hung, Chang, 2021).

Thus, the purpose of this study is to explore the research related to water at the intersection of environmental psychology and biophilic design. Thanks to this research, current research gaps, authors, theorists, keywords, added terms, significant sources, and publications can be identified by reaching the research conducted in the selected scientific disciplines. Consequently, two research questions were identified in this study: Research Question 1: What are the current research gaps, authors, theorists, keywords, added terms, significant sources, and publications about water at the intersection of environmental psychology and biophilic design? Research Question 2: Which research areas are more recent and open to study new concepts within the lens of water in environmental psychology or biophilic design?

This study suggests which scientific field is recent and open to study new concepts and how new connections can be made with the current scientific field when water is examined at the intersection of environmental psychology and biophilic design. The workflow of the study consists of introduction, methodology, findings and conclusion. This study begins with an introduction section stating the purpose, research questions and the scope. The methodology section follows which includes the steps of the research design, bibliographic data collection and an analysis. Then, the findings are presented descriptively with the mapping techniques. The study closes with the conclusion section (Tab. 1).

METHODOLOGY

There are many methodologies of structured review of scientific literature in the scientific fields (de Bem Machado, Secinaro, Calandra, Lanzalunga, 2022). Bibliometric approaches are structured literature reviews aimed to investigate the selected research topic. Therefore, to investigate the growing interest and social networks around the topic in this study, bibliometric methods were applied. Along with the use of bibliometric analysis with science mapping techniques used in the previous scientific studies, the bibliometric methods have become more widely used with the rise of online databases (Zupic, Čater, 2015). In the former studies, the methods were related to the growth of the study areas or changes over time (Peritz, 1988) and some approaches, such as the co-citation analysis by cited references (Small, 1973), the co-citation analysis by cited authors (White, Griffith, 1981), the citation analysis by documents (Smith, 1981), the co-cited author mapping (McCain, 1986), the co-word analysis (Callon, Courtial, Turner, Bauin, 1983), and the bibliographic coupling (Kessler, 1963) were used in the scientific papers. As a result, the bibliometric analysis with science mapping techniques was found to be the suitable, fast, conceptual, intellectual (Cobo, López-Herrera, Herrera-Viedma, Herrera, 2011), and the most comprehensive (Aria, Cuccurullo, 2017) method for the discovery to be made within the scope of this study.

Tab. 1. Workflow map for this study. (Source: Katuk, Köseoğlu, 2023)

In this paper, the Scopus and Web of Science Core Collection databases were selected to retrieve more scientific and systematic data from them, to compare and combine collected findings, draw a common conclusion and to establish more connections in order to examine water at the intersection of environmental psychology and biophilic design. Scopus and the Web of Science Core Collection are broad in scope; they contain important, comprehensive, and qualified indexes, because they include journals with proven scientific quality and with certain criteria (Secinaro, Calandra, Lanzalonga, Ferraris, 2022; Budler, Župič, Trkman, 2021; Martín-Martín, Orduña-Malea, Thelwall, López-Cózar, 2018; Mas-saro, Dumay, Guthrie, 2016; Zupic, Čater, 2015). Although Scopus and Web of Science Core Collection databases contain differences within themselves, they are multi-disciplinary (Secinaro, Calandra, Secinaro, Muthurangu, Biancone, 2021), practical in use (Falagas, Pitsouni, Malietzis, Pappas, 2008), they include peer-reviewed journals (Budler, Župič, Trkman, 2021) and are supported by bibliometric software packages (Zupic, Čater, 2015).

In addition, collecting data from Scopus and Web of Science Core Collection provides information for the analysis, such as by co-authors, cited references, citations and co-citations, bibliographic coupling, and co-word by the documents (Zupic, Čater, 2015). Moreover, Scopus and Web of Science Core Collection databases constitute bibliometric sources which have been given priority as they allow to produce scientific mapping with VOSviewer. The most recent version of VOSviewer can be downloaded from its website, and it can be used freely for any purpose (van Eck, Waltman, 2022, p. 3). Scopus includes an open-access indicator for journals in which all peer-reviewed scholarly articles are available without any restrictions (Elsevier Scopus, 2020, p. 14). Web of Science Core Collection is the world's leading citation database and includes open access journals, conference proceedings and books (Clarivate Web of Science Help, 2021). To access the Scopus and Web of Science Core Collection databases, researchers sign in in the database with the university library access and statistics system (Vetis) and log in with their username and password. It is important to provide information about the sources of data and the methodology of the study where the extracted search data is used.

The aim is to investigate the type of findings in the literature on the approach to water in environmental psychology and biophilic design. In this context, the bibliometric analysis method is considered to be quick to find these approaches. Applying the bibliometric analysis method to the collected data can determine which fields are more recent, which authors work in these fields, which keywords are used, and which references can be used. For this reason, Scopus and Web of Science Core Collection databases were scanned with the bibliometric analysis using the science mapping techniques. This study is based on a quantitative research design, and quantitative data was collected from Scopus and Web of Science Core Collection databases. Bibliometric analysis is a research method that evaluates and examines data from any discipline with quantitative analysis (Santos, Costa, Grilo, 2017; Şen, 2020; Karagöz, Savaş, 2021; Özkaraca, Halaç, 2022; Ding, Yang, 2022). For this study, a quantitative research design was developed, with bibliometric analysis and science mapping techniques (Tab. 2) to be used. In addition, the bibliometric analysis technique is considered to be an exploratory or descriptive study (Kurutkan, Orhan, 2018, p. 8).

Tab. 2. Quantitative research design for this study. (Source: Katuk, Köseoğlu, 2023)

Bibliometric Analysis with Science Mapping Techniques
Purpose: Exploring the research related to water at the intersection of environmental psychology and biophilic design and determining the current research gaps and the primary authors – concepts.
Material and Methods: Bibliometric analysis with science mapping techniques
Sample: Documents
Data Sources: Scopus and Web of Science Core Collection
Data Visualization and Analysis Tools: VOSviewer
Selected Bibliometric Analysis Techniques: Mapping based on co-authorship data by the authors Mapping based on co-occurrences data by author keywords Mapping based on citation data by documents Mapping based on co-citation data by the cited references Mapping based on co-citation data by the cited authors
Findings Descriptive findings obtained from Scopus and Web of Science Core Collection Findings According to Scientific Mapping Technique by VOSviewer: Scopus and Web of Science Core Collection
Conclusion

Primarily, scanning was performed using Scopus and Web of Science Core Collection web pages and by applying the bibliometric analysis method (Tab. 2). The keywords *environmental psychology*, *biophilic design*, and *water* are the words identified to be scanned in the Scopus and Web of Science Core Collection databases. In the documents section of the Scopus database, all fields were scanned with the code ALL (“Environmental Psychology” AND “Biophilic Design” AND “Water”) in the advanced search field. In the documents section of the Web of Science Core Collection database, all fields were scanned with the code ALL=(“Environmental Psychology” and “Water”) OR ALL=(“Biophilic Design” and “Water”) in the advanced search field. There is no temporal restriction on the databases. The scanning was performed over the entire period covered by the databases. The number of documents as shown in Tab. 3 was obtained. A total of 292 documents were identified, of which 139 were found in Scopus and 153 in the Web of Science Core Collection (Tab. 3). The scanning and data download date is 1 May 2022.

Tab. 3. Scan findings in all fields. (Source: Scopus, 2022; Web of Science Core Collection, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

Scopus	Web of Science Core Collection
Code: ALL (“Environmental Psychology” AND “Biophilic Design” AND “Water”)	Code: ALL=(“Environmental Psychology” and “Water”) OR ALL=(“Biophilic Design” and “Water”)
Scan Findings: 139 documents (2007-2022)	Scan Findings: 153 documents (1995-2022)
Scopus and Web of Science Core Collection	
Total Scan Findings: 292 documents (1995-2022)	

After scanning the bibliometric data of Scopus and Web of Science Core Collection databases on 1 May 2022, .csv and .txt data files were downloaded. Data files were transferred to VOSviewer. VOSviewer is a computer program that can create large bibliometric maps, scientific networks, graphical representation, and visualization with free access (van Eck, Waltman, 2010; Sarkodie, Strezov, 2019; Moral-Muñoz, Herrera-Viedma, Santisteban-Espejo, Cobo, 2020). In this program, “Mapping Based on Co-authorship Data by Authors” (Tab. 2), “Mapping Based on Keyword Association (Co-occurrences) Data” by the authors’ keywords (Tab. 2), “Mapping Based on Citation Data By Documents” (Tab. 2), “Mapping Based on Co-citation Data By Cited References” and (Tab. 2) “Mapping Based on Co-citation Data by Cited Authors” was performed one after another (Tab. 2). In this study, including the quantitative information and visuals, such as documents and cited references, years, countries, subject areas, sources, authors and authorship, cited authors, authors’ keywords and occurrences, concepts and gaps, citations and co-citations, affiliations, and sponsors in all disciplines was determined by the bibliometric analysis with the science mapping techniques.

FINDINGS

Descriptive findings obtained from Scopus and Web of Science Core Collection

By examining the information held on the Scopus and Web of Science Core Collection databases, the following descriptive findings were obtained. Eight analysis types common to both databases were identified based on scan findings in all fields. These analysis types contained information about the document types, publication years, top 15 countries or territories, top 15 subject areas, top 10 sources, top 10 authors, top 10 affiliations, and top 10 funding sponsors. Moreover, the oldest document in Scopus is dated from 2007, while the oldest document in the Web of Science Core Collection is dated from 1995.

Tab. 4. Document types according to scan findings in all fields. (Source: Scopus, 2022; Web of Science Core Collection, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

Scopus	Web of Science Core Collection
Document Analysis (2007-2022)	Document Analysis (1995-2022)
Article: 69	Articles: 136
Book: 22	Review Articles: 10
Book Chapter: 19	Proceedings Papers: 5
Review: 19	Book Chapters: 4
Conference Paper: 9	Editorial Materials: 1
Note: 1	Meeting Abstracts: 1

Both databases established that the number of articles as document type was the highest when scanned with the keywords *environmental psychology*, *biophilic design*, *water* (Tab. 4). When the findings were examined with the cut-off date 1 May 2022, it was observed that there are more articles in the Web of Science Core Collection (Tab. 4).

Tab. 5. Document publication years according to scan findings in all fields. (Source: Scopus, 2022; Web of Science Core Collection, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

Scopus	Web of Science Core Collection
Document Analysis (2007-2022)	Document Analysis (1995-2022)
2022: 10	2015: 10
2021: 47	2014: 3
2020: 10	2013: 5
2019: 12	2012: 4
2018: 13	2011: 3
2017: 14	2010: 2
2016: 5	2007: 1
2022: 7	2016: 13
2021: 23	2015: 12
2020: 14	2014: 7
2019: 16	2013: 4
2018: 14	2012: 3
2017: 10	2011: 6
2016: 5	2010: 6
	2009: 2
	2008: 2
	2007: 2
	2006: 2
	2005: 3
	2004: 1
	2003: 2
	2002: 1
	2001: 1
	2000: 1
	1999: 1
	1997: 1
	1995: 2

Again, both databases established that the number of documents was the highest in 2021 when scanned with the keywords *environmental psychology*, *biophilic design*, *water* (Tab. 5). When the findings were examined with the cut-off date 1 May 2022, it was observed that there are more new documents in Scopus (Tab. 5).

Tab. 6. Documents by top 15 country or territory according to scan findings in all fields. (Source: Scopus, 2022; Web of Science Core Collection, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

Scopus	Web of Science Core Collection
Document Analysis (2007-2022)	Document Analysis (1995-2022)
United States: 51	USA: 36
Australia: 19	Australia: 22
United Kingdom: 18	England: 19
Canada: 8	Netherlands: 12
China: 8	People R China: 12
Netherlands: 6	Germany: 9
Italy: 5	Spain: 9
Mexico: 5	Italy: 8
Spain: 5	Switzerland: 8
Belgium: 4	Canada: 6
France: 4	Mexico: 6
Singapore: 4	Singapore: 6
Taiwan: 4	Sweden: 6
Germany: 3	France: 4
New Zealand: 3	Colombia: 4

Further, both databases established that the number of documents by the top 15 countries or territories was the highest in the USA when scanned with the keywords *environmental psychology*, *biophilic design*, *water* (Tab. 6). When the findings were examined with the cut-off date 1 May 2022, it was observed that countries other than Belgium, Taiwan, New Zealand, Switzerland, Sweden, and Colombia were common to both databases (Tab. 6).

Tab. 7. Documents by top 15 subject areas according to scan findings in all fields. (Source: Scopus, 2022; Web of Science Core Collection, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

Scopus	Web of Science Core Collection
Document Analysis (2007-2022)	Document Analysis (1995-2022)
Environmental Science: 64	Environmental Sciences Ecology: 117
Social Sciences: 52	Psychology: 93
Engineering: 49	Engineering: 13
Arts and Humanities: 28	Science Technology Other Topics: 11
Energy: 25	Urban Studies: 8
Psychology: 15	Public Administration: 5
Business, Management and Accounting: 12	Water Resources: 5
Medicine: 12	Business Economics: 3
Agricultural and Biological Sciences: 11	Construction Building Technology: 3
Computer Science: 6	Geography: 3
Economics, Econometrics and Finance: 5	Agriculture: 2
Biochemistry, Genetics and Molecular Biology: 3	Architecture: 2
Neuroscience: 3	Education Educational Research: 2
Nursing: 3	Energy Fuel: 2
Chemistry: 2	Forestry: 2

Another matching result delivered by the databases was that *environmental science* had the highest number of documents by the top 15 subject areas when scanned with the keywords *environmental psychology, biophilic design, water* (Tab. 7). When the findings were examined with the cut-off date 1 May 2022, it was observed that only Web of Science Core Collection had *architecture* as a subject area (Tab. 7).

Tab. 8. Documents by top 10 sources according to scan findings in all fields. (Source: Scopus, 2022; Web of Science Core Collection, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

Scopus	Web of Science Core Collection
Document Analysis (2007-2022)	Document Analysis (1995-2022)
Sustainability Switzerland: 11	Journal of Environmental Psychology: 77
Frontiers in Psychology: 6	Frontiers in Psychology: 4
International Journal of Environmental Research and Public Health: 5	Journal of Cleaner Production: 4
Building and Environment: 3	Sustainability: 4
Buildings: 3	Journal of Environmental Management: 3
Journal of Cleaner Production: 3	Ecological Economics: 2
Landscape and Urban Planning: 3	Energy and Buildings: 2
Urban Forestry and Urban Greening: 3	Environment and Behavior: 2
Science of The Total Environment: 2	Landscape and Urban Planning: 2
ACM International Conference Proceeding Series: 1	Science of The Total Environment: 2

In both databases, Frontiers in Psychology, Landscape and Urban Planning, and Science of The Total Environment were among the top 10 common sources when scanned with the keywords *environmental psychology, biophilic design, water* (Tab. 8). When the findings were examined with the cut-off date 1 May 2022, it was observed that the Journal of Environmental Psychology had more documents in Web of Science Core Collection (Tab. 8).

Tab. 9. Documents by top 10 authors according to scan findings in all fields. (Source: Scopus, 2022; Web of Science Core Collection, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

Scopus	Web of Science Core Collection
Document Analysis (2007-2022)	Document Analysis (1995-2022)
Beatley, T.: 4	Fielding, K. S.: 4
Chang, C.Y.: 3	Williams, Nicholas S. G.: 4
Corral-Verdugo, V.: 3	Contzen, N.: 3
Desha, C.: 3	Corral-Verdugo, V.: 3
Hung, S.H.: 3	Lee, K.E.: 3

Joye, Y.: 3	Newman, P.: 3
Newman, P.: 3	Tam, K.P.: 3
Xue, F.: 3	Apaolaza-Ibanez V.: 2
Amel, E.L.: 2	Barrera-Hernandez L.F.: 2
Fraijo-Sing, B.: 2	Benavides-Castillo J.M.: 2

In both databases, the highest number of documents by the top 10 authors was four for Beatley and Fielding when scanned with the keywords *environmental psychology, biophilic design, water* (Tab. 9). When the findings were examined with the cut-off date 1 May 2022, it was observed that authors other than Corral-Verdugo and Newman were different in both databases (Tab. 9).

Tab. 10. Documents by top 10 affiliation according to scan findings in all fields. (Source: Scopus, 2022; Web of Science Core Collection, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

Scopus	Web of Science Core Collection
Document Analysis (2007-2022)	Document Analysis (1995-2022)
University of Washington: 6	University of Queensland: 7
Texas A&M University: 6	League of European Research Universities Leru: 6
Curtin University: 6	Hong Kong University of Science Technology: 5
University of Virginia: 4	University of Melbourne: 5
National Taiwan University: 3	Centre National De La Recherche Scientifique CNRS: 4
Queensland University of Technology: 3	Commonwealth Scientific Industrial Research Organization CSIRO: 4
University of Derby: 3	Curtin University: 4
National University of Singapore: 3	Swiss Federal Institute of Aquatic Science Technology Eawag: 4
University College London: 3	Universidad de Sonora: 4
KU Leuven: 3	University of Bern: 4

In both databases, Curtin University was among the top 10 common affiliations when scanned with the keywords *environmental psychology, biophilic design, water* (Tab. 10). When the findings were examined with the cut-off date 1 May 2022, it was observed that The University of Queensland had more documents in Web of Science Core Collection (Tab. 10).

Tab. 11. Documents by top 10 funding sponsors according to scan findings in all fields. (Source: Scopus, 2022; Web of Science Core Collection, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

Scopus	Web of Science Core Collection
Document Analysis (2007-2022)	Document Analysis (1995-2022)
European Commission: 2	National Science Foundation Nsf: 11
Horizon 2020: 2	European Commission: 5
Horizon 2020 Framework Programme: 2	Australian Government: 3
National Institutes of Health: 2	Australian Research Council: 3
National Natural Science Foundation of China: 2	Behavioral Studies in The Energy Water Waste and Transportation Sectors Programme of The Singapore National Research Foundation: 2
National Science Foundation: 2	Bill Melinda Gates Foundation: 2
Academy of Neuroscience for Architecture: 1	Committee for Melbourne: 2
Agentúra na podporu výskumu a vývoja: 1	Hong Kong University of Science and Technology Hong Kong: 2
Agència de Gestió d'Ajuts Universitaris i de Recerca: 1	Melbourne Water: 2
Arizona State University: 1	Swiss National Science Foundation Nsf: 2

In both databases, the European Commission and National Science Foundation were among the top 10 common funding sponsors when scanned with the keywords *environmental psychology, biophilic design, water* (Tab. 11). When the findings were examined with the cut-off date 1 May 2022, it was observed that National Science Foundation sponsored more documents in Web of Science Core Collection (Tab. 11).

Findings of the scientific mapping technique by VOSviewer: Scopus and Web of Science Core Collection

This section presents the findings obtained with the scientific mapping technique via VOSviewer. The data downloaded from the Scopus and Web of Science Core Collection databases was gradually transferred to VOSviewer. Visuals were created by progressing step by step applying the options presented in the software's interface. Co-authorship, co-occurrences, citation, and co-citation relationships were examined by various criteria.

A. Mapping based on co-authorship data by the authors

Co-authorship analysis by authors is a valid and reliable method to understand the models of scientific collaborations between authors in the specified field to identify collaboration networks and to reveal leading authors (Uddin, Hossain, Abbasi, Rasmussen, 2012; Karagöz, Savaş, 2021). In this analysis, the clusters and the cluster sizes represent the authors. The links between the clusters express the cooperation between the authors. The thickness of the line of networks increases with the total link strength between the authors.

Tab. 12. Interface sorted by the most cited author before mapping. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

VOSviewer Interface, 2022				
Scopus Data		Web of Science Core Collection Data		
Selected	Author	Documents	Citations	Total link strength
<input checked="" type="checkbox"/>	beatley t.	4	234	2
<input checked="" type="checkbox"/>	newman p.	3	182	3
<input checked="" type="checkbox"/>	kellert s.r.	2	132	0
<input checked="" type="checkbox"/>	corral-verdugo v.	3	114	4
<input checked="" type="checkbox"/>	fraijo-sing b.	2	112	4
<input checked="" type="checkbox"/>	tapia-fonllem c.	2	112	4
<input checked="" type="checkbox"/>	white m.p.	2	103	0
<input checked="" type="checkbox"/>	joye y.	3	66	0
<input checked="" type="checkbox"/>	xue f.	3	49	3
<input checked="" type="checkbox"/>	gou z.	2	47	3
<input checked="" type="checkbox"/>	song y.	2	31	3
<input checked="" type="checkbox"/>	desha c.	3	26	1
<input checked="" type="checkbox"/>	jones d.r.	2	22	0
<input checked="" type="checkbox"/>	marshall-baker a.	2	19	1
<input checked="" type="checkbox"/>	hidalgo a.k.	2	10	0
<input checked="" type="checkbox"/>	peters t.	2	10	0
<input type="button" value="Back"/> <input type="button" value="Next >"/> <input type="button" value="Finish"/> <input type="button" value="Cancel"/>				
Selected	Author	Documents	Citations	Total link strength
<input checked="" type="checkbox"/>	gifford, robert	2	302	0
<input checked="" type="checkbox"/>	fielding, kelly	4	196	3
<input checked="" type="checkbox"/>	williams, nicholas s. g.	3	177	6
<input checked="" type="checkbox"/>	lee, kate e.	2	160	6
<input checked="" type="checkbox"/>	sargent, leisa d.	2	160	6
<input checked="" type="checkbox"/>	williams, kathryn j. h.	2	160	6
<input checked="" type="checkbox"/>	chan, hoi-wing	2	116	1
<input checked="" type="checkbox"/>	tam, kim-pong	3	114	1
<input checked="" type="checkbox"/>	smith, liam	2	98	1
<input checked="" type="checkbox"/>	apaolaza-ibanez, vanessa	2	96	2
<input checked="" type="checkbox"/>	hartmann, patrick	2	96	2
<input checked="" type="checkbox"/>	moser, gabriel	2	67	0
<input checked="" type="checkbox"/>	newman, peter	2	46	0
<input checked="" type="checkbox"/>	cottet, marylise	2	44	0
<input checked="" type="checkbox"/>	schultz, p. wesley	2	38	0
<input checked="" type="checkbox"/>	schultz, tracy	2	26	2
<input checked="" type="checkbox"/>	hiller, carolina	2	24	0
<input checked="" type="checkbox"/>	contzen, nadja	3	16	0
<input type="button" value="Back"/> <input type="button" value="Next >"/> <input type="button" value="Finish"/> <input type="button" value="Cancel"/>				

When proceeding with mapping in Scopus, VOSviewer warned that some of the 16 items in our network were not connected to each other and the larger set of connected items consisted of 4 items. When asked by the software, "Do you want to show this set of items instead of all items?", the mapping in Fig. 1 was created by answering the question with a "No". According to this mapping, there were three clusters of co-authorship: Cluster 1 (Gou, Marshall-Baker, Song, and Xue), Cluster 2 (Corral-Verdugo, Fraijo-Sing, and Tapia-Fonllem), and Cluster 3 (Beatley, Desha, and Newman) (Fig. 1). When proceeding with mapping in Scopus, VOSviewer warned that some of the 16 items in our network were not connected to each other and the larger set of connected items consisted of 4 items. When asked by the software, "Do you want to show this set of items instead of all items?", the mapping

in Scopus, the minimum number of documents of an author and the minimum number of citations of an author was set to 2 and 10 as criteria, respectively. After setting these limits, the total of 379 authors were narrowed down to 16 that met the thresholds. For each of the 16 authors, the total strength of co-authorship links with other authors was calculated. The authors with the greatest total link strength were filtered. The number of authors to be selected was 16. Before proceeding to the author relationships network mapping, the ranking according to the most cited author could be seen in the interface created by the software, as shown in Tab. 12.

In Web of Science Core Collection Data, the minimum number of documents of an author and the minimum number of citations of an author was set to 2 and 10 as criteria, respectively. After setting these limits, the total of 504 authors were narrowed down to 18 that met the thresholds. For each of the 18 authors, the total strength of co-authorship links with other authors was calculated. The authors with the greatest total link strength were filtered. The number of authors to be selected was 18. Before proceeding to the author relationships network mapping, the ranking according to the most cited author could be seen in the interface created by the software, as shown in Table 12.

in Fig. 1 was created by answering the question with a "No". According to this mapping, there were three clusters of co-authorship: Cluster 1 (Gou, Marshall-Baker, Song and Xue), Cluster 2 (Corral-Verdugo, Fraijo-Sing and Tapia-Fonllem), and Cluster 3 (Beatley, Desha and Newman) (Fig. 1).

When proceeding with mapping in Web of Science Core Collection, VOSviewer warned that some of the 18 items in our network were not connected to each other and the larger set of connected items consisted of 4 items. When asked by the software, "Do you want to show this set of items instead of all items?", the mapping in Fig. 2 was created by answering the question with a "No". According to this mapping, four clusters had co-authorship: Cluster 1 (Lee, Sargent, Williams, and Williams), Cluster 2 (Fielding,

Schultz, and Smith), Cluster 3 (Apaolaza-Ibanez and Hartmann), and Cluster 4 (Chan, and Tam) (Fig. 2).

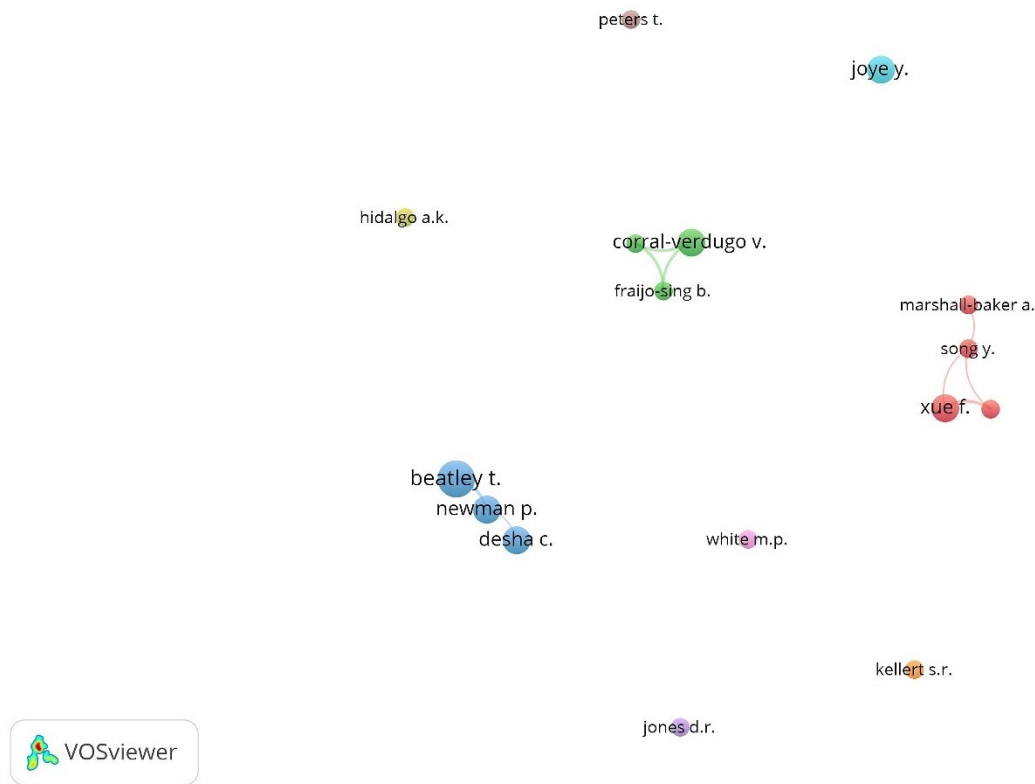


Fig. 1. Mapping based on co-authorship data in Scopus. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.



Fig. 2. Mapping based on co-authorship data in Web of Science Core Collection. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

B. Mapping based on co-occurrences data by author keywords

Co-occurrences analysis by author keywords is an exploration method to understand the concepts of scientific collaborations between author keywords in the specified field to identify themes and to reveal new study areas (Ding, Yang, 2022; Güney, Somuncu, 2020). In addition, with this analysis method, growth of the study areas, new gaps in some specific disciplines and highlighted changes over time can be understood (Peritz, 1988). In this analysis, the clusters and the cluster sizes represent the keywords. The links between the clusters express the cooperation between the keywords. The thickness of the line of networks increases with the total strength of the link between the keywords.

In Scopus, the minimum number of occurrences of a keyword was set to 2 as a criterion. After the limits, the total of 431 keywords were narrowed down to 57 that met the thresholds. For each of the 57 keywords, the total strength of co-occurrence links with other keywords was calculated. The keywords with the greatest total link strength were filtered. The number of keywords to be selected was 57. Before proceeding to the concept of network mapping, the ranking according to the most occurrences of the keywords could be sorted in the interface created by the software. This mapping shows that biophilic design and biophilia have more co-occurrences than the other keywords (Fig. 3).

The keyword that came first in this ranking was *biophilic design*; followed by *biophilia*; *well-being*; *sustainability*; and *built environment*. The mapping process has been completed without any warnings when proceeding with the mapping. There were 10 clusters in the co-occurrences mapping as shown in Fig. 3. These

clusters were represented by circles of varied sizes and colours. Other keywords included in the clusters with the keywords *biophilic design*, *environmental psychology*, *architectural design*, and *biophilic architecture* were examined in Tab. 13.

Tab. 13. Concepts related to biophilic design, environmental psychology, architectural design, biophilic architecture clusters based on data downloaded from Scopus. (Source: VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus. © Copyright Elsevier 2022. All rights reserved.

Scopus Data		
Cluster 3	Cluster 7	Cluster 1
Architectural Design	Environmental Psychology	Biodiversity
Attention Restoration	Mental Health	Biophilic Architecture
Biophilia	Psychological Restoration	Children
Biophilic Design	Restorative Environments	Health and Well-being
Housing	Well-being	Nature
Restorative Environment		Nature-based Solutions
Thermal Comfort		Preferences
		Sense of Place
		Sustainable Development
		Urban Design

VOSviewer can also show developments over time (current trends) by overlay visualization of the keywords network mapping created in Fig. 3. In this way, the relationship of new keywords that have been used in publications recently can be seen in Fig. 4. New study areas are colour-coded with yellow and light green toned small clusters in the time mapping. The keywords *biophilic design* and *environmental psychology* were compared for developments over time. It was observed that the keyword *biophilic design* was coloured light green, while *environmental psychology* was highlighted purple.

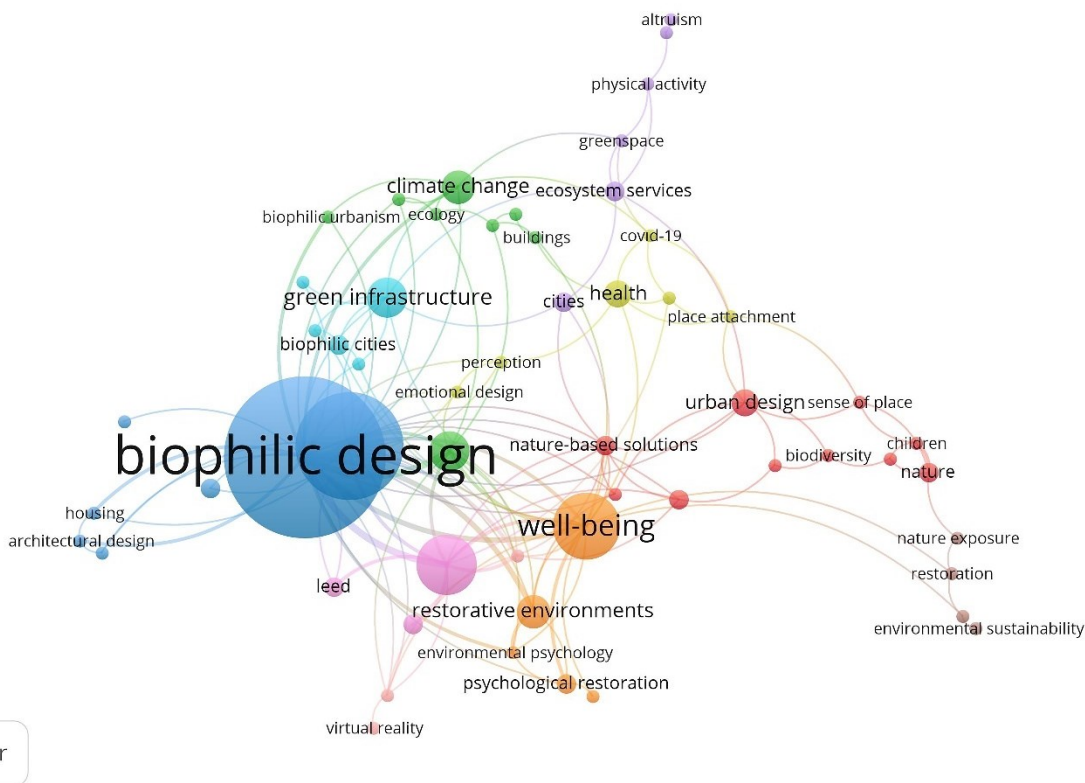


Fig. 3. Mapping based on co-occurrences data in Scopus. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier 2022. © Copyright Clarivate 2022. All rights reserved.

In the developments over time (current trends) by overlay visualization network map made in the VOSviewer analysis, yellow and light green tones represent new study areas. According to Scopus data, the field of *biophilic design* is a newer field of study when comparing the two fields. Therefore, concepts related to the field of biophilic design have been accepted as current research gaps. In this context, to select new concepts that can be associated with the *biophilic design* keyword, yellow and light green-coloured small clusters close to the cluster they belong to were considered (Fig. 5).

In Web of Science Core Collection data, the minimum number of occurrences of a keyword of 2 was set as a criterion. After setting his limit, 64 out of the 576 keywords that met the thresholds were selected by the software. For each of the 64 keywords, the total strength of co-occurrence links with other keywords was calculated. The keywords with the greatest total link strength were filtered. The number of keywords to be selected was 64. Before proceeding to the concept of network mapping, the ranking according to the most occurrences of the keywords can be sorted in the interface created by the software. According to this mapping, *environmental psychology* and *biophilic design* have more co-occurrences than other keywords (Fig. 6).

The keyword that came first in this ranking was *environmental psychology*, followed by *biophilic design*, *pro-environmental behaviour*, *water conservation*, and *disgust*. When proceeding with

mapping in Web of Science Core Collection data, VOSviewer warned that some of the 64 items in our network were not connected to each other and the largest set of connected items consisted of 57 items. When asked by the software, "Do you want to show this set of items instead of all items?", the mapping in Fig. 6 was created by answering the question with a "Yes". There were 10 clusters in the co-occurrences mapping shown in Fig. 6. These clusters were represented by circles of varied sizes and colours. Other keywords included in the clusters with the keywords *biophilic design* and *environmental psychology* were examined in Tab. 14.

Tab. 14. Concepts related to biophilic design-environmental psychology clusters based on data downloaded from Web of Science Core Collection. (Source: VOSviewer, 2022). Certain data included herein is derived from Clarivate Web of Science. © Copyright Clarivate 2022. All rights reserved.

Web of Science Core Collection Data		
	Cluster 5	Cluster 2
Biophilia		Air Quality
Biophilic Design		Beliefs
Built Environment		Environmental Health
Singapore		Environmental Psychology
Water Demand Management		Health Psychology
Well-being		Mental Health
		Sustainable Development
		Urban Heat Island

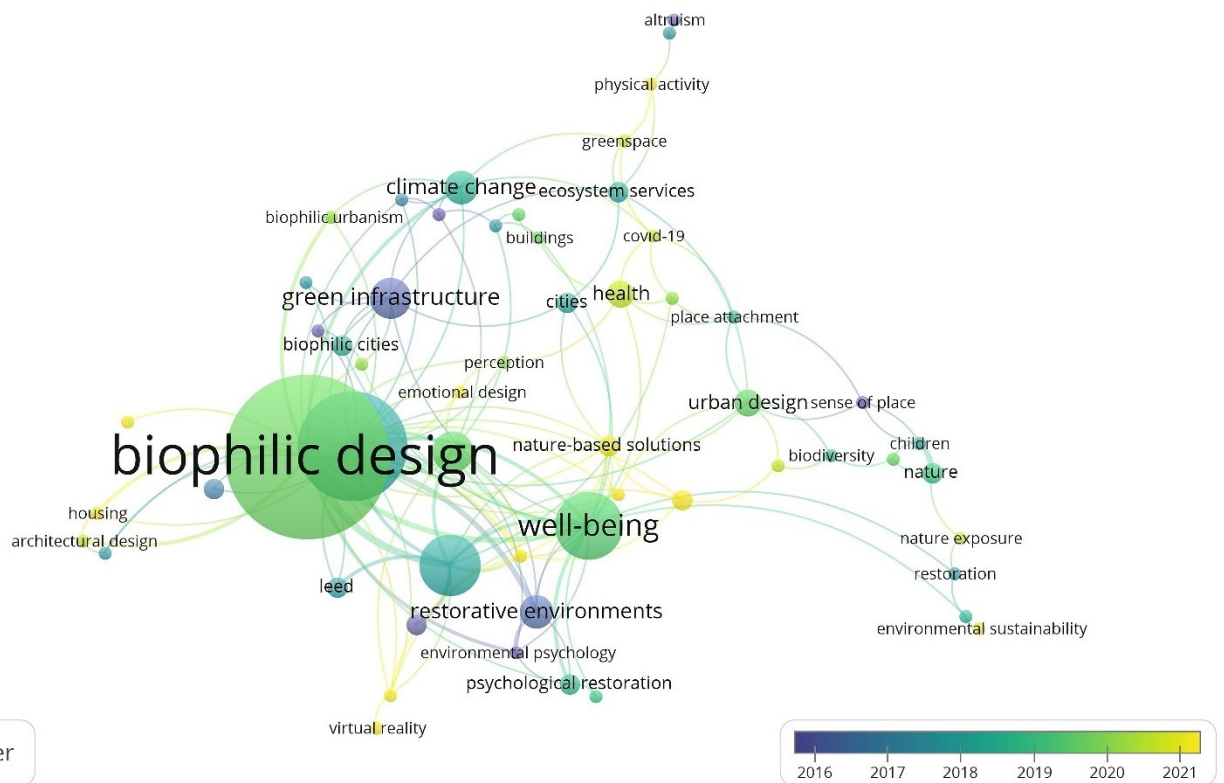


Fig. 4. Mapping based on developments over time by overlay visualization of co-occurrences data in Scopus. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier 2022. © Copyright Clarivate 2022. All rights reserved.

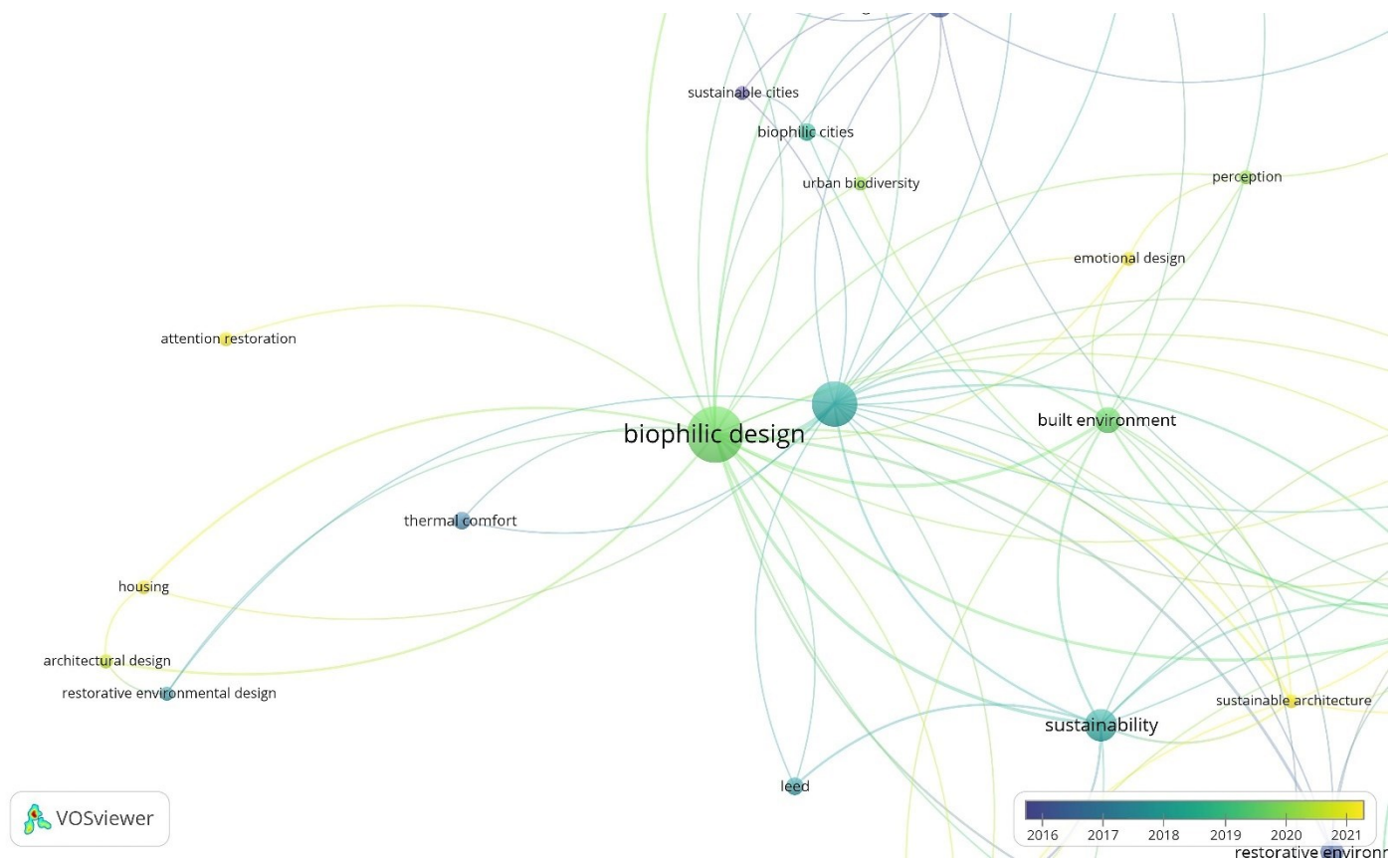


Fig. 5. Yellow and light green small clusters around *biophilic design* by overlay visualization in Scopus. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier 2022. © Copyright Clarivate 2022. All rights reserved.

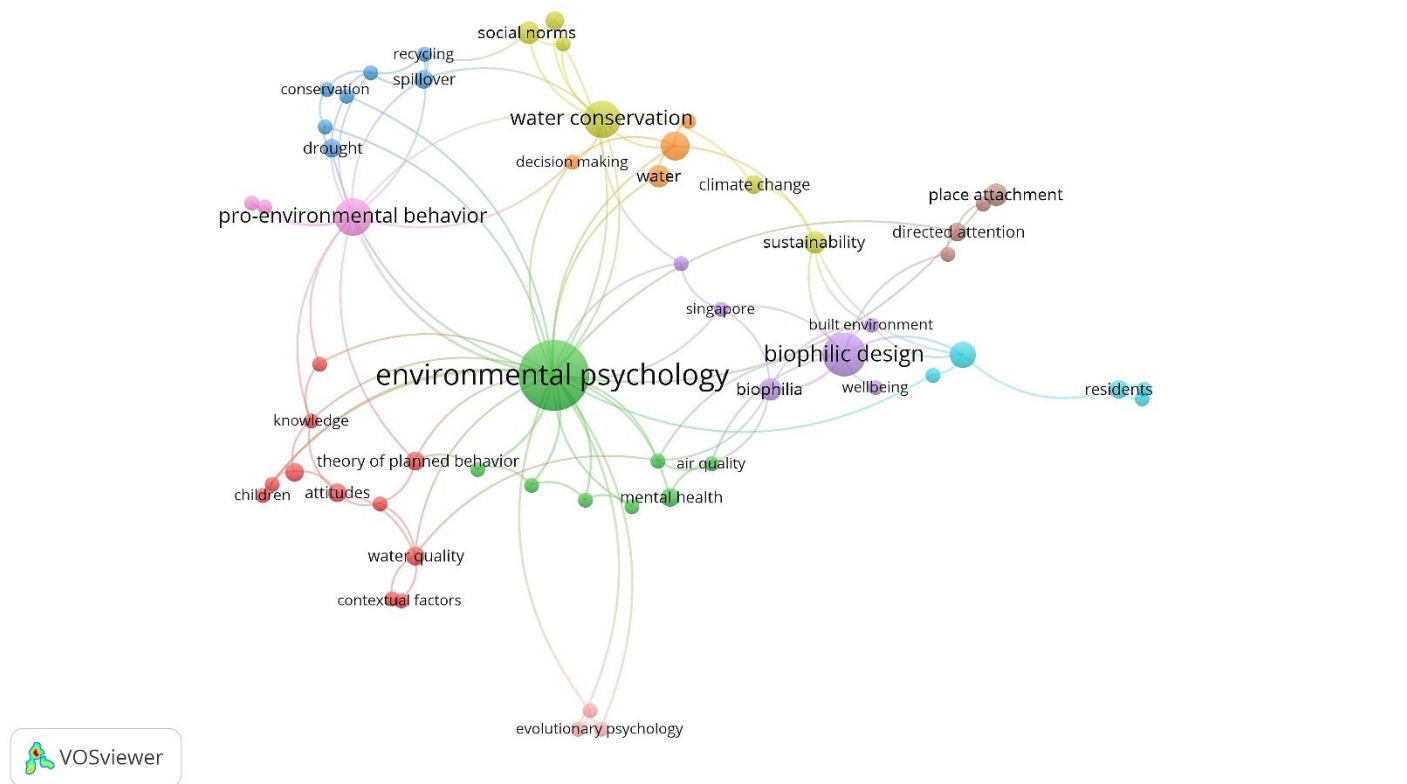


Fig. 6. Mapping based on co-occurrences data in Web of Science Core Collection. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier 2022. © Copyright Clarivate 2022. All rights reserved.

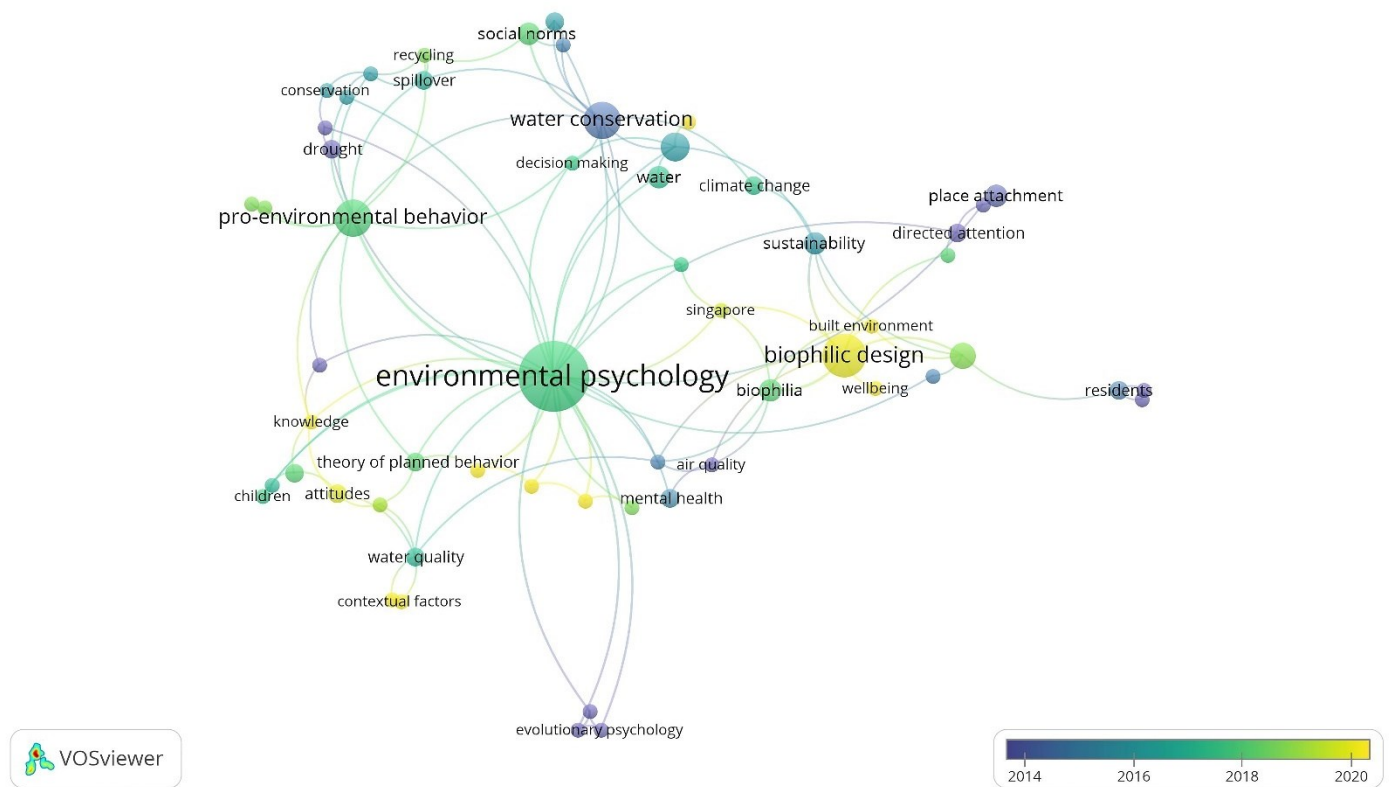


Fig. 7. Mapping based on developments over time by overlay visualization of co-occurrences data in Web of Science Core Collection. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

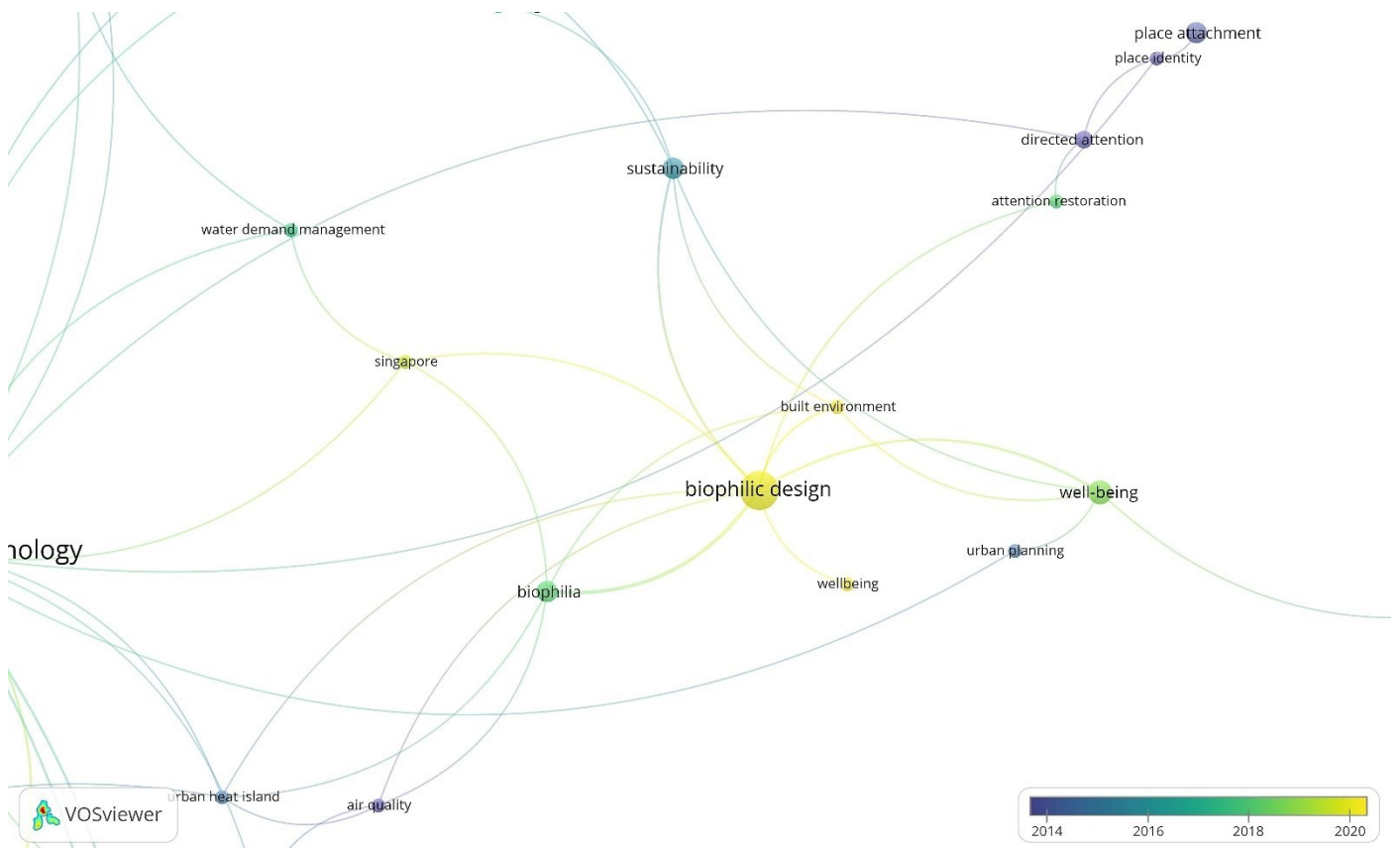


Fig. 8. Yellow and light-green small clusters around *biophilic design* by overlay visualization in Web of Science Core Collection. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

VOSviewer can also show developments over time (current trends) by overlay visualization of the keywords network mapping created in Fig. 6. In this way, the relationship of new keywords that have been used in publications recently can be seen in Fig. 7. New study areas are marked as yellow and light green-toned small clusters in the time mapping. The keywords *biophilic design* and *environmental psychology* were compared for developments over time. It was observed that the keyword *biophilic design* was coloured yellow, while the green colour-code was used for the keyword *environmental psychology*.

In the developments over time (current trends) by overlay visualization network map made in the VOSviewer analysis, yellow and light green tones represent new study areas. According to Web of Science Core Collection data, the field of *biophilic design* is a newer field of study in the comparison made for the two fields. Therefore, concepts related to the field of biophilic design have been accepted as current research gaps. In this context, to select new concepts that can be associated with the *biophilic design* keyword, small yellow clusters and light green colours close to the cluster they belong to were considered (Fig. 8).

C. Mapping based on citation data by documents

Citation analysis by documents is an exploration method to understand the relationship between the cited document and the citing document in the specified field (Smith, 1981, p. 83). In this analysis, the clusters and the cluster sizes represent the documents. The links between the clusters express the cooperation between the documents. The thickness of the line of networks increases with the total strength of the link between the documents.

In Scopus, the minimum number of citations of a document was set to 10 as a criterion. After setting the limit, the total of 139 documents were narrowed down to 37 that met the thresholds. For each of the 37 documents, the number of citation links was calculated. The documents with the largest number of links were filtered. The number of documents to be selected was 37. Before

proceeding to the concept relationship network mapping, the ranking according to the most cited documents could be sorted in the interface created by the software.

When proceeding with mapping in Scopus, VOSviewer warned that some of the 37 items in our network were not connected to each other and the largest set of connected items consisted of 15 items. When asked by the software, "Do you want to show this set of items instead of all items?", the mapping in Figure 9 was created by answering the question with a "Yes". According to this mapping, the highest-ranked document was "Beatley (2013)" with 120 citations, followed by "Ryan (2014)" with 116 citations, "Corral-Verdugo (2011)" with 106 citations, "Grellier (2017)" with 93 citations, "Kellert (2012)" with 85 citations, and finally "Gillis (2015)" with 85 citations (Fig. 9).

In Web of Science Core Collection data, the minimum number of citations of a document was set to 10 as a criterion. After setting this limit, the total of 153 documents were narrowed down by the software to 83 that met the thresholds. For each of the 83 documents, the number of citation links was calculated. The documents with the largest number of links were selected, resulting in 83 documents. Before proceeding to the concept relationships network mapping, the ranking according to the most cited documents could be sorted in the interface created by the software.

When proceeding with the mapping in Web of Science Core Collection data, VOSviewer warned that some of the 83 items in our network were not connected to each other and the largest set of connected items consisted of 21 items. When asked by the software, "Do you want to show this set of items instead of all items?", the mapping in Figure 10 was created by answering the question with a "Yes". According to this mapping, the highest-ranked document was "Kaiser (1999)" with 664 citations, followed by "White (2010)" with 357 citations, "Kormos (2014)" with 298 citations, "Greaves (2013)" with 290 citations, "Voelker (2011)" with 247 citations, and finally "Kumar (2008)" (Fig. 10) with 237 citations.

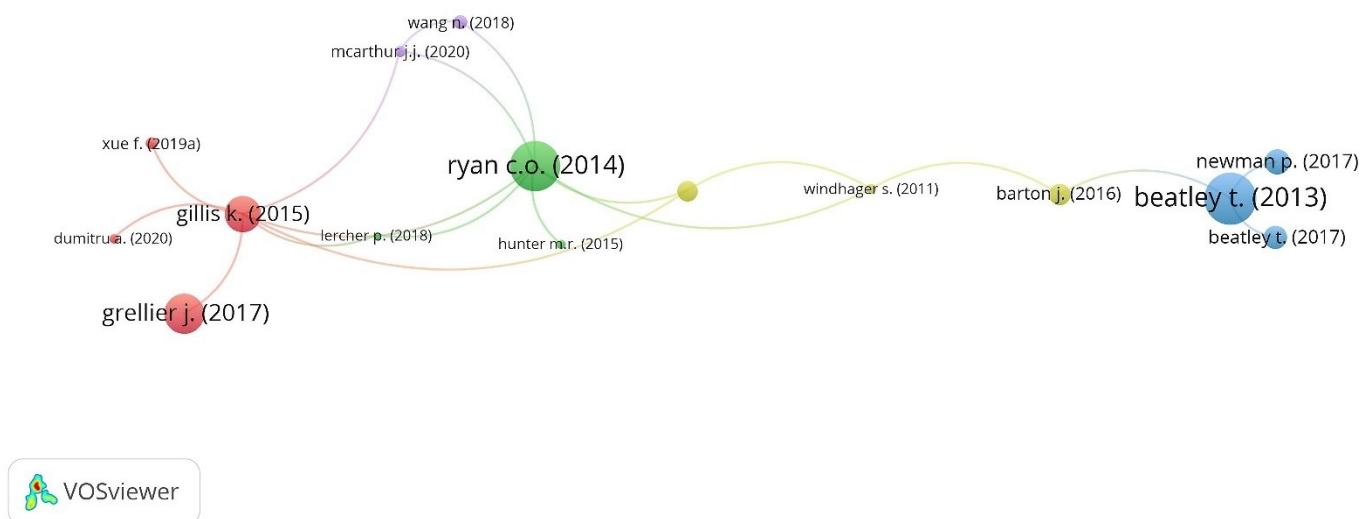


Fig. 9. Mapping based on citation data by documents data in Scopus. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

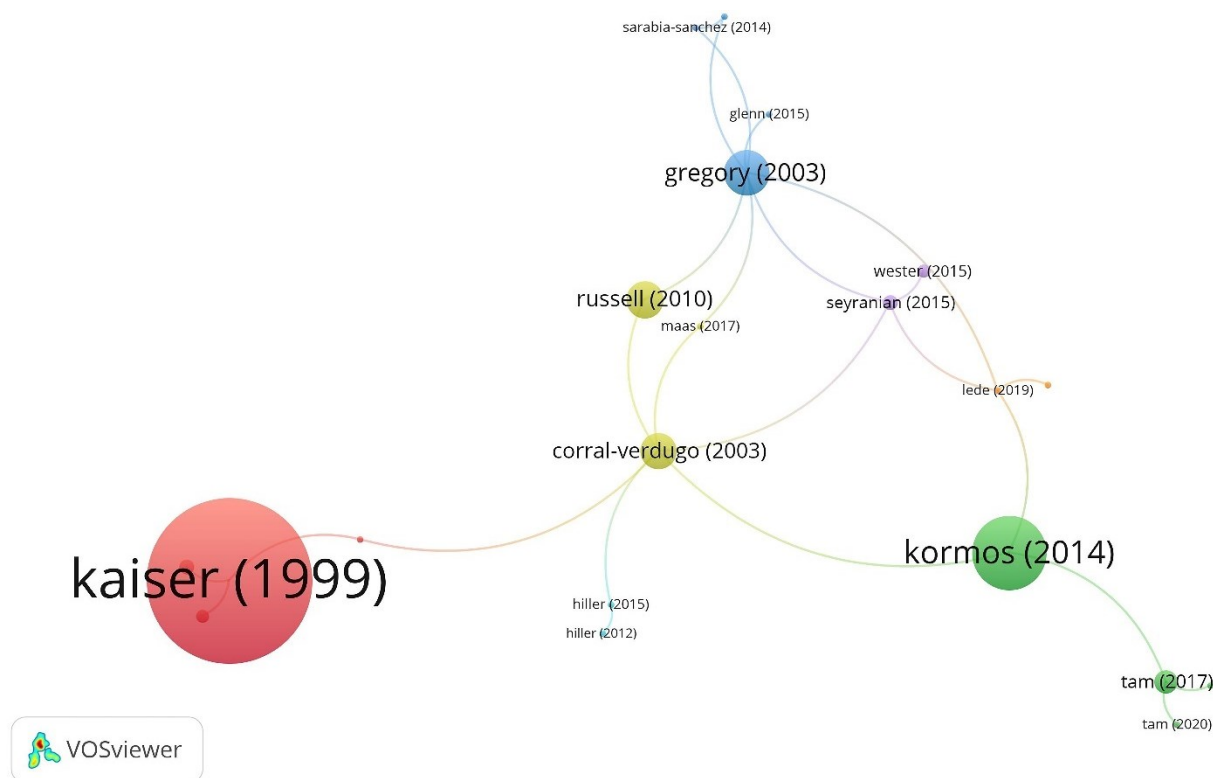


Fig. 10. Mapping based on citation data by documents in Web of Science Core Collection. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

D. Mapping based on co-citation data by cited references

Co-citation analysis by cited references is a provider method to study the specialty structure of science in the specified field (Small, 1973, p. 265). Co-citations to the 3rd document in two independent documents are examined through references cited together. In this analysis, the clusters and the cluster sizes represent the cited reference frequency. The links between the clusters denote the cooperation between the cited references. The thickness of the line of networks increases with the total strength of the link between the cited references.

In Scopus data, the minimum number of citations of a cited reference was set to 5 as a criterion. After setting this limit, the total of 24,645 cited references were narrowed down by the software to 26 that met the thresholds. For each of the 26 cited references, the total strength of co-citation links with other cited references was calculated. The cited references with the greatest total link strength were filtered. The number of cited references to be selected was 26. Before proceeding to the reference's relationships network mapping, the ranking according to the most citations could be seen in the interface created by the software, as shown in Tab. 15.

In Web of Science Core Collection data, the minimum number of citations of a cited reference was set to 8 as a criterion. After setting this limit, the total of 8,189 cited references were narrowed down by the software to 27 that met the thresholds. For each of the 27 cited references, the total strength of co-citation links with other cited references was calculated. The cited references with the greatest total link strength were filtered. The number of cited references to be selected was 27. Before proceeding to the reference's relationships network mapping, the ranking according to the most citations could be seen in the interface created by the software, as shown in Tab. 15.

When proceeding with the mapping in Scopus data, VOSviewer warned that some of the 26 items in our network were not connected to each other and the larger set of connected items consisted of 24 items. When asked by the software, "Do you want to show this set of items instead of all items?", the mapping in Figure 11 was created by answering the question with a "Yes". According to this mapping, the ranking by most cited references was as follows: 1. "Ulrich (1984) View Through A Window May Influence Recovery From Surgery" with 14 co-citations, 2. "Wilson (1984) Biophilia" with 11 co-citations, 3. "The academy of neuroscience for architecture: la jolla" with 11 co-citations, 4. "Beatley (2011) Biophilic Cities: Integrating Nature Into Urban Design and Planning" with 9 co-citations, 5. "Gillis & Gatersleben (2015) A Review of Psychological Literature on The Health and Wellbeing Benefits of Biophilic Design" with 9 co-citations, 6. "Kaplan (1995) The Restorative Benefits of Nature: Toward an Integrative Framework" with 8 co-citations, 7. "Joye (2007) Architectural Lessons From Environmental Psychology: The Case of Biophilic Architecture" with 7 co-citations, 8. Kellert (2005) Building for Life" with 7 co-citations, 9. "Hartig et al. (2014) Nature and Health" with 6 co-citations, and 10. "(2005) Ecosystems and Human Well-Being: Synthesis" with 6 co-citations (Fig. 11).

The data mapping process in the Web of Science Core Collection has been completed without any warnings (Fig. 12). According to this mapping, the first cited reference was "[no title captured]" with 27 co-citations; followed by "Ajzen (1991) The Theory of Planned Behavior" with 23 co-citations; "Stern (2000) Toward a coherent theory of environmentally significant behaviour" with 22 co-citations; "Kaplan & Kaplan (1989) The experience of nature: A psychological perspective" with 19 co-citations; "Kaplan (1995) The restorative benefits of nature: Toward an integrative framework"; with 17 co-citations; "Steg (2009) Encouraging pro-environmental behavior: An integrative review and research agenda" with 17 co-citations; "Bamberg (2007) Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of

psycho-social determinants of pro-environmental behaviour” with 15 co-citations; Ulrich (1991) Stress Recovery During Exposure to Natural and Urban Environments” with 13 co-citations; “Abrahamse (2005) A review of intervention studies aimed at

household energy conservation” with 12 co-citations; and “Berto (2005) Exposure to restorative environments helps restore attentional capacity” (Fig. 12) with 10 co-citations.

Tab. 15. Interface sorted by most cited reference before mapping. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

VOSviewer Interface, 2022

Scopus Data

Create Map

Verify selected cited references

Selected	Cited reference	Cita...	Total link strength
<input checked="" type="checkbox"/>	ulrich, r.s., view through a window may influence recovery from s...	14	35
<input checked="" type="checkbox"/>	wilson, e.o., (1984) biophilia, , cambridge, ma: harvard university ...	11	29
<input checked="" type="checkbox"/>	the academy of neuroscience for architecture: la jolla, ca, usa	11	0
<input checked="" type="checkbox"/>	beatley, t., (2011) biophilic cities: integrating nature into urban de...	9	45
<input checked="" type="checkbox"/>	gillis, k., gatersleben, b., a review of psychological literature on th...	9	1
<input checked="" type="checkbox"/>	kaplan, s., the restorative benefits of nature: toward an integrative...	8	26
<input checked="" type="checkbox"/>	joye, y., architectural lessons from environmental psychology: the...	7	25
<input checked="" type="checkbox"/>	wilson, e.o., (1984) biophilia: the human bond with other species, ...	7	22
<input checked="" type="checkbox"/>	joye, y., architectural lessons from environmental psychology: the...	7	11
<input checked="" type="checkbox"/>	kaplan, s., the restorative benefits of nature: toward an integrative...	7	2
<input checked="" type="checkbox"/>	kellert, building for life	7	0
<input checked="" type="checkbox"/>	hartig, t., mitchell, r., de vries, s., frumkin, h., nature and health (2...	6	54
<input checked="" type="checkbox"/>	ulrich, r.s., view through a window may influence recovery from s...	6	32
<input checked="" type="checkbox"/>	(2005) ecosystems and human well-being: synthesis, , washingto...	6	27
<input checked="" type="checkbox"/>	ulrich, r.s., simons, r.f., losito, b.d., fiorito, e., miles, m.a., zelson, ...	6	23
<input checked="" type="checkbox"/>	ulrich, r.s., simons, r.f., losito, b.d., fiorito, e., miles, m.a., zelson, ...	6	19
<input checked="" type="checkbox"/>	berto, r., exposure to restorative environments helps restore atten...	6	18
<input checked="" type="checkbox"/>	kaplan, r., kaplan, s., (1989) the experience of nature: a psychologi...	5	24
<input checked="" type="checkbox"/>	kellert, s.r., wilson, e.o., (1993) the biophilia hypothesis, , washingt...	5	24
<input checked="" type="checkbox"/>	hartig, t., evans, g.w., jamner, l.d., davis, d.s., garling, t., tracking f...	5	20
<input checked="" type="checkbox"/>	kaplan, r., kaplan, s., (1989) the experience of nature: a psychologi...	5	15
<input checked="" type="checkbox"/>	gillis, k., gatersleben, b., a review of psychological literature on th...	5	8
<input checked="" type="checkbox"/>	kaplan, s., the restorative benefits of nature: toward an integrative...	5	8
<input checked="" type="checkbox"/>	beatley, t., newman, p., biophilic cities are sustainable, resilient cit...	5	7
<input checked="" type="checkbox"/>	ulrich, r.s., simons, r.f., losito, b.d., fiorito, e., miles, m.a., zelson, ...	5	4
<input checked="" type="checkbox"/>	wilson, e.o., (1984) biophilia, , harvard university press: cambridge...	5	1

Web of Science Core Collection Data

Create Map

Verify selected cited references

Selected	Cited reference	Cita...	Total link
<input checked="" type="checkbox"/>	[no title captured]	27	60
<input checked="" type="checkbox"/>	ajzen i, 1991, organ behav hum dec, v50, p179, doi 10.1016/0749-5978(9...	23	72
<input checked="" type="checkbox"/>	stern pc, 2000, j soc issues, v56, p407, doi 10.1111/0022-4537.00175	22	78
<input checked="" type="checkbox"/>	kaplan r., 1989, experience nature ps	19	56
<input checked="" type="checkbox"/>	kaplan s, 1995, j environ psychol, v15, p169, doi 10.1016/0272-4944(95)9...	17	67
<input checked="" type="checkbox"/>	steg l, 2009, j environ psychol, v29, p309, doi 10.1016/j.jenvp.2008.10.004	17	53
<input checked="" type="checkbox"/>	bamberg s, 2007, j environ psychol, v27, p14, doi 10.1016/j.jenvp.2006.1...	15	61
<input checked="" type="checkbox"/>	ulrich rs, 1991, j environ psychol, v11, p201, doi 10.1016/s0272-4944(05)...	13	49
<input checked="" type="checkbox"/>	abrahamse w, 2005, j environ psychol, v25, p273, doi 10.1016/j.jenvp.20...	12	29
<input checked="" type="checkbox"/>	berto r, 2005, j environ psychol, v25, p249, doi 10.1016/j.jenvp.2005.07.0...	10	51
<input checked="" type="checkbox"/>	berman mg, 2008, psychol sci, v19, p1207, doi 10.1111/j.1467-9280.2008...	10	49
<input checked="" type="checkbox"/>	wilson e.o., 1984, biophilia	10	40
<input checked="" type="checkbox"/>	schwartz s. h., 1977, adv expt social psych, v10, p221, doi [10.1016/s0065...	10	29
<input checked="" type="checkbox"/>	ulrich rs, 1984, science, v224, p420, doi 10.1126/science.6143402	9	39
<input checked="" type="checkbox"/>	dunlap re, 2000, j soc issues, v56, p425, doi 10.1111/0022-4537.00176	9	32
<input checked="" type="checkbox"/>	gifford r, 2011, am psychol, v66, p290, doi 10.1037/a0023566	9	24
<input checked="" type="checkbox"/>	cialdini rb, 1990, j pers soc psychol, v58, p1015, doi 10.1037/0022-3514...	9	22
<input checked="" type="checkbox"/>	white m, 2010, j environ psychol, v30, p482, doi 10.1016/j.jenvp.2010.04...	9	21
<input checked="" type="checkbox"/>	hartig t, 2003, j environ psychol, v23, p109, doi 10.1016/s0272-4944(02)0...	8	34
<input checked="" type="checkbox"/>	kellert s.r., 1993, biophilia hypothesis	8	28
<input checked="" type="checkbox"/>	gregory gd, 2003, j appl soc psychol, v33, p1261, doi 10.1111/j.1559-181...	8	25
<input checked="" type="checkbox"/>	hardin g, 1968, science, v162, p1243, doi 10.1126/science.162.3859.1243	8	25
<input checked="" type="checkbox"/>	hines j.m., 1987, j environ educ, v18, p1, doi 10.1080/00958964.1987.994...	8	25
<input checked="" type="checkbox"/>	schultz pw, 2007, psychol sci, v18, p429, doi 10.1111/j.1467-9280.2007.0...	8	25
<input checked="" type="checkbox"/>	corral-verdugo v, 2002, environ behav, v34, p531, doi 10.1177/00116502...	8	24
<input checked="" type="checkbox"/>	dunlap re, 1978, j environ educ, v9, p10, doi 10.1080/00958964.1978.108...	8	23
<input checked="" type="checkbox"/>	kollmuss a, 2002, environ educ res, v8, p239, doi [10.1080/13504620220...	8	21

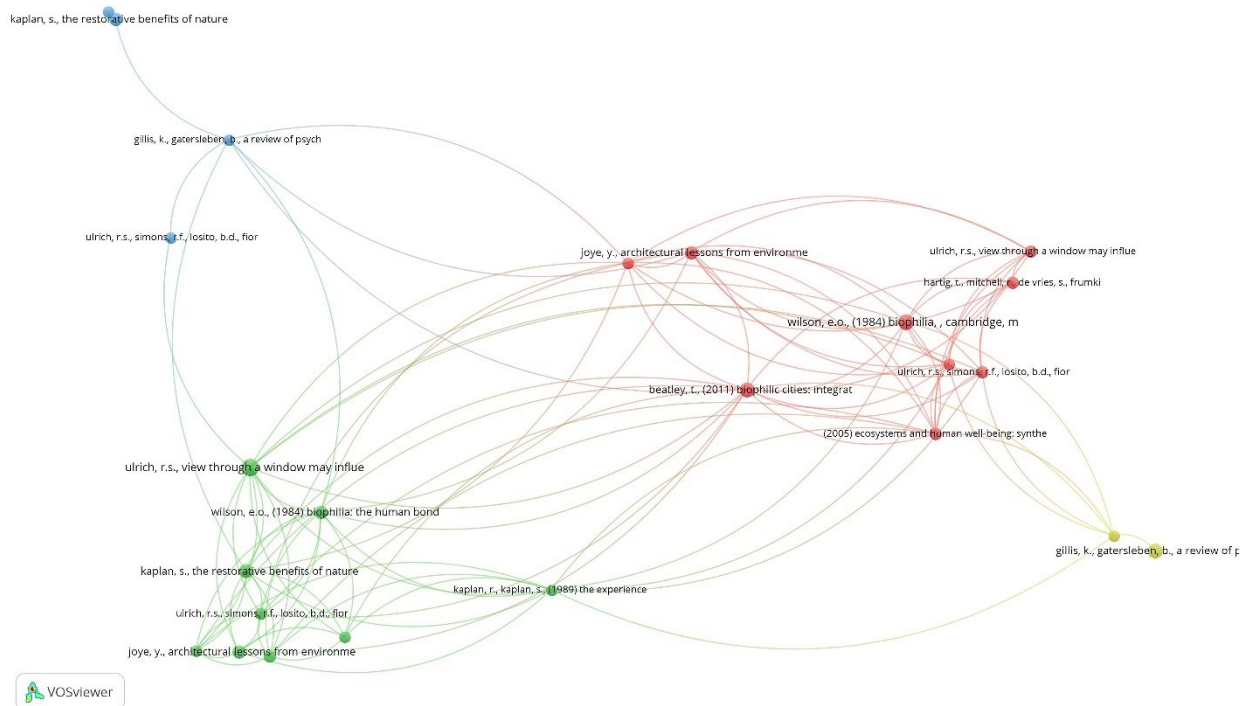


Fig. 11. Mapping based on co-citation data according to the cited references data in Scopus. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

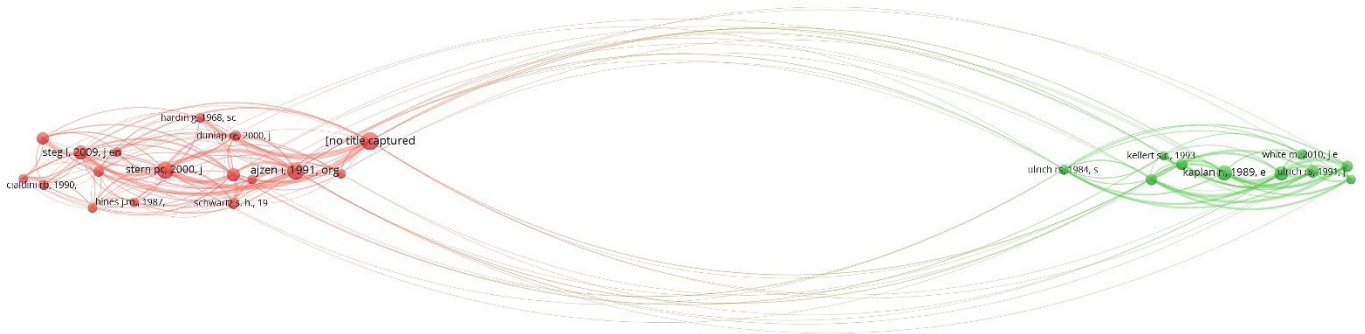


Fig. 12. Mapping based on co-citation data by cited references in Web of Science Core Collection. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

E. Mapping based on co-citation data by the cited authors

Co-citation analysis by cited authors is used in understanding intellectual structure in science (White, Griffith, 1981, p. 163). Co-citations to the 3rd document in two independent documents are examined through authors cited together. In this analysis, the clusters and the cluster sizes represent the cited authors' frequency. The links between the clusters denote the cooperation between the cited authors. The thickness of the line of networks increases with the total strength of the link between the cited authors.

In Scopus data, the minimum number of citations of an author was set to 100. After setting this limit, the total of 30,499 authors were narrowed down by the software to 7 that met the thresholds. For each of the 7 authors, the total strength of co-citation links with other authors was calculated. The authors with the greatest total link strength were filtered. The number of authors to be selected was 7. Before proceeding to the reference's relationships network mapping, the ranking according to the most

citations could be seen in the interface created by the software, as shown in Tab. 16.

In Web of Science Core Collection data, the minimum number of citations of an author was set to 20 as a criterion. After setting this limit, the total of 6,249 authors were narrowed down by the software to 20 that met the thresholds. For each of the 20 authors, the total strength of co-citation links with other authors was calculated. The authors with the greatest total link strength were filtered. The number of authors to be selected was 20. Before proceeding to the reference's relationships network mapping, the ranking according to the most citation could be seen in the interface created by the software, as shown in Tab. 16.

The Scopus data mapping process has been completed without any warnings (Fig. 13). According to this mapping, the first author was Hartig with 251 co-citations; followed by Ulrich with 194 co-citations; Kaplan, S. with 189 co-citations; Kellert with 185 co-citations; Wilson with 159 co-citations; Kaplan, R. with 125 co-citations; and Steg with 111 co-citations (Fig. 13).

Tab. 16. Interface sorted by the most cited author before mapping. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

VOSviewer Interface, 2022

Scopus Data

Create Map
✕

Verify selected authors

Selected	Author	Citations	Total link strength
<input checked="" type="checkbox"/>	hartig, t.	251	4831
<input checked="" type="checkbox"/>	ulrich, r.s.	194	3369
<input checked="" type="checkbox"/>	kaplan, s.	189	3339
<input checked="" type="checkbox"/>	kellert, s.r.	185	2393
<input checked="" type="checkbox"/>	wilson, e.o.	159	1888
<input checked="" type="checkbox"/>	kaplan, r.	125	2429
<input checked="" type="checkbox"/>	steg, l.	111	2841

< Back
Next >
Finish
Cancel

Web of Science Core Collection Data

Create Map
✕

Verify selected authors

Selected	Author	Citations	Total link strength
<input checked="" type="checkbox"/>	stern, pc	59	495
<input checked="" type="checkbox"/>	kaiser, fg	57	901
<input checked="" type="checkbox"/>	ajzen, i	52	683
<input checked="" type="checkbox"/>	schultz, pw	45	355
<input checked="" type="checkbox"/>	kaplan, s	44	304
<input checked="" type="checkbox"/>	corral-verdugo, v	42	352
<input checked="" type="checkbox"/>	kaplan, r	41	252
<input checked="" type="checkbox"/>	hartig, t	39	278
<input checked="" type="checkbox"/>	steg, l	34	307
<input checked="" type="checkbox"/>	ulrich, rs	34	244
<input checked="" type="checkbox"/>	herzog, tr	31	218
<input checked="" type="checkbox"/>	dunlap, re	29	310
<input checked="" type="checkbox"/>	gifford, r	29	277
<input checked="" type="checkbox"/>	thogersen, j	29	224
<input checked="" type="checkbox"/>	schwartz, sh	26	256
<input checked="" type="checkbox"/>	kellert, sr	26	140
<input checked="" type="checkbox"/>	bamberg, s	24	300
<input checked="" type="checkbox"/>	han, h	23	735
<input checked="" type="checkbox"/>	ulrich, rs	22	155
<input checked="" type="checkbox"/>	fielding, ks	20	140

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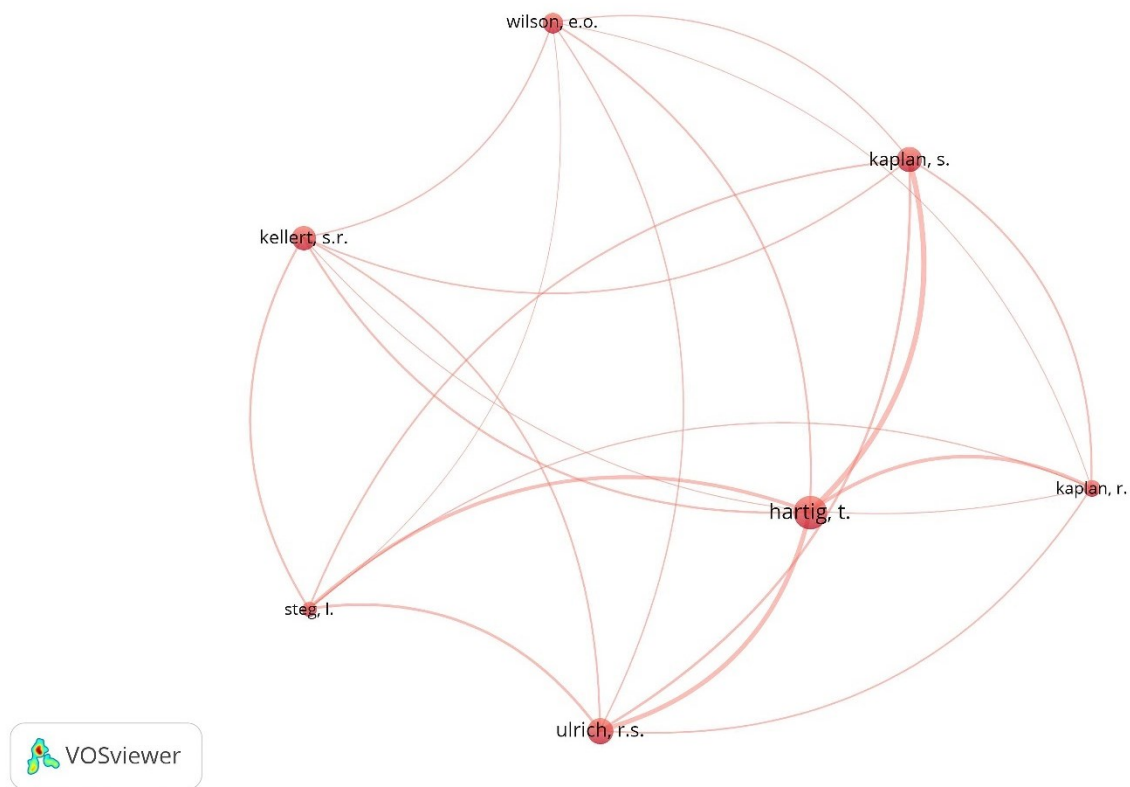


Fig. 13. Mapping based on co-citation data by cited authors data in Scopus. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

The process for mapping Web of Science Core Collection data has been completed without any warnings (Fig. 14). According to this mapping, the first author was Stern with 59 co-citations; followed by Kaiser with 57 co-citations; Ajzen with 52 co-citations; Schultz with 45 co-citations; Kaplan, S. with 44 co-citations; Corral-Verdugo with 42 co-citations; Kaplan, R. with 41 co-citations; Hartig

with 39 co-citations; Steg with 34 co-citations; Ulrich with 34 co-citations; Herzog with 31 co-citations; Dunlap with 29 co-citations; Gifford with 29 co-citations; Thogersen with 29 co-citations; Schwartz with 26 co-citations; Kellert with 26 co-citations; Bamberg with 24 co-citations; Han with 23 co-citations; and Fielding with 20 co-citations (Fig. 14).

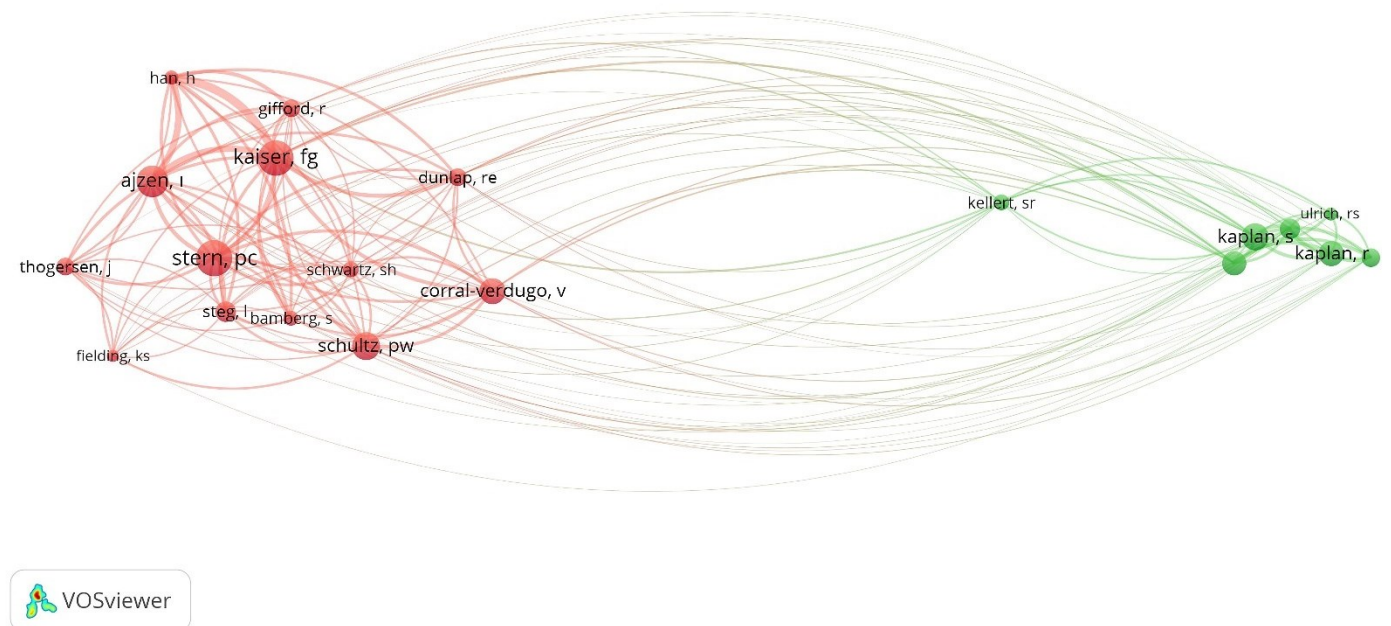


Fig. 14. Mapping based on co-citation data by the cited authors data in Web of Science Core Collection. (Source: Created by VOSviewer, 2022). Certain data included herein is derived from Elsevier Scopus and Clarivate Web of Science. © Copyright Elsevier, Clarivate 2022. All rights reserved.

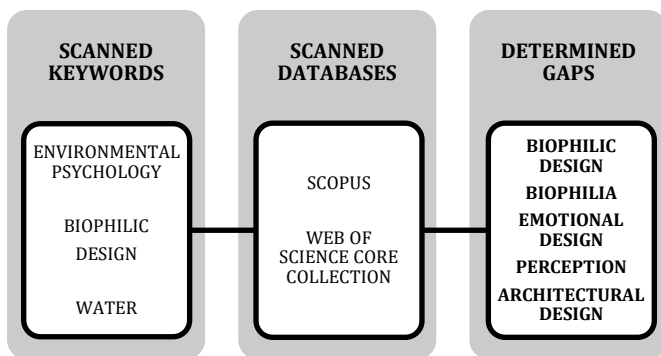
CONCLUSION

In this study, scientific papers about the water at the intersection of environmental psychology and biophilic design were examined via bibliometric data collected from Scopus and Web of Science Core Collection databases. In this context, document types, publication years, top countries, top subject areas, top sources, top affiliations, top funding sponsors, primary authors and co-authorship, author keywords and co-occurrences, citations of documents, co-citations of cited references and cited authors were evaluated based on the bibliometric data of 292 documents in total collected since 1995.

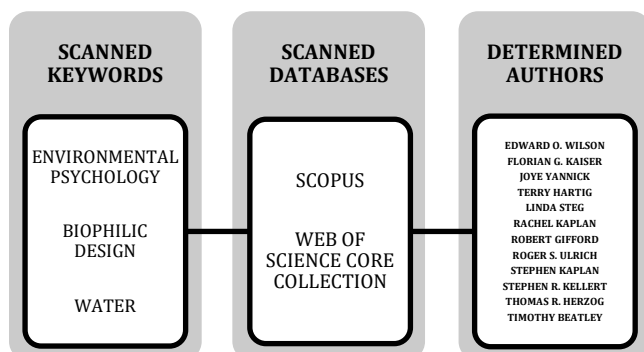
Bibliometric analysis with science mapping techniques was applied to the data downloaded by scanning with the keywords *environmental psychology*, *biophilic design*, and *water* in Scopus and Web of Science Core Collection. The concepts related to the biophilic design-environmental psychology clusters and the developments over time (current trends) by overlay visualization for the concepts were established via co-occurrence mapping. The cited authors and cited references related to the biophilic design-environmental psychology clusters were established via co-citation mapping. The documents' relationships and the authors' relationships with respect to biophilic design and environmental psychology study areas were established via "citation of documents" mapping and co-authorship mapping.

As a result of the co-occurrence mapping, current research gaps and concepts were identified based on the findings (Tab. 17). In the databases selected for scanning, the gaps determined by the scanned keywords are Biophilic Design, Biophilia, Emotional Design, Perception, Architectural Design (Tab. 17). While determining these gaps, new concepts that may be related to design and architecture were emphasized.

Tab. 17. From the Keywords to the New Research Gaps "Concepts". (Source: Katuk, Köseoğlu, 2023)



Tab. 18. From the Keywords to the Authors. (Source: Katuk, Köseoğlu, 2023)



As a result of co-citation mapping, authors and references were identified based on the findings (Tab. 18). In the databases

selected for scanning, the primary authors who can be examined as reference sources determined by the scanned keywords are Edward O. Wilson, Florian G. Kaiser, Joye Yannick, Terry Hartig, Linda Steg, Rachel Kaplan, Robert Gifford, Roger S. Ulrich, Stephen Kaplan, Stephen R. Kellert, Thomas R. Herzog, Timothy Beatley (Tab. 18). When ascertaining these authors, cited references that may be related to design and architecture were emphasized.

To conclude, it was pointed out that the concepts determined from water at the intersection of environmental psychology and biophilic design research areas have just begun to be studied and there is a growing tendency. In addition to this situation, in the approach to the relationship between space and water in architecture, biophilic design has been found to be a more recent field than environmental psychology. Consequently, the concepts identified in this study and –especially the new combinations that can be established with the biophilic architecture approach– allow to design new research topics.

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Traces of former mill races in Krnov: Possibilities of revitalization and interpretation

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Abstract:

Mill races were an integral part of many towns in the past. But when they lost their economic importance, they were mostly filled and buried underground. Although we can now find them in their original form in a few cases only, their spatial corridors have often been preserved in the urban structure. The research aims to detect the historical trace of the former mill races in Krnov, a small town in the district of Bruntál in the Moravian-Silesian region of the Czech Republic, and investigate the possibilities of their interpretation and revitalization. The research focuses on the identification of the remnants and traces of the former mill races using historical maps, literary and visual sources, and subsequently on the investigation of the state of their current existence in the urban structure, according to current orthophoto maps, real estate cadastre records, and field research. During the 19th century, the mill race system in Krnov and its surrounds consisted of four mill race channels. Two of them have been preserved with water flow to the present day. The other two mill races were filled. Research shows, however, that the footprint of their corridors is legible in the urban structure even today, and its presentation in new forms could significantly contribute to regenerate the urban fabric and revitalize public spaces. The mill races represent historical and cultural heritage, and the presentation and interpretation of their values, even those that have disappeared, can significantly help increase the quality and attractiveness of urban public spaces for residents and tourists.

Keywords:

mill race, industrial heritage, extinct heritage, urban revitalization, placemaking

INTRODUCTION

In innovative and sustainable development efforts and in creative planning approaches, the transformations of the relations between the city and water are becoming the key issue in urban renewal strategies (Baker, 2009; Carta, Ronsivalle 2022; Benkő, Gregor, Vitková, 2019; Chochrunová, 2018; Bašová, 2011; Bašová, Sopiřová, 2018; Kristianová, 2018; Shangi, Tanvir, Imtiaz, 2020; Dal Cin, Hooimeijer, Matos Silva, 2021; Joklová, Furdík, 2015). The presence of water in various forms ever was and still is a prerequisite for the birth and existence of human settlements. On the one hand, water was a friend, a source of sustenance, but on the other, a dangerous enemy, an element that threatened human lives with floods (Bostenaru Dan, Dill, 2018; Kristianová, Kaisheva, Bostenaru Dan, 2019). These multifaceted aspects of the communities' relationship to water were dynamically reflected in the characteristics behind the formation of the urban structure in different historical periods and represent specific values for towns and cities.

In the past, mill races were a characteristic and influential element of the infrastructure of many urban settlements. They enabled the use of water energy for various economic purposes.

They powered water mills and mechanical processes of grinding, rolling, and hammering, enabling the production of many material goods – flour, textiles, lumber, and paper. They were important in mining and the production of metal products. Later, with the invention of the steam engine and the expansion of the use of other sources of energy, they began to lose their importance. Although with the technological development of water turbines some mill races and old mills were adapted for the production of electricity, yet they usually could not compete sufficiently with the necessary capacities (Illés, Kristianová, Joklová, 2022). Thus, in many cases, mill races have not been preserved in the urban structure of settlements to the present day. Impacts of collectivization, nationalization of mills, and new regulation of rivers all contributed to the disappearance of mill races. In the urban structure of towns, mill races were often perceived as an obstacle to modern building development. They were filled, buried, or channelled underground.

Although we can find them in their original form in a few cases only, their spatial corridors have often been preserved in the urban structure. Regeneration of settlements' urban structure can significantly be advanced by finding a new use and presentation for the historical traces of former mill race corridors. At

the same time, the mill races represent a historical cultural heritage (Kristianová, Gécová, Putrová, 2015), and the presentation and interpretation of their values, even those that have disappeared, can significantly help increase the quality and attractiveness of the urban public spaces for residents and tourists (Illéš, Kristianová, Jaszczak, Pochodyla, 2022).

Several remarkable examples of preserved and revitalized mill water channels point to their significant benefits and contributions to the urban structure of settlements in Czech towns. For example, a successful project based on residents' suggestions is the revitalization of a mill race in Chrudim, carried out in individual stages from 1995 to 2009. The watercourse flowing in the neighbourhood of the historic town centre got its new attractive form of a morphologically varied stream with a whole range of natural river elements (Tomášková, 2020). A unique example is the modified water course of Nečitz, which flows through the central square under the town hall tower in Litovel, and forms a significant urban compositional axis of the town (Augustinková, Páclová, 2013). Another example worth mentioning is the reminder of a defunct mill race restored along with an artificial water area and a park arrangement in the city of Plzeň (Pilsen) (Damec, Wilhelmová, 2007), which won the Park of the Year Award in 2010.

Our research aims to survey the historical traces of former mill races in Krnov, a town located in the district of Bruntál in the Moravian-Silesian region of the Czech Republic, and investigate the approaches to the possibilities of their new interpretation and use. Krnov provides a suitable case study for examining the current state of mill races in the urban structure and approaches to their possible presentation and revitalization, given its past as a town of textile production closely tied to the existence of mill races.

BACKGROUND

Krnov lies in the Moravian-Silesian Region, where the Czech Republic borders Poland (Fig. 1). The town lies between the rivers Opava and Opavica, which flow through Krnov and merge into a single watercourse of the Opava River, continuing towards the Opava town. The town has a rich history associated with textile production. The cloth workers guild founded in 1570 was one of the oldest in Krnov. At the turn of the 18th and 19th centuries, woven woollen cloth-making was one of the town's most important crafts in the location. And it was the mill races that were an important source of energy and water for manufactories, water-powered fulling mills, spinning, and dyeing, and for driving machines connected with the fabric production. In 1824, 276 cloth makers, 9 cloth cutters, 70 weavers, and 15 knitters worked in the town. The cloth-making industry reached its peak at the beginning of the 19th century, and subsequently, other crafts related to textile production, such as weaving and yarn production, also developed. Even in today's Krnov you can see former textile factories or representative villas of factory owners (Ryšková, 2008; Šperková, 2019).

The site of the Alois Larisch and Sons textile factory, which has been preserved to this day, is one of the most important in the town and its buildings are listed as national cultural monuments. It is located near the now-defunct mill race in the central part of the town. The history of the textile factory Alois Larisch and Sons illustrates the transition in the powering of production processes from using a water wheel to steam engines and the transition from a manufactory to industrial processing of cloth. Alois Larisch's business reflects the development of the entire cloth-making industry in the town. He became a clothier in 1831, and in 1832 he established a manufactory, which consisted of a handloom, a laundry, and a cloth dyeing plant. Ten years

later, he established a mechanical spinning mill when he bought a fulling mill with water rights from the tanners' guild. Driving by water wheels was also used in other enterprises in Krnov until the time when steam engines took over. The first steam engine in Krnov was put into operation in 1862 in the Larisch factory.



Fig. 1. Location of Krnov in the Czech Republic. (Source: Illéš, 2023)

The period after 1870 stands out as the era of a rapid development of the textile industry in Krnov. In 1870 there were 8 industrial spinning mills working in the town, while raw wool was imported from Hungary, Russia, England, and the Netherlands. Weaving remained handmade-based for a longer time. Mechanical looms replaced manual looms in the 1870s. The connection of Krnov to the railway network in 1872 contributed to further development of production. In 1895, there were 49 businesses in Krnov, with only 16 cloth factories and 4 spinning mills able to survive the economic crisis later in the 1930s. After World War II and nationalization, part of the wool factories merged into a national enterprise Karnola Krnov. The other part of them disappeared, taken over by other companies. Karnola continued the production until 1997 when it closed, and this was the end of the famous cloth-making tradition in Krnov. Haberdashery production continued in the national enterprise producing ribbons, braids, elastic fabrics, and elastic yarns; today operating as PEGA-VEL (Ryšková, 2008).

The history of many other textile factories in Krnov also confirms the importance of water channels for the development of cloth production in this town. For example, the woollen goods factory, Josef Alscher and Sons was built on a mill race that separates a place called the Island from the Opava River, in the early 1850s. A spinning mill and a fulling mill were built here, powered by water wheels. In 1858, a second water wheel was installed (Ryšková, 2008). In 1862, the factory was expanded with a steam plant, and in 1930, a turbine was put into operation (Ryšková, 2008). Another woollen goods factory, taken over by its founder Franz Czerny from the cloth workers guild in 1863, also used a water wheel (Schulig, 1923; Ryšková, 2008; Klívar, 2010). On the opposite bank of the mill race there stood a fulling mill. In 1890, the water wheel was replaced by a turbine (Ryšková, 2008). In 1912, the operation was ensured by a pair of aggregates – a water turbine and a steam engine, each with a power of 30 HP (Klívar, 2010). In 1919 a stronger turbine was installed to supply energy to the Municipal Power Plant in Krnov later (Ryšková, 2008).

The Krnov textile mills, their buildings, and their premises, even in the poor condition in which they have been preserved to this day, stand as unique testimonies to the history of Krnov. Many of them are protected monuments. They shape the town's genius loci, its specific local identity. The mill races were also integral to this identity, representing a part of the historical heritage

of the town (Illéš, 2021). It is necessary to pay attention to their research, to the possibilities of their protection, revitalization, new interpretation, and use.

MATERIALS, DATA AND METHODS

In the first stage, the research focused on identifying the routes of the mill races using historical maps, and historical literary and visual sources. The maps of the first, second, and third military mapping were used: the First Military Survey of Duchy of Upper Silesia (1763), the Second Military Survey of the Habsburg Empire – Moravia (1836–1842), and the Third Military Survey of the Habsburg Empire (1869–1887), through the Arcanum Maps portal. The main map sources were the historical cadastral maps – the Imperial Obligatory Imprints of the Stable Cadastre – Moravia and Silesia accessed by the Geobrowser of the Archive of Czech Office for Surveying, Mapping, and Cadastre.

The Stable Cadastre became the basis for tax assessment in Bohemia in 1860. The mapping was carried out between 1826 and 1843. The Stable Cadastre is an excellent source for identifying the routes of mill races, mills, and other water-related objects. The number of water wheels is often indicated on the map, but this information is not always reliable. Very important parts are the land register maps and water register maps on a scale of 1:2880. In them, we can find details about the ownership of individual parcels or the management of sections of watercourses and the exercise of water rights, e.g., mill rights (vodnimlynny.cz, 2017; Štěpán, Urbánek, Klimešová, 2008; Pekař, 1932).

Subsequently, in the second stage, we conducted a survey of the current existence of mill races in the urban structure of Krnov from an urban planning point of view, according to the current orthophoto maps, current records of the real estate cadastre, and our own survey in the field. Finally, in the third stage, the results of the research were evaluated from the landscape-architectural and urban-planning points of view. Various poten-

tial possibilities for the revitalization and use of the spatial corridors of the former mill races to interpret the preserved tangible, as well as intangible and extinct cultural heritage values, were analysed.

RESULTS

The routes of the mill races during the development of the urban structure of Krnov are documented in various historical map sources. Four mill races can be seen on the map of the Imperial Obligatory Imprints of the Stable Cadastre from 1826–1843; these formed a system of mill races in the town and its surroundings in the past (Fig. 2). At present, the bed of the Opava River in Krnov is directionally maintained in a constant route by modifications made before 1945. The largest adjustment dates back to 1919, followed by a modification beyond the confluence with the Opavica River from 1988–1989 (Vodní toky: Krnov, 2019). Of the original four mill races, only two have been preserved to this day, the other two were filled up (Fig. 3).

The first mill race: Past, present and possibilities of revitalization and interpretation in urban structure

The first mill race belongs to the preserved torso of the original mill race system in the territory of Krnov. It is an approximately 2 km long, artificially constructed watercourse. It begins at the Kostelec weir on the right side of the Opava River, on km 75. Kostelec (Weisskirch) was once an independent village and it was joined to Krnov in 1921. In the past, a flour mill was located on the mill race in the area of the former village Chářová (Krotendorf) (Fig. 4). Later, the area became more urbanized and joined to Krnov. Krnov Starch Company and Karnola textile plant were established in the area of former small factories. Nowadays, after textile production terminated, the buildings of the former Karnola premises are rented for other types of production and for commercial, administrative and storage purposes. Passing through the Karnola premises and towards the flow into the Opava River, the mill race is piped (Fig. 5).

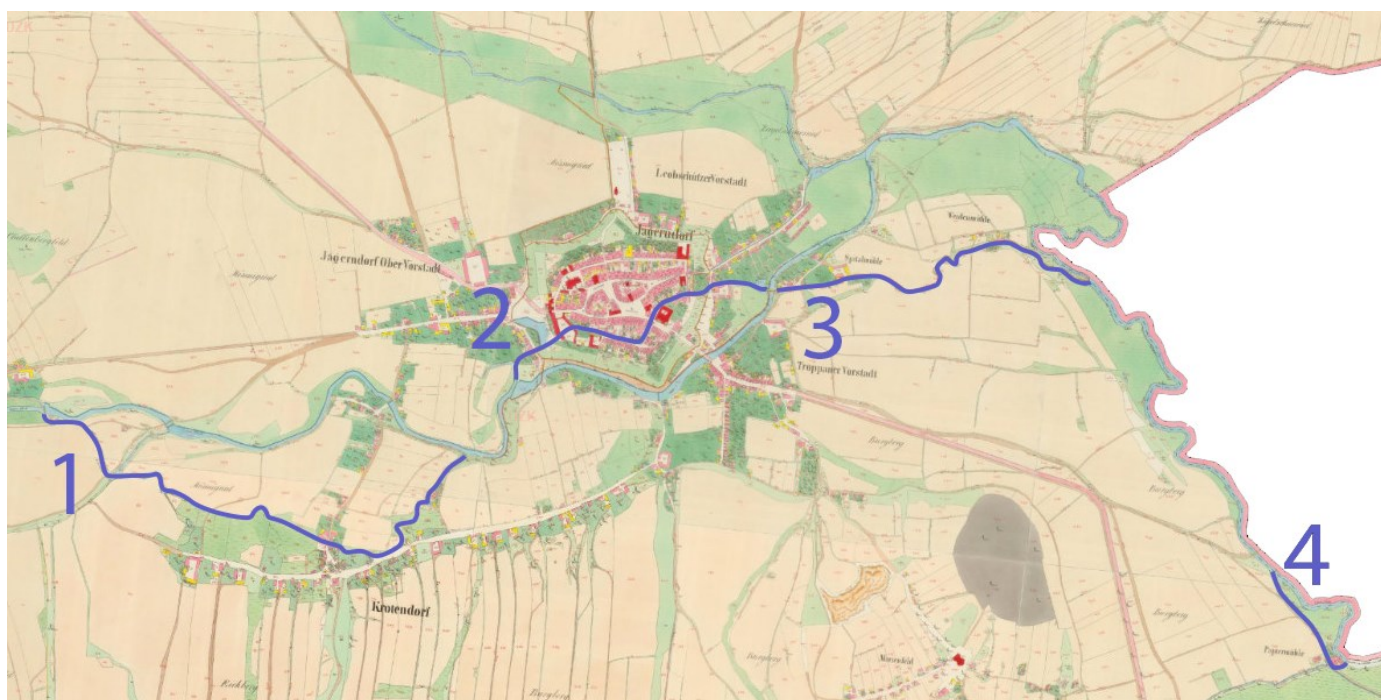


Fig. 2. Historical routes of four mill races in Krnov and its surroundings. (Source: Illéš based on the map of Imperial Obligatory Imprints of the Stable Cadastre 1826–1843, ČÚZK, c, 2010; 2023)

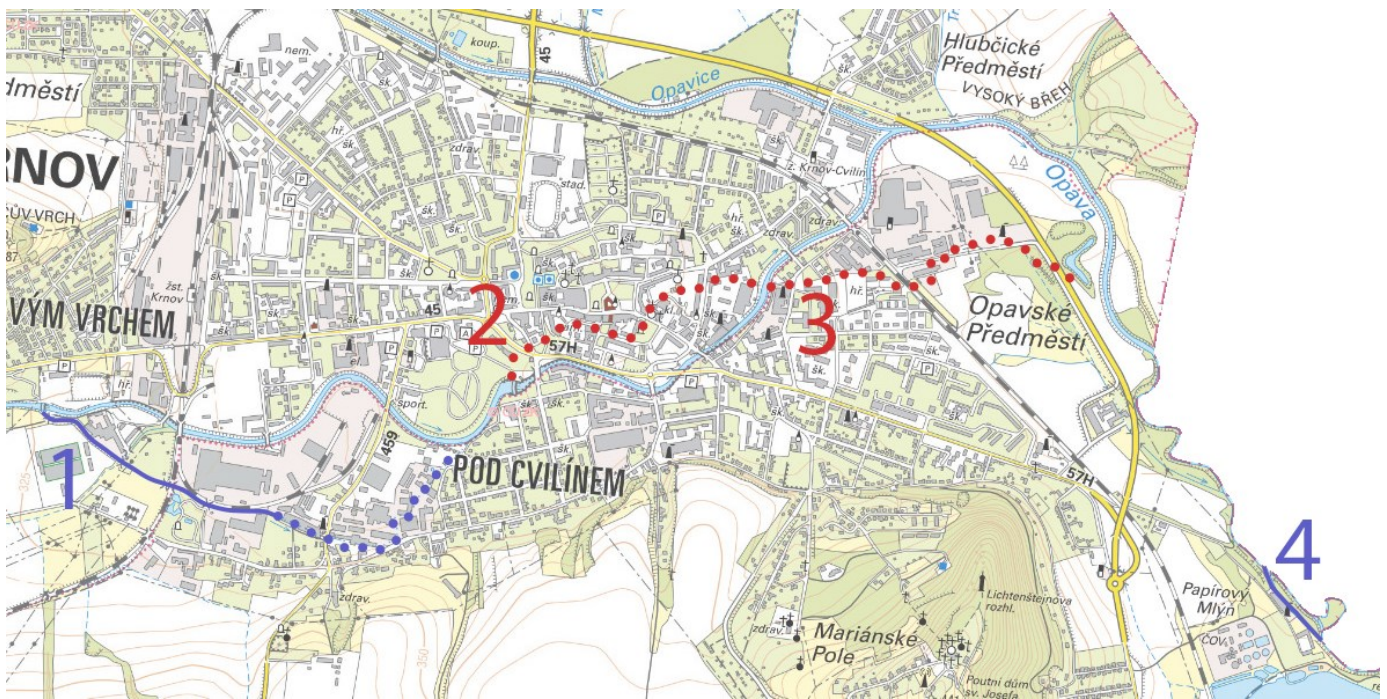


Fig. 3. Routes of mill races at the present time. (Source: Illés based on the current Base map of Czech Republic 1:10 000, ČÚZK, a, 2010; 2023)

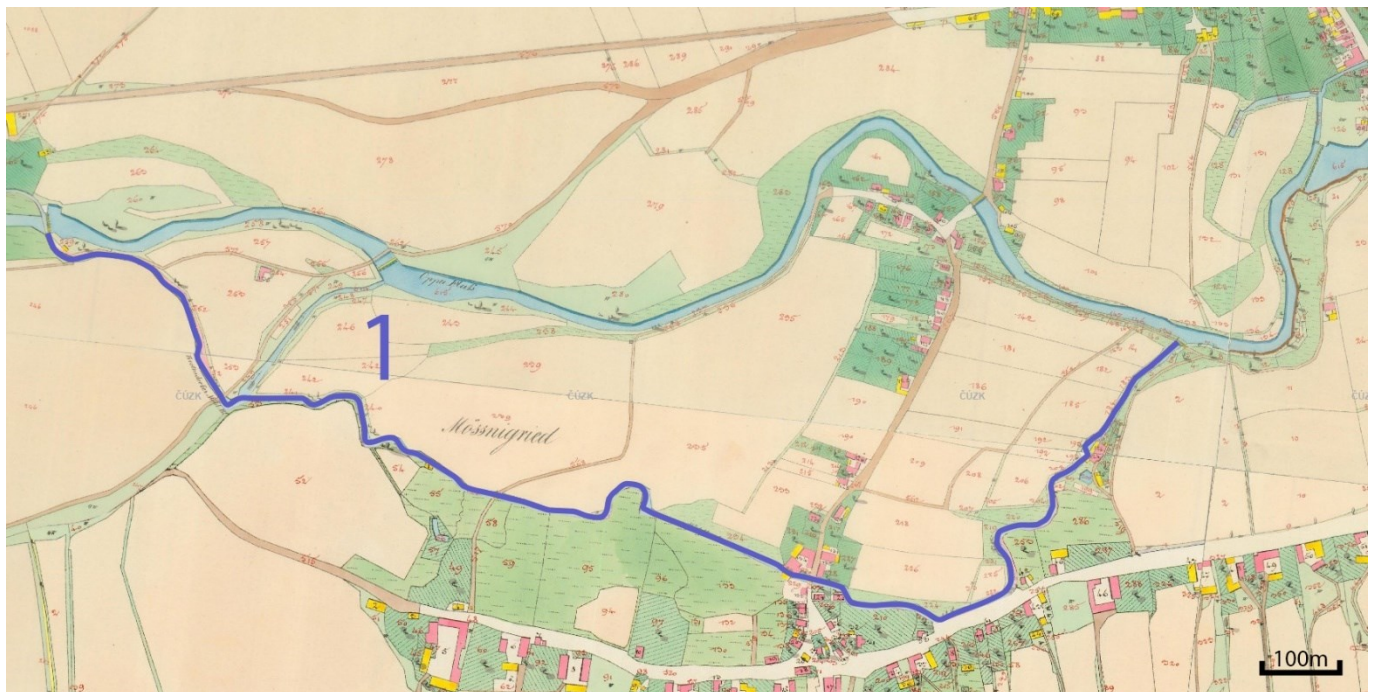


Fig. 4. The first mill race with mills in the 19th century. (Source: Illés based on the map of Imperial Obligatory Imprints of the Stable Cadastre 1826-1843, ČÚZK, c, 2010; 2023)

The urban structure offers spatial possibilities such as reopening the buried parts of the mill race or its presentation in other forms by landscape design solutions. This approach can be applied in some parts of the Karnola area and mainly in the public space along Tyršova street towards the inflow of the mill race to the Opava River. The possibility to present this part of the mill race is enabled also by the fact that this part of the mill race's spatial corridor is a municipal property according to the Cadastre of Real Estate (Fig. 6). In this case, the municipality of Krnov recognized the revitalization potential of the buried part of the mill race. As part of the 'River for All' initiative, the municipality commissioned an architectural study 'Krnov – River in

Town', which included a proposal to open the mill race in this part, construct a footbridge, and create an interesting public space. The study includes architectural, landscape, and water management improvements that will strengthen the ecological functions of the river, make the river corridor more accessible, and create lively public areas with recreational, social, and cultural significance (Círová, 2022; Machovský, Ondruška, Havlíček, Řiháček, 2019). The project works and municipal activities are coordinated with the activities of a state-owned enterprise Povodie Odry within the framework of planning anti-flood measures in Horná Opava (Machovský, Ondruška, Havlíček, Řiháček, 2019).

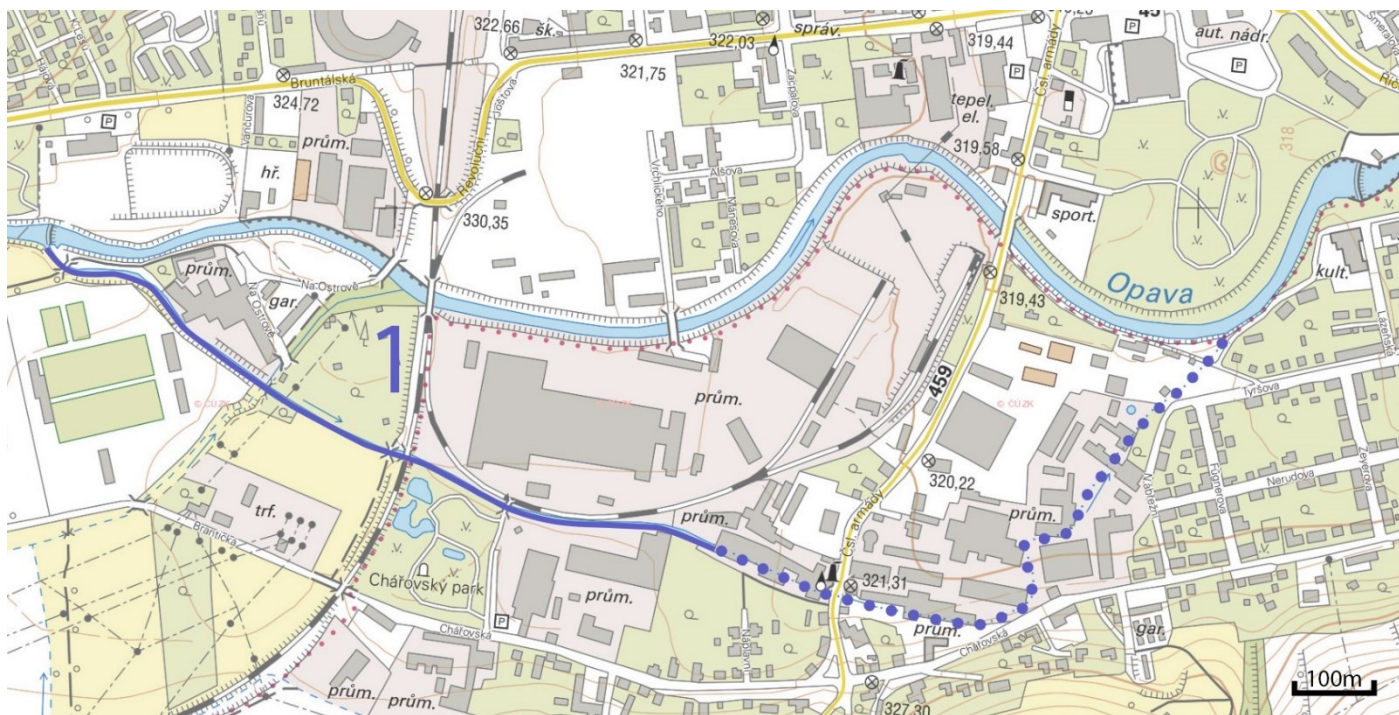


Fig. 5. The first mill race and its piped part today. (Source: Illěš based on the current Base map of Czech Republic 1:10 000, ČÚZK, a, 2010; 2023)



Fig. 6. Spatial and ownership preconditions for revitalizing the mill race along Tyršova street. (Source: Cadastral map, ČÚZK, b, 2010)

When evaluating the potential of this mill race, it is also necessary to pay attention to its route in the area of the former Karnola plant. This territory is undergoing a transition and can also be understood as a bluefield, a type of brownfield located near the water source, with its former functions closely related to the use of water (Pinch, Munt, 2002; Turečková, 2021). The part of the mill race deserves conversion – appropriate modification for a new use. The presentation of the mill race in this part of the territory would further contribute to recalling the genius loci and the values of the industrial heritage.

The second mill race: Past, present and possibilities of revitalization and interpretation in urban structure

The second mill race passed through the town's historic centre, through the fortification walls and the castle courtyard. It was fed from the weir on the Opava River, km 73.3. The upper and lower mill buildings were on the mill race, which was also adjacent to the premises of the Larisch textile factory (Fig. 7). The mill race was filled up during the 1950s. Today there is a small hydroelectric plant with two turbines that reach a total installed

power of 52 kW, to be found at the weir where once used to be the place of inflow into the mill race. The trace of the former drive is not visible at first glance in the current urban structure,

but spatial conditions for presenting its route remained available in many places (Fig. 8).

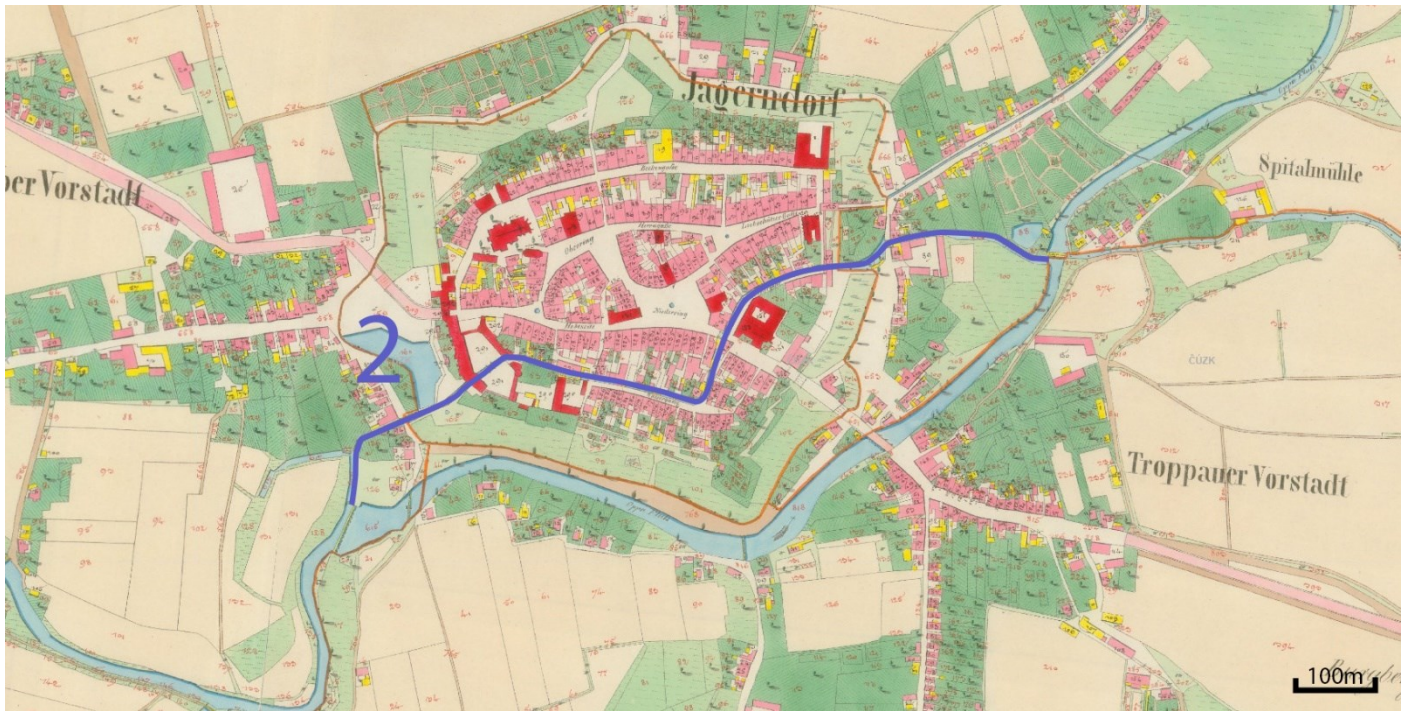


Fig. 7. The second mill race in the 19th century. (Source: Illéš based on the map of Imperial Obligatory Imprints of the Stable Cadastre 1826-1843, ČÚZK, c, 2010; 2023)

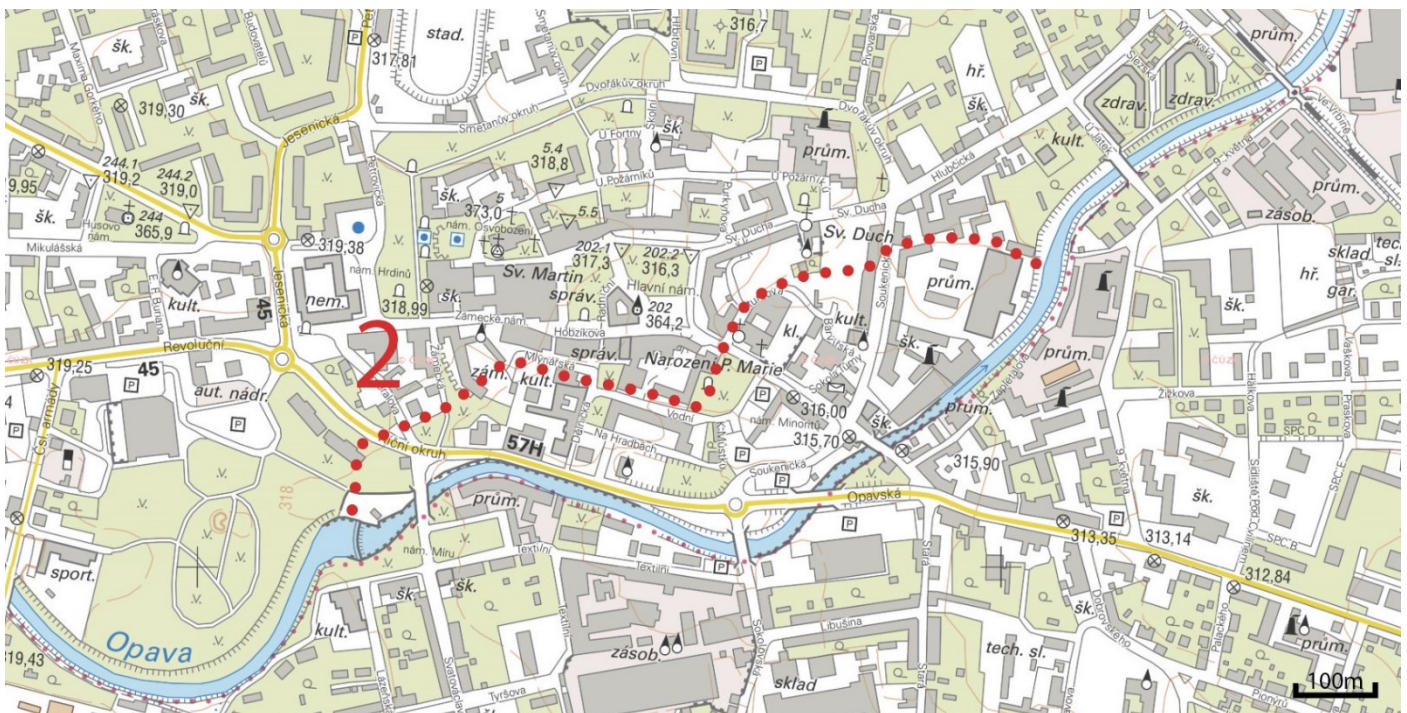


Fig. 8. The route of the extinct mill race in the historical centre of the town. (Source: Illéš based on the current Base map of Czech Republic 1:10 000, ČÚZK, a, 2010; 2023)

Such places include some parts of the town park, the castle courtyard, and the areas along today's Mlynářská and Vodní streets, which names refer to the route of the mill race. Here the urban structure offers spatial possibilities for landscaping solutions to comprise a reminder of the mill race, e.g., in the form of stormwater retention ponds or swales with the planting of

plants, which support the need and importance of water in the urban environment within the demands of adaptation to climate change. The location in the central area of the historical town offers the assumption that the presentation of the mill race is likely contribute to strengthening its specific identity and increasing the quality and attractiveness of public spaces for resi-

dents and tourists. Some studies (Kolarz 2006; Illéš, 2021) proposed the possibility of restoring and interpreting the mill race in this part of the city (Fig. 9).



Fig. 9. The proposal for the mill race interpretation in the historical centre: in the park, in the castle courtyard and behind the A. Larisch factory. (Source: Illéš, 2021)

Archaeological research by the Czech National Institute of Monuments near the Church of the Holy Spirit uncovered the remains of a dyehouse and a mill race with an arched vault through which the water flew through the town walls. The findings were presented to visitors in the form of guided tours (Kohutová, 2016). A part of these findings is presented in the revitalized park (Mathiasová, 2018). Although the archaeological findings i.e. the fortification wall, the dyehouse, and the vault of the mill race were buried, they are presented on the surface. The route of the mill race is interpreted by a pavement from granite blocks. The place of the former bridge over the mill race is remembered by a wooden pavement (Mach, 2017). Information panels are also installed, as well as two 3D bronze models depicting the former historical urban structure from 1779 and the turn of the 19th and 20th centuries (Fig. 10).



Fig. 10. Archaeological findings presentation in public space: the dyehouse and the mill race. (Source: Mlčák, 2022)

When evaluating the current approach to the presentation of the heritage of this former mill race in the town's urban structure

from the landscape-architectural and urban planning points of view, it is necessary to say that it would be beneficial to apply more solutions that would contribute to strengthening the green and blue infrastructure of the town. Even when it is unfeasible to revive the water flow in the mill race in its entirety, it is possible to return the phenomenon of water to public spaces in other ways. In those places along the former mill race route, where spatial possibilities and ownership relations allow, for example, in the municipal park or along Mlynářská and Vodná streets, it is possible to remind today's people of the route in the form of retention ponds, rain gardens, or ditches for collecting rainwater, with plantings of moisture-loving plants. Such landscaping would improve the urban microclimate and could also support pedestrian or cycling ways in the spatial corridor of the former mill race and enliven and increase the quality of public spaces for residents and visitors of the town.

The third mill race: Past, present and possibilities of revitalization and interpretation in urban structure

The third mill race started at the weir, on the opposite side, where the second mill race entered the Opava River. In the past, it was an undeveloped agricultural area outside the city. There were two mills on the mill race – Spital mill (Spitalmühle) and Willow mill (Weidenmühle) (Fig. 11). Currently, the mill race does not exist, it has been filled. (Fig. 12). In the current cadastral map, only the shape of the subdivision of plots and the name of the street Ve Vrbině remind people of the former mill race route. In the places where the mill race flowed into the Opava River, there are still wet places, a part of the dead arm with woody vegetation. The history of the place and the route of the former mill race could be presented in a few locations in this area. Its route passes the edge of an elementary school campus, where its interpretation could pursue educational goals related to history or environmental education on the importance of water in an urban environment. Partially there is a potential to present the route along Ve Vrbině street and to commemorate the places of Spital and Willow mills.

The fourth mill race: Past, present and possibilities of revitalization

The fourth mill race in Krnov belongs to those that have been preserved (Fig. 13, 14). It was built at the weir on the Opava River, km 68.2. A paper mill for the production of hand-made paper operated here, in 1863 owned by Ludwig and Heinrich Schrader (Klívar, 2010). At the turn of the century, a water power plant was also built in the location. Its later owner was Gustav Gröger junior, the owner of the Pflanzenöl – Werke Gröger factory founded in 1905. At that time there was a soap factory in the paper mill. After the Second World War, the factory premises belonged to the factory Stanislav Kostka Neumann Works. The mill race is still functional today, it is used by the Papírový Mlýn Hydroelectric Power Plant. The hydroelectric power plant uses the slope created by a 140 m-long derivation channel, led from the dam reservoir. One turbine in the engine room of the power plant has an installed power of 125 kW. The small power plant annually produces electricity of an average of 0.252 GWh, enough to supply about 90 households (TV-ADams, 2021). The water channel supplies Peter's fish pond, too (Fig. 14). The location of the fourth and still functional mill race has tourism potential. The cycling route Krnov – Opava leads along the river, so the presentation of the history of the place could attract visitors and enhance tourism in the region.

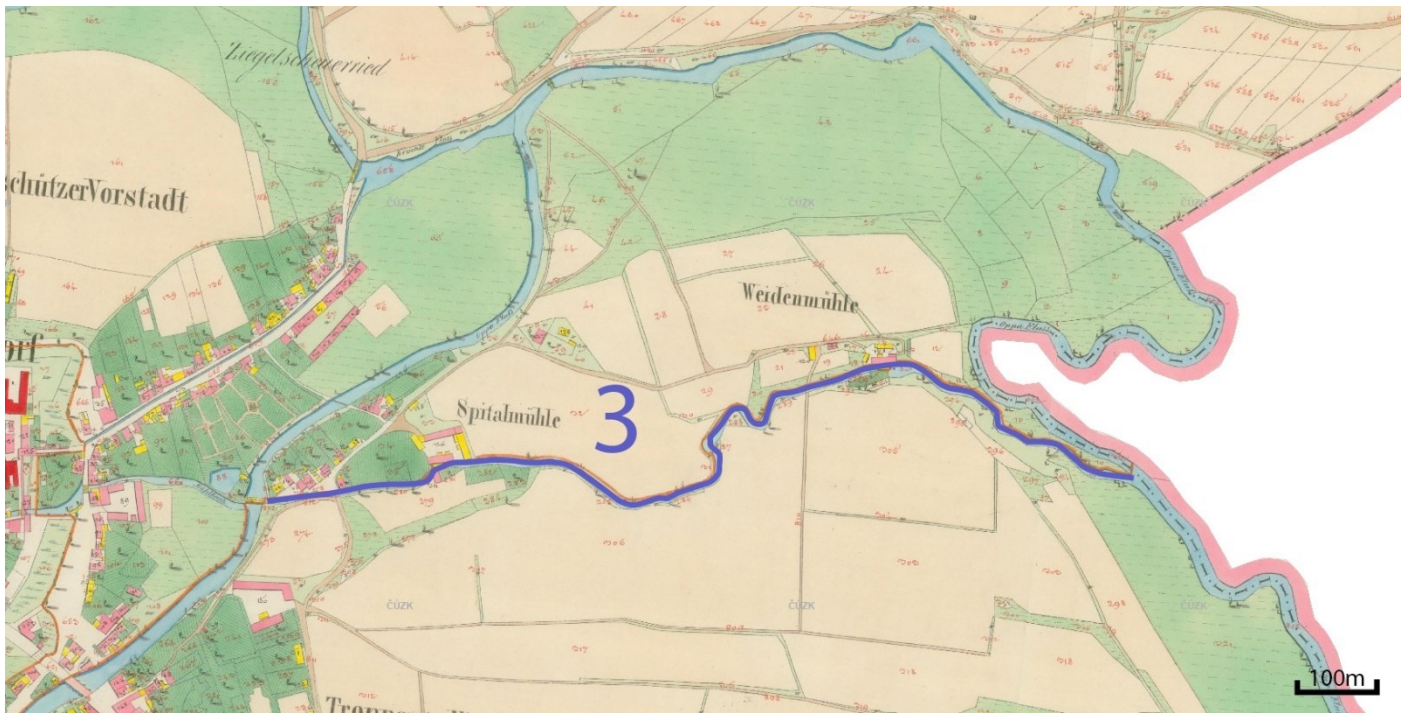


Fig. 11. The third race with two mills in the 19th century. (Source: Illéš based on the map of Imperial Obligatory Imprints of the Stable Cadastre 1826-1843, ČÚZK, c, 2010; 2023)

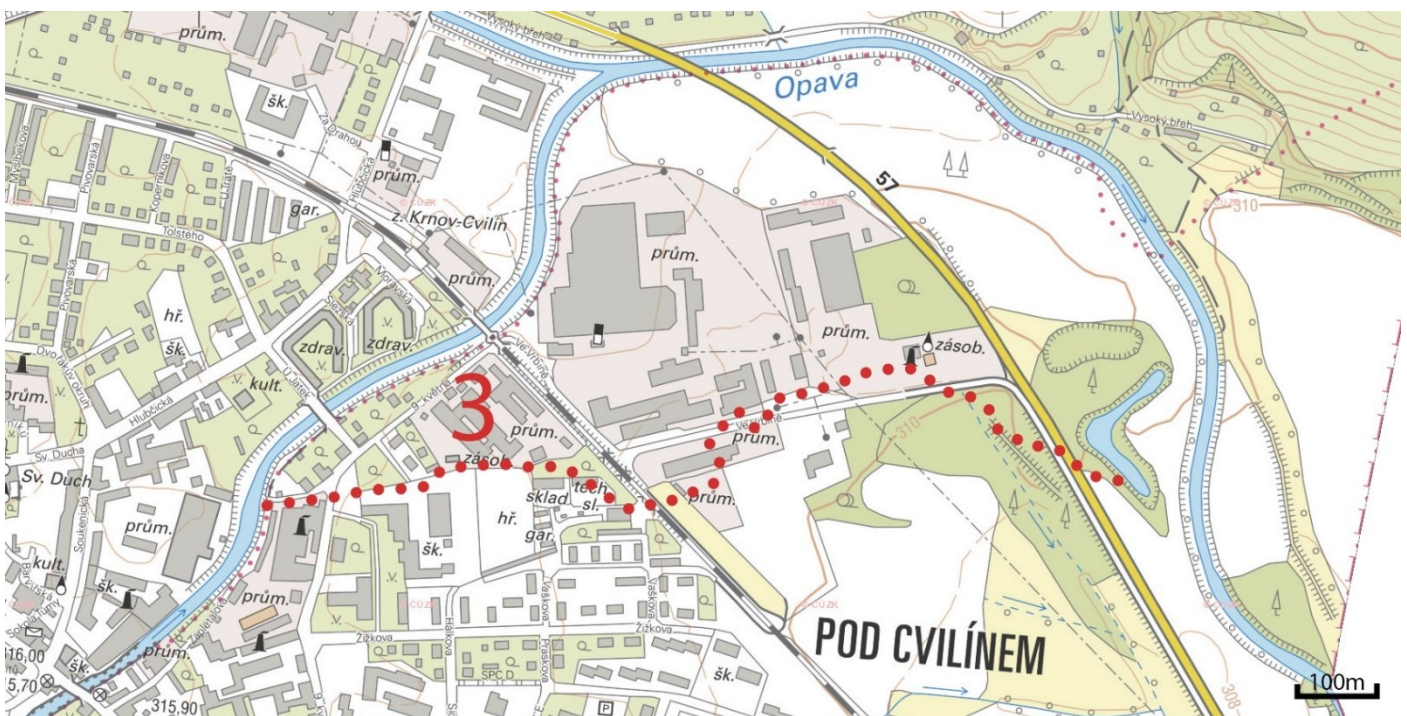


Fig. 12. The extinct third mill race in the urban structure today. (Source: Illéš based on the current Base map of Czech Republic 1:10 000, ČÚZK, a, 2010; 2023)



Fig. 13. The first mill race with mills in the 19th century. (Source: Illéš based on the map Imperial Obligatory Imprints of the Stable Cadastre 1826-1843, ČÚZK, c, 2010; 2023)



Fig. 14. The first mill race with mills in the 19th century. (Source: Illéš based on the current Base map of Czech Republic 1:10 000, ČÚZK, a, 2010; 2023)

DISCUSSION AND CONCLUSION

Weirs and mill races are important water management constructions that alter the flow and the river bed and must be designed to operate satisfactorily in all flow conditions. They need constant maintenance to preserve the optimal water flow and to prevent the risks associated with their neglect, such as loss of water and habitat quality or possible flood dangers. For example, in Krnov, during the flood in July 1997, the weir on the Opava River and the inlet to the mill race in Kostelec were extensively damaged (Vodní toky: Krnov, 2019). Weirs are physical barriers across the width of a river. They alter the flow regime of the rivers and can affect the local ecology and migration of species. A requirement today is to build fish ladders into the design of a weir that ensures that fish can bypass the barriers.

Several examples of preserved mill races from other towns as well as examples of two preserved mill races in Krnov show that the maintenance and operation of historic mill races is beneficial for the town and its public spaces. They bring social, recreational and environmental benefits of green and blue infrastructure to the urban environment. The presented historical and cultural heritage of mill races can indeed increase the attractiveness of the town and its public spaces for residents and tourists. The revitalization of the piped parts of the Krnov mill race and the presentation of the heritage of the defunct races in various forms can be encouraged by spatial conditions available thanks to the town's urban structure and convenient municipal property ownership relations.

Archaeological findings of the mill race drive near the Church of the Holy Spirit and the idea of their presentation in public space met with a positive response from the residents (Mathiasová, 2018). The current forms of presentation of the extinct and intangible historical heritage can include various presentation forms through virtual reality, mobile applications, and games. In Krnov, for example, many stories about Wassermann characters are associated with the mill races. The most famous Krnov Wassermann used to live under the weir on the Opava River near today's Mír cinema. The citizens were on good terms with him thanks to his two pretty daughters who liked to dance to the

music with the local boys. At the confluence of the Opava and Opavica Rivers, 'fiery' men often wandered at night.

The most popular was the one from around the vicinity of the Paper Mill. He often lit up the way to a lonely pilgrim, but badly punished the impolite ones who failed to thank him (Košťátek, 1989). To present these stories the forms of interactive animated virtual storytelling can be used as they become popular and effective in presenting the intangible cultural heritage (Huseinovic, Turcinhodzic, Rizvic, 2013). Mill races in Krnov represent a historical heritage, even if they are not subject to monument protection. It is often civic associations, enthusiastic individuals or groups of people who map, promote, and present the values of forgotten heritage (e.g., historical water mills in the Czech Republic are mapped by the website vodnimlyny.cz, 2017).

The case study of mill races in Krnov shows the importance of this specific phenomenon in the past and also its importance today. The extinction of the mill race channels from the urban structure of towns translates as the loss of cultural identity and, in the context of current threats of climate change, also as the loss of environmental benefits provided by the blue infrastructure (Illéš, Kristianová, Joklová, 2022). The Krnov example shows that the municipality of Krnov and its citizens actively initiate activities aiming to revitalize and interpret the unused heritage of the mill race system. Even though not every opportunity is used, such as the solutions that would strengthen the aspects of building green and blue infrastructure or greenways for pedestrian and bicycle movement. The mill races represent a historical and cultural heritage and the presentation and interpretation of their values, even those that have disappeared, can greatly contribute to increasing the quality and attractiveness of urban public spaces for residents and tourists, proving beneficial for the development of town and region (Illéš, Kristianová, Jaszczak, Pochodyla, 2022).

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Alpine huts: Architectural innovations and development in the High Tatras in the second half of the 20th century

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Abstract: The innovative 20th century brought many problems, but it brought many solutions too. The problems architecture was trying to handle at the time were no longer solvable with traditional methods. The world learned about new architectural movements like post-war modernism, brutalism, high-tech architecture, and postmodernism. However, there were places where innovative tendencies were implemented at a slower rate, with some delay, or not at all. The paper analyses buildings built in the alpine territories of the High Tatras in former Czechoslovakia and examines three typologies of huts: small huts, large-capacity huts, and huts transformed into mountain hotels. The research concentrates on huts and the innovations through the process of architectural planning, changes and adaptations of newly-built objects, extensions of the existing and reconstruction of decayed huts and also on the never built projects. The main focus is on the huts Chata pri Popradskom plese, Sliezsky dom, Chata pod Rysmi, Chata pri Zelenom plese and Kežmarská chata. The building process of the huts is explained in the social and political context with the notion of the second half of the 20th century paradigm. It was the era shaped by post-war recovery, architecture for the masses, television, exploration of eight-thousanders and space trips. In the second half of the 20th century, Czechoslovakia was under Soviet control with the command or planned economy. The paper explores the phenomena of the period, examining the effect they had on the care for the huts and what happened after the revolution in 1989. Despite the lack of architectural interventions in the alpine territories, the paper found examples of socialist realism, post-war modernism, and high-tech ideas in the architecture of the High Tatras highest terrains.

Keywords: alpine architecture, post war modernism, innovations, High Tatras, hut, Czechoslovakia

MODERNISM IN THE LANDSCAPE

This study is based on the research of the High Tatras building history in the second half of the 20th century in former Czechoslovakia. The main focus is on the typology of alpine huts and the process of their architectural planning. The paper aims to clarify the processes behind the huts' development and analyse their place in the architectural debate. The study describes how architects apply the architectural ideas of post-war modernism in the high-altitude environment. What was the decisive factor, the mountain wind, the architect's ego, or the investor's finances?

Alpine huts were not a typical assignment for architects. In the past, Alpine huts in Slovakia did not reflect innovative architectural ideas. Instead, they were based on the knowledge of traditional civil engineering and more conservative design practices. We assume the trend continued during the second half of the 20th century. Architects still faced problems such as extreme environment, rough terrain, and distance from the urbanised environment. The use of helicopters could be seen as a solution to the problem of transporting building materials. As regards

new transport possibilities, we expect the utilisation of new materials like thermal insulation and waterproofing to solve the problems of extreme climate. The paper explores the influence of architectonic movements such as socialist realism, post-war modernism, high-tech and postmodernism on the architecture of the Tatra huts. Which influences have affected the architecture of the buildings in the mountains? Has the architecture been influenced by urban trends, has it elaborated on vernacular architecture, or has it gone its own way?

The development of Tatra huts in the second half of the 20th century was influenced by social phenomena such as the nationalisation of accommodation facilities (under Czechoslovak Act no. 124/1948 Coll.) and mass recreation (under Section 28 of Czechoslovak Constitutional Act no. 150/1948 Coll.), which resulted in mass tourism. In the past, the huts within the tourist network of the High Tatras were owned by tourist associations or private individuals. After the nationalisation, they were placed under the administration of national enterprises, which were subject to frequent reorganisation, and the management of the huts was (ir)regularly changed. Did the disruptions to the continuity in the management affect the fate of the huts? (Fig. 1)

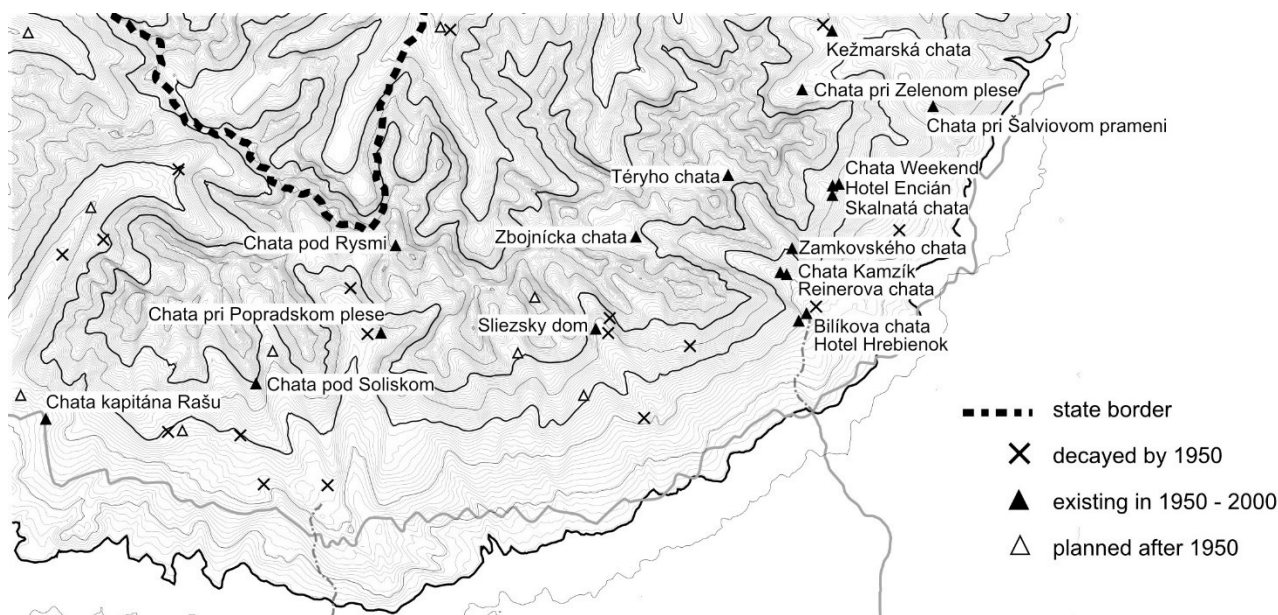


Fig. 1. A map of the High Tatras displaying the status of huts in the period between 1950 and 2000. (Source: Novotná, 2022)

MATERIALS AND METHODS

The architecture of the Tatra huts has not been the main focus of interest of scientific research by architects yet. However, some historiographical works, short studies or sections in complex scientific publications analyse building activities in the high mountain environment. They are mostly publications in which Tatra architecture was part of a broader assessment of Slovak architecture. In holistic publications, authors Henrieta Moravčíková and Matúš Dulla (Dulla, Moravčíková, 2002) describe the approach to construction in the Tatras in the context of the 20th century architecture in Slovakia. A deeper understanding of the context of the second half of the 20th century is presented in the publication *Modern and/or Totalitarian in the Architecture of the 20th Century in Slovakia* (Moravčíková, Szalay, Dulla, Topolčanská, Potočár, Haberlandová, 2013). The search for the form of Tatra architecture against the background of social changes is explored by Henrieta Moravčíková (Moravčíková, 2013). An immediate assessment of Tatra architecture is offered by Matúš Dulla's study from 1989 (Dulla, 1989) and his reflection on the same issue thirty years later (Dulla, 2019). Huts are described as a base for hiking activities in the publication *Tatranské chaty majúky v mori skál a snehu* (Bohuš, 2011). A comprehensive publication *Vysoké Tatry včera a dnes* (Kollárová, 2017) provides a holistic approach to the region of the High Tatras. Other sources include reviews of specific buildings in specialised Slovak periodicals, especially *Projekt*, *Vysoké Tatry* and *Krásy Slovenska*.

This research was based on the abovementioned publications, historical postcards and photographs, and archival materials. Individual building objects were identified by analysing historical maps and tourist guides. The sources for the huts Chata pri Zelenom plese and Kežmarská chata from the project documentation of the ŠPTÚ (State Project and Typification Institute) are from the archive of Michal Legutky. A field survey was a tool used to verify the huts' position and their change in status compared to the analysed situation. The survey, combined with interviews with the hut keepers, clarified some aspects of the existence of a hut in the mountain environment and the interactions between huts. In the study, the authors use the word 'alpine' which does not necessarily refer to the Alps, but to alpine terrain and environment in general. Individual objects are referred to by their current or most recent name, not by their

original name. Plan schemes, views and isometries are based on archival material and historical photographs.

MODERNISM IN THE ALPINE TERRAIN

After the Second World War, the High Tatras were to become the most important recreational centre for the war-decimated population (Kollárová, Šlampová, Janigová, 2017, p. 149). Subsequently, after nationalization, all the recreation, wellness and tourism facilities became the property of the public. Natural wealth was perceived in the same way. Recreation and tourism were supposed to "prepare the broad masses of workers for highly productive socialist work and the defence of the fatherland." (Viktory, 1955, p. 402) The High Tatras' importance and exceptional landscape were acknowledged by the establishment of the Tatra National Park (TANAP) in 1949. In 1950, the implementation of the five-year plan for construction in the High Tatras began. (Kollárová, Šlampová, Janigová, 2017, p. 151) One of the planned activities was the construction of a resort and a cable car to the peak Gerlachovský štít. The long-term construction plan envisaged the building of eight new huts, the renovation of 3 decayed huts, and the reconstruction of 5 Tatra huts, whose final capacity was to rise from 700 to 2850 beds. The required increase in capacity explains the trend towards organized mass tourism, whose focus is on "the mass" and not "the increase of the performance of experienced tourists". (Viktory, 1955, p. 402) We assume that these principles were supposed to prevent the adulation for idols from the capitalist world, whose climbers managed to climb 7 of the 14 eight-thousanders in 1955. However, climbers from Czechoslovakia did not manage to climb the first eight-thousanders until 1971.

Socialist realism for masses (1948-1960)

The Tatra huts as tourist facilities were nationalised. They became part of the national enterprise "Tatranské hotely komunálny podnik" (Tatra huts communal enterprise) in 1951; a year later, the enterprise was merged with the enterprise "Hostiteľský a ubytovací komunálny podnik" (Hosting and accommodation communal enterprise) and renamed to "Tatranské chaty a pohostinské závody" (Tatra huts and hospitality facilities, TCHPZ). Subsequently, in 1953, the national enterprise "Turista" (The Tourist) was established, which took over the agenda of TCHPZ and other enterprises that organised recrea-

tion and tourism in the High Tatras. (Kollárová, Šlampová, Janigová, 2017, pp. 150-154) The condition of huts in the High Tatras after the Second World War was better than in other mountain ranges, as during the war, the researched network of Tatra huts lost only two huts (1943 Krivánska chata, 1944 Važecká chata), but during the '50s four more huts disappeared from the map. Guhrova chata fell into disrepair in the early '50s, Furkotská chata burnt down in 1956, and the huts Chata pri Šalviovom prameni and Majláthova chata were in such a condition that by the beginning of the '60s, they had to be demolished. Other huts underwent necessary repairs, and central heating was installed in most of them. (Bohuš, 2011)

The first step towards the realisation of the plan from 1950 was the construction of a new hut at the lakeside Popradské pleso, the most visited place in the High Tatras. An architectural competition for the new hut was announced in 1956. The competition brief was to draw up a conceptual design that would serve as a basis for supplementing the hut network with a large-capacity object. The jury found the connection to the mountain, to the terrain and the climatic conditions to be essential. They considered developing a proposal "without regard to the other huts". The competition proposal was to be reflected in the materials chosen, which were also to reflect "traditional local conditions" but have a "contemporary expression". (Blablo, 1956, p. 253) According to the periodical "Krásy Slovenska", the competition participants were: Bauer and Čapka; E. Bednárová; M. Krukovská, Ďurkovič, Svetko, Vician; Ficker and Drahoš; Begán; Špitzer. There was no winner, but two proposals were placed second. The first of the two was proposed by architect E. Bednárová (Štefánia Krumlová), and the second one by Bauer and Čapka.

In the end, the jury recommended the implementation of the project by the architects from Žilina's Stavoprojekt, Ladislav Bauer and Ferdinand Čapka, based on "their practical experience with the construction of several Tatra huts in Slovakia" (Blablo, 1956, p. 255). Architect Krumlová also confirms this version of the two-second place proposals and the selection of older architects in an interview for the daily Pravda (Gahérová, 2017). The review of the competition proposal by the "more experienced architects" praised the connection to the terrain and the proportion but questioned the hut placement too close to the lake. The review expressed objections to the layout and questioned the structural height and the deep double tract. Overall, the design was assessed as a building whose "alpine character [...] veers into romanticism and even formalism [...]". While the design of the "young architect" Krumlová was evaluated as "properly oriented with well-managed views and refined architectural expression." The layout was particularly criticised for its undersized volume. However, the connections between the spaces were highlighted. (Blablo, 1956, pp. 255-256, Fig. 2)

The question whether the factors that influenced the choice of the final hut designers were only their experience or the proximity of Žilina to the building site or the preference for the men's collective remains unanswered for the time being. Projekt, Revue of Slovak architecture, published a review by Martin Oríšek, where neither the name of the architect Krumlová nor her maiden name (Bednárová) nor the fact that the first prize was not awarded and two proposals were placed second is mentioned. According to the article, architects Bauer and Čapka were the only winners. The review mentions the building as a romantic hut that blends in with the environment in which it is set. The author of the review attributes the romanticism of the hut to the architectural trend of the time, socialist realism, but adds that in spite of it, the hut is sensitively set and "has an appropriate scale." (Oríšek, 1963, pp. 128-129)

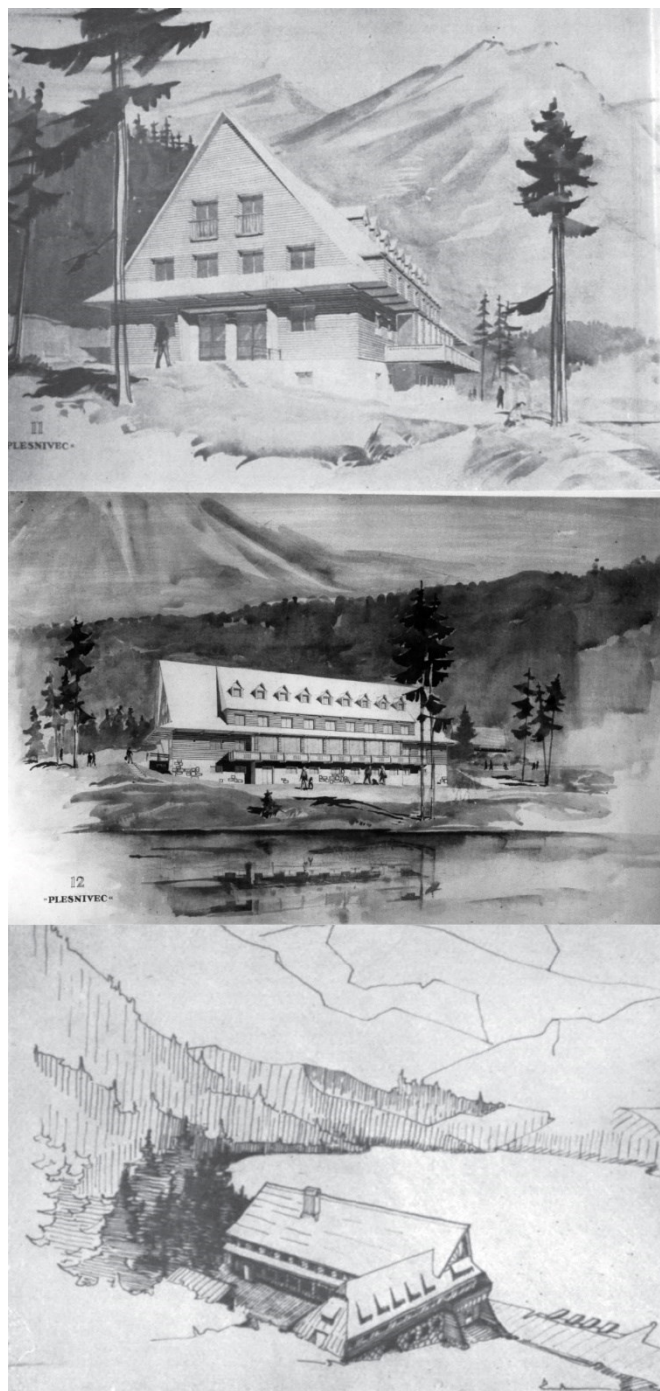


Fig. 2. Chata pri Popradskom plese. Perspectives from competition proposals show the similarities and the differences between the two. Top to bottom: Krumlová east perspective, Krumlová south-east perspective, Bauer and Čapka north-west perspective. (Source: Blablo, 1956)

The problem of too-small volume in the design by architect Krumlová was solved by Bauer and Čapka already in the competition in the "L" plan form. The layout results in the "closing off of the backyard from intrusive views". The longer part is set in the ground in the direction of the terrain contours and offers an "overlook of the lake". While the opinion expressed in the competition regarding the "elongated shape" of the dining room is questioned, the possibility of this type of interior separating the section during the "off-season" is highlighted. In the comments on the hut's design, Ladislav Bauer only focuses on the second part of the assessment, namely that "the division of the dining room into two parts in the off-season eliminates the feeling of emptiness". In the same article, there is a comment regarding

the entrance, which is "controllable" and allows "passage to the hall, conservatory and main wing of the dining room". (Bauer, 1957, pp. 34-35) Such a positive review of the layout is found in the architect Krumlova's competition proposal review, where "the positioning of the reception room allows good control of the access to all rooms from the hall." (Blablo, 1956) Based on the analysed texts and the available competition documents, we can say that the realised form of the hut followed the intentions of the competition design by Bauer and Čapka. However, the final project may be a hybrid of the two top placed competition designs.

If the intention of the authors was "to follow the architecture of our (Slovak) wooden houses in the romantic concept" (Bauer, 1957, p. 35), the hut could be considered to be one of the first contributions of post-war architecture to the architectural discussion that was "to embody the legacy of Slovak folk in a modern concept" (Dulla, 2019, p. 332). This idea is confirmed by a statement referring to the hut as "a prime example of the transformation of folk building motives" (Dulla, 1989, p. 10). However, the review strongly questions the location, which exploits the mountain environment. The author later compares its "great volume" to "the more spacious dwellings of the German ethnic group." (Dulla, 2019, p. 332, Fig. 3, 4)



Fig. 3 (left). Chata pri Popradskom plese. Original state, east perspective. (Source: TASR, 1962)



Fig. 4. Chata pri Popradskom plese. Current state, east perspective. (Source: Novotná, 2022)

Post-war modernism in alpine terrain (1961-1970)

Post-war modernity appeared in the High Tatras with the constantly growing need to increase the capacity and standard of recreational facilities. The culmination of the architectural work of that decade was devoted to developing a complex infrastructure for the FIS Nordic World Ski Championships 1970 (FIS70). Little attention was paid to the huts, the most noticeable objects of tourism in the High Tatras. In 1962, the "Turista" company, which managed the huts, was divided into the Tatra Hotels and the Interhotel Tatry. The buildings assigned to the Tatra Hotels were in poor condition, while the Interhotel Tatry managed the most prosperous facilities in the High Tatras. The huts became part of the less prosperous Tatra Hotels (Kollárová, Šlampová, Janigová, 2017, p. 155), which took on a difficult task: the reconstruction of Sliezsky dom (Silesian House). The previous reconstruction (1959), which concentrated mainly on the electrification, had been financed by the Turista company. In 1962 the hut burnt down. (Bohuš, 2011, p. 61)

The hut was originally built in 1895 and has been expanded several times. In the 1950s, the interior was renovated and connected to public utilities. After the 1959 rebuilding, Sliezsky dom had the capacity of 103 beds. (Bohuš, 2011, p. 61, Fig. 5)

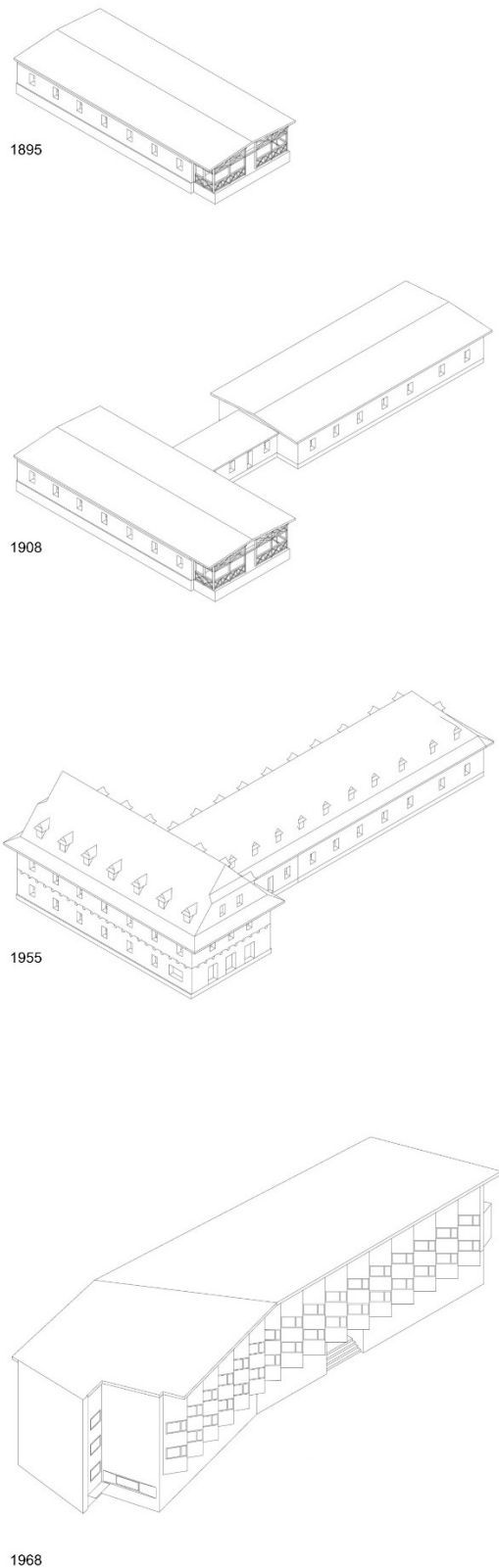


Fig. 5. Isometric diagram of the Sliezsky dom evolution. It displays the extensions to the original hut building in line with the tradition of craftsmanship and new architectural approach to the new volume. (Source: Novotná, 2022)

The location of the original Sliezsky dom was subject to criticism due to the lack of sunlight and the inadequate mass, which

was completely covered with snow during winter. A guideline for a redesign could have suggested moving the building to a position more suitable in terms of illumination, but this was rejected because of the existing in-ground utilities. (V. G., 1963, p. 17) During the negotiations (1963) concerning the restoration of Sliezsky dom, the capacity of approximately 50 beds and 120 chairs in the dining room was first considered. The TANAP management even agreed to build a ski lift in the valley Velická dolina. During the construction (1968), the capacity was increased to 124 beds and 380 chairs. The rooms had projected washbasins, shower rooms and toilets. (Čejka, 1966, p. 23, Fig. 6)

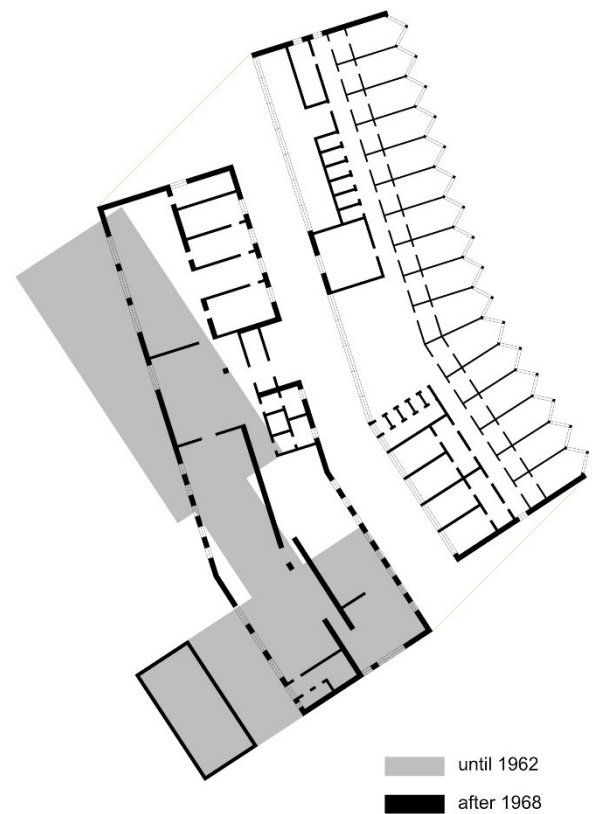


Fig. 6. Scheme of the Sliezsky dom development in 1955 and 1969. The new volume (black blueprint) deviates from the original one (grey footprint), but also follows it. (Source: Novotná, 2022)

The new building was constructed as a compact, slightly bent mountain hotel by architect Jaromír Sirotek from the State Design Institute of Trade (ŠPTÚO) Brno and opened in 1968 (Kos, 2021, p. 55). The innovative approach is based on the type of construction used in an alpine environment. The mountain hotel is constructed as a reinforced concrete structure with a steel frame and wooden cladding of the facade at an altitude of 1670m above sea level. Plastic insulation was used in the project to allow a return to a flat roof. The roof structure was to be an adaptation to an alpine environment where snow would be blown off the flat roof, and the structure was to withstand gusting winds (Fig. 7).



Fig. 7. East elevation of Sliezsky dom in 1969, in the morning light. (Source: Novotná, 2022)

A year after the opening of the Silesian House, its modernist form was accepted and referred to as an "imposing building" (Kováčik, 1966, p. 29); however, in contemporary responses, it is reflected as more of an "expressively controversial mass" (Bujna, 2013; Fig. 8).



Fig. 8. Slezský dom, 2021, in the afternoon light. (Source: Novotná, 2021)

Reorganisation of mass tourism (1971-1980)

In the High Tatras, the period of normalisation was accompanied with intensification of mass tourism, the popularity of which increased exponentially after the successful FIS70. In order to make it possible for the hotel complexes to invest and develop, the tourism facilities had to undergo yet another reorganisation. The reorganization of tourism enterprises had an impact on huts in 1971 when Interhotel Tatry merged with Tatra Hotels and Interhotel Košice. The enterprise with prestigious hotel facilities only kept Slezský dom, Bilíkova chata and Horský hotel Popradské pleso. The other huts were incorporated into a newly established enterprise, Oblastná správa účelových telovýchovných zariadení slovenskej telovýchovnej organizácie so sídlom v Novom Smokovci (the Regional Administration of Special Purpose Sports Facilities of the Slovak Sports Organisation based in Nový Smokovec).

In 1972, they were renamed to Tatranská správa účelových zariadení slovenskej organizácie československého zväzu telovýchovy so sídlom v Novom Smokovci (Tatra Administration of Special Purpose Facilities of the Slovak Organization of the Czechoslovak Sports Union with headquarters in Nový Smokovec, TSUZSOČSZTV). (Kollárová, Šlampová, Janigová, 2017, pp. 167-169) In that decade, the capacity of accommodation in the alpine environment decreased significantly. Several Tatra huts were closed down due to their poor condition (Skalná chata, chata Kamzík). As regards the hut Chata kpt. Rašu, its purpose was changed to a recreation centre of the OD PRIOR company and it stopped serving the general public. The eastern side of the High Tatras lost a hut in 1974, when Kežmarská chata burnt down. However, the issue of disrepair had to be addressed by the competent authorities also in case of the highest-located hut in Czechoslovakia (Fig. 9).

The hut Chata pod Rysmi, built by Jozef Šašinka between 1931 and 1932, was built on an avalanche slope of local granite with a flat roof. A significant structural change occurred in 1977 when the hut was extended with a superstructure. The initial study was prepared by Milan Marenčák (1975), and the project by Igor Petro. (Repka, 1978, p. 21) The architects faced problems such as a short construction period, limited possibilities of transporting materials, the problem of waste disposal, insufficient space for efficient service and the avalanche threat.

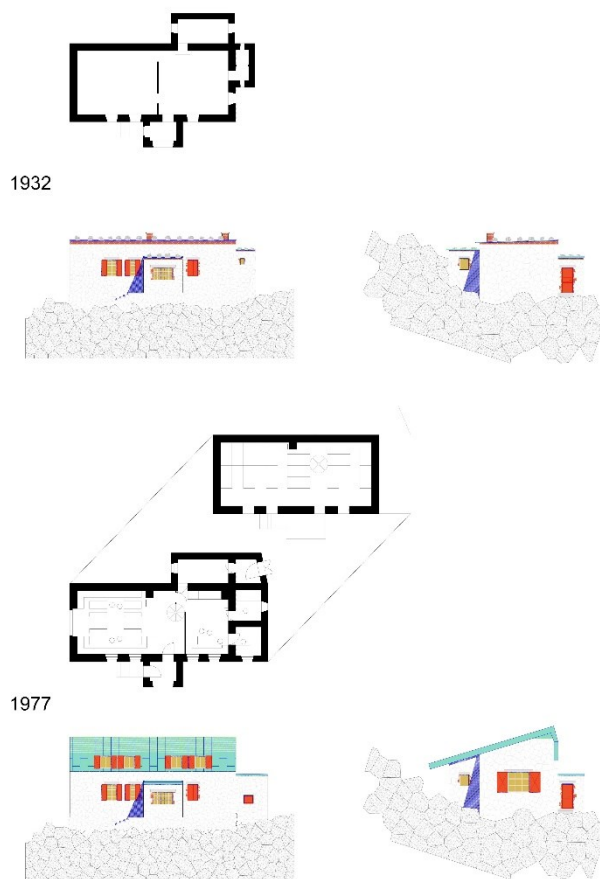


Fig. 9. Evolution of the hut Chata pod Rysmi. 1932 – 1977. The horizontal extension follows the logic of original building techniques and local materials, while the vertical extension introduces new materials and new expression. (Source: Novotná, 2022)



Fig. 10. Small intervention concerning Chata pod Rysmi in the form of sheathed superstructure. The façade remained without change, blending into the surrounding environment. (Source: TASR, 1986)

The volume of reconstruction work was effectively reduced to

the necessary functional minimum. It was completed in 4 months thanks to the help of climbers and a helicopter used for the material transportation. Waste disposal was left without an upgrade. In the renovation, the hut was enlarged with added storage space and a hut keeper's room. The lodging area was moved from the dining room to the superstructure (Fig. 10). It was the superstructure in the form of a lean-to roof that was supposed to serve as avalanche protection (Repka, 1978, p. 22), which, as it turned out later, was not sufficiently dimensioned. Chata pod Rysmi thus followed the trend huts with sheathed superstructures in the mountain environment, which can also be seen in the realization of the superstructure of the hut Chata M. R. Štefánika pod Ďumbierom in the Low Tatras (Jozef Jahn, project 1973, realization 1974-1976) and later in the superstructure of the hotel at Hrebienok (Bystrický, Mihálik, project 1988, realization 1999).

Unbuilt modernity (1980-1990)

In the 1980s, the Tatras were targeted by mass tourism, which exceeded tolerable limits. Regulations were introduced, which resulted in the reduced income of individual establishments that failing to meet the required planned limits. The Tatra huts were facilities that could have increased the income of recreational tourism establishments. This is probably why the discussion concerning the scope of construction in the alpine environment mainly focused on the renovation of the hut Kežmarská chata. The first project for a new hut was drawn up by architects Ludovít Jendreják, Ján Šilinger and architect Olga Babjaková at the Štátny projektový a typizačný ústav (State Project and Typification Institute, ŠPTÚ) in 1984. It was to be a south-facing hut with a large lean-to roof with a capacity of 55 beds (the TANAP administration saw no reason to build a facility for more than 20) and 150 chairs.

The lean-to roof was to touch the ground and trap snow during the winter, which was to serve as additional thermal insulation. Innovative features such as glulam beam construction, triple-glazed windows, and wind power (even if only as a back-up) were to be supplemented with more conservative façade materials. The ground floor was to have the appearance of a stone plinth, and incorporate some stonework from the remains of the old hut, and the rest of the south elevation was to be clad in timber shingles. All materials were to be transported to the site by helicopter, which meant standardisation at the level of building structure preparation. All the individual parts of the building elements could not exceed the weight of 2 tonnes. This proposal was not realised, and neither were the two subsequent ones, which came out of the SIAL, architects and engineers' association in Liberec, at the turn of 1984-1985 (Fig. 11).

The first linear variant by Jiří Suchomel and the second, circular, by Martin Nemeč, remained on paper. The innovativeness of Liberec's designs consisted in adapting the structure and materiality of the hut to the new paradigm of high-tech architecture and the emerging postmodernism, which translated into the concept of energy efficiency of buildings. The architects and engineers designed a façade in computer software that would be able to distribute heat gains from sunny days. Both SIAL proposals featured Jozef Franc as the structural engineer. (Suchomel, 1987, pp. 38-40) Although the design of Kežmarská chata was not realised, the reconstruction of another hut, Zbojnická chata, was carried out in cooperation with members of SIAL. The authors of the project were Karel Novotný (Švácha, 2010, p. 155) and Jozef Franc (Bohuš, 2011, p. 89) and, as other sources claim, also Igor Petro (Dulla, 1989, p. 10). The positives of the reconstruction consisted mainly in the improvement of the service areas and the upgrade of the hut's equipment. However, the SIALists' signature, futuristic experiment with form

and material, with emphasis on the energy efficiency of the building structure, was reduced to solar collectors. The Jendrelák Šilinger Babjaková project team developed another yet-unrealised project, but this one was for a hut Chata pri Zelenom please. The hut design was based on the original concept of a "knoll-like hut", which was elaborated into a more complex and spacious idea with a sophisticated layout of a large-capacity hut. The hut's design was explicitly atypical, not only from the structural but also from the layout point of view (Fig. 12).

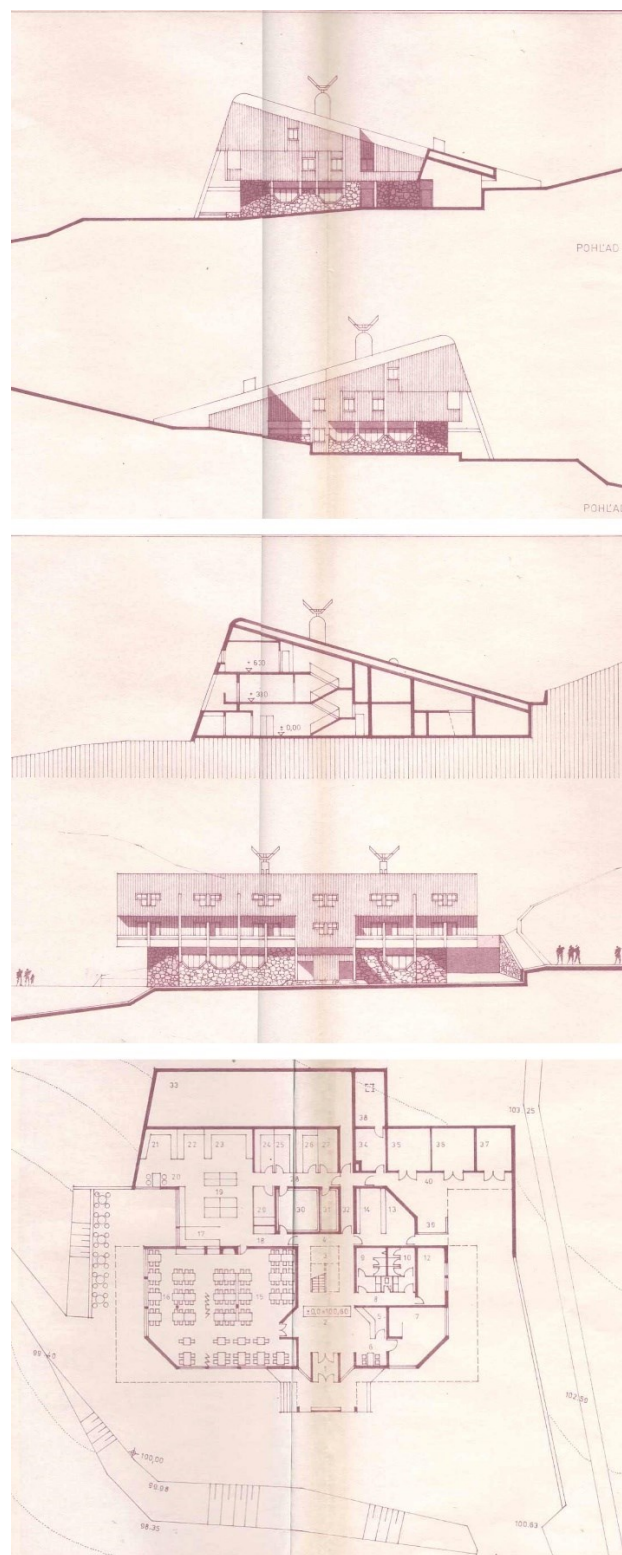


Fig. 11. Kežmarská chata proposal, 1984. Authors: Ludovít Jendreják, Ján Šilinger, and Olga Babjaková, ŠPTÚ Bratislava. Top to bottom: east elevation, west elevation, cross-section, south elevation, plan of the first floor. (Source: Legutky, 1984)

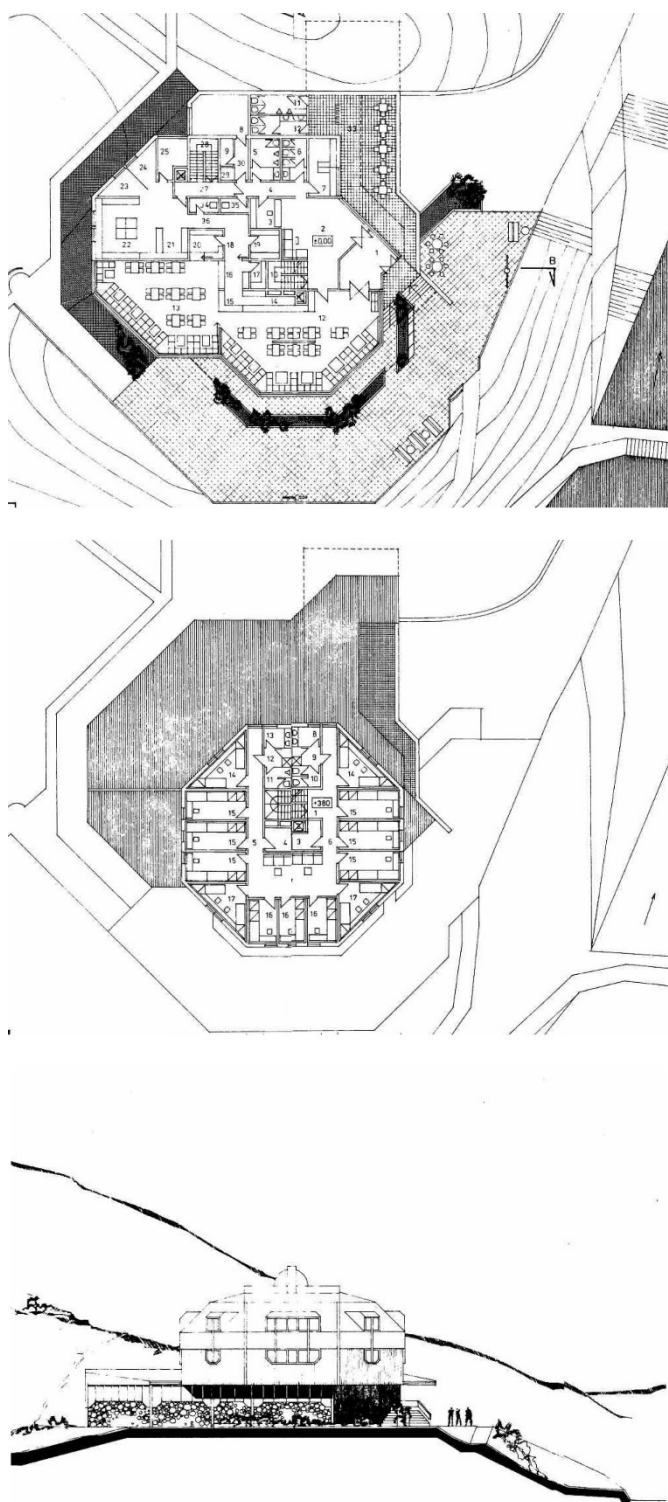


Fig. 12. Chata pri Zelenom plese proposal, 1985. Authors: Ludovít Jendreják, Ján Šilinger and Olga Babjaková, ŠPTÚ Bratislava. Top to bottom: plan of the first floor, plan of the second floor, west elevation. (Source: Legutky, 1985)

Commercialisation (1991-2000)

The change in the social system and the privatisation of state-owned property after 1989 also resulted in changes in the ownership of the huts and influenced their management. The renewed hiking associations tried to regain ownership of the huts, and those built by individuals before 1948 were claimed by the descendants of the former owners. Under the administration of Tatra Administration of Special Purpose Facilities of the Slovak Organization of the Czechoslovak Sports Union, the rest of the huts became the property of the hiking and mountaineering club again. However, the huts managed by Interhotel Tatry were

privatised and sold to private companies. Apart from administrative activities, there were cautious attempts at the building management of individual huts, depending on their popularity. Bilíková chata reduced its capacity but increased its standard, the operation of the preserved Rainerova chata was renewed, the burnt-out Zbojnická chata was renovated, and Skalnatá chata was reopened. Perhaps the most curious reconstruction was the hut Chata pod Soliskom, located at the last stop of the Štrbské pleso - Solisko cable car. After privatisation, its new owners decided to improve its thermal properties but did not want to demolish the hut. Therefore, when the hut was fully operational, they rebuilt it and dismantled the old structure. The effort to improve the thermal properties is also reflected in the trend to replace windows with ones with plastic frames. In the case of many buildings, this is a replacement that nostalgically tries to hold on to the previous 'hut' aesthetics, and the windows are retrofitted. The false nostalgia creates a pretend atmosphere of the past, in which there was no notable support for the development of the huts.

HIGH TATRAS, LANDSCAPE OF MODERNISM

Until the second half of the 20th century, the typology of the huts in the alpine environment developed almost independently of the foothill's architectural trends and urban areas. Socialist realism, which appeared in the territory of post-war Czechoslovakia in the 1950s, can be partially identified in the hut Chata pri Popradskom plese. (According to Oríšek, scale-transcending) Socialist realism of the hut can be characterised as a romanticising vernacular offshoot with a scale that does not transcend the context. The post-war modernism in the alpine terrain could be seen in the hut Sliezsky dom (Silezian House). With its rhythmic façade, the hut seems to be responding to the functionalist Morava Recreation Centre (1933) by another Brno architect, Bohuslav Fuchs. A similar formal treatment of form and materiality can be seen in Labská Bouda (1975) by architect Zdeněk Řihák, who, like Sirotek, was part of ŠPTÚO Brno. Chata pod Rysmi does not follow any specific line of post-war modernism. However, the hut is an example of the importance of architectural design that effectively combines spatial demands, economic and transport constraints with the structural and material essence in an alpine environment. A glimpse of the holistic input of architectural opinion influenced by the direction of high-tech architecture is shown by the proposals of the SIAL for Kežmarská chata in which innovative and progressive architectural design practices were applied in the spatial and material concept of an energy-efficient hut building, including experiments with PC software in the 80s.

The architectural solutions of the huts in the High Tatras were not self-referential. They responded to building activities within and outside the High Tatras and innovations applied in foothill settlements and towns. In the case of more conservative solutions, architecture gave other meanings or expressions to the traditional materials and established building methods. Unlike the Alpine environment, the High Tatras do not reflect the trends of typified mountain huts or the application of prefabricated elements. In the Alpine environment during the 19th century, elements were standardised and then prefabricated in a valley and brought to the site. (Gibello, 2011, p. 37) In the context of standardisation, only the weight and volume of material that can be carried to the site by helicopter and carried up by a mountain porter were considered. We cannot predict how the architecture would have evolved if the continuity of care for the huts had not been permanently disrupted. However, both this phenomenon and tourism have caused many non-conceptual disruptions to the identity of the Tatra alpine architecture. Architects' interventions mostly meant the transformation of small huts into large-capacity huts or hotel-like structures. The common denominator that shaped the image of the Tatra huts were

ad hoc extensions, architecture without architects and temporary buildings that became permanent.

Nowadays, we can observe how cottages have been changing under the increasing pressure of tourism. The most notable developments are in the day-stay and catering areas. Dining rooms are often expanded with added outdoor terraces. The terraces are then roofed over and, in the final stage, enclosed with light walls. Such ad hoc extensions are not unique even in the Alpine region. The mountain huts have gradually been turned into mountain buffets, and their purpose of providing shelter for climbers has changed to that of a mountain restaurant. (Dini, Girodo, 2018) These modifications are usually done without the involvement of an architect and they often do not follow, either logically or aesthetically, the qualities of the original building. However, we can unequivocally confirm that the presence of an architect in the planning process, even if limited, is definitely beneficial. The paper also shows that the High Tatras alpine environment (might) became home to exceptional architectural designs. The architects could propose innovative and sophisticated solutions and respond to the problems that both the huts and the hut keepers face on a daily basis. Thanks to all the circumstances that prevented the expansion of the capacity of the Tatra huts to 2850 beds, the mountains continue to be seen as a place offering the unique experience of being at the higher altitudes.

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Summaries

Aida Shayegani, Viera Joklová

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Mária Novotná

INVESTIGATING PRIVACY PRINCIPLES' FORMATION IN VERNACULAR ARCHITECTURE OF ARID AND SEMI-ARID PARTS OF IRAN

Aida Shayegani, Viera Joklová

Keywords: privacy, climatic architecture, Iran, Islamic rules, vernacular residential architecture

Traditional Iranian architecture principles have deep roots in this region's culture, thoughts, and climatic conditions. Privacy, as one of these principles, which regulated all aspects of life, was beautifully embodied in the vernacular residential architecture of Iran. It had profound effects and resulted in a specific spatial organization of the house and the placement of various functions, either private or semi-private. Many pieces of research have claimed that privacy was an attribute of Islamic rules in Iranian architecture. Based on historical and phenomenological analyses of vernacular Iranian architecture this paper strives to confront the privacy principle according to Iranian (or former Persian) culture, climate, and security conditions. Changed geopolitical and cultural conditions in the 20th century raised new forms of architectural residential morphology almost completely negating the principle of privacy. The question is whether the vernacular principle of privacy should be embodied in the new design of Iranian residential houses or just be preserved as an expression of ancient culture and thus increasing the quality of the image of the city and its attractiveness. The research completed by qualitative morphological and analytical methods clarifies mentioned principles and identifies the definition of privacy, the factors affecting it, the roots of its formation, its influence on the physical-spatial organization of traditional residential architecture in Iran, and its continuation in modern residential architecture in Iran.

Based on the morphological survey of traditional Iranian residential architecture, we can consider main elements affecting privacy in Iranian vernacular architecture as indicated below:

(i) Privacy principles according to culture and religion. Traditional Iranian housing has been merged with religious rituals, principles, the spirit of thinking, traditions, characteristics, and the attitude of generations. The culture, religion, and art in Iran mixed with new factors after the rise of Islam. Privacy, as an Islamic principle governing all aspects of life, has formed traditional Iranian housing and has had profound impacts on and outcomes in its spatial organization and function.

(ii) Privacy principles according to climatic conditions. Weather in the major part of the Iranian central plateau is hot and arid, and many historic cities with valuable architectural designs are located in this hot and arid region. Residential structures in these conditions were characterized by narrow streets and dwelling units turned inward. Narrow streets provided shade from the scorching sun as well as greater protection from the expanding desert. Over thousands of years, people were driven to find astonishing solutions to reduce the disturbing aspects of the climate and use its

convenient aspects. We can observe brilliant morphological solutions developed in such difficult climatic conditions to provide thermal comfort in vernacular Iranian architecture. Building orientation, methods of communication with the ground and underground, introversion and closure, wall thickness, the height of rooms, and applied materials confirm the maturity of the traditional builder's respect to and semiotics with the environment.

Another point worth mentioning is the issue of security and freedom in the home environment. A person in their private territory achieves a kind of freedom and a sense of security. As it is evident, the strategies used in plan design and supported climatic architectural approaches act in harmony with introversion and hierarchy principles in reaching the house's private zone and separating it from the public area. Among all the constituting features of privacy, cultural and religious or climatic, a specific architectural morphology can be observed, developed, and blessed by both these compelling reasons. However, changes in the way of life, and in social and cultural spheres, led to the need to reassess the sustainability of the privacy principle being strictly applied in residential architecture in Iran. The contemporary residential architecture of Iran extensively adopts the features of global modern architecture without considering the roots of ancestors' deep creative attitudes. State policies that supported women's education and employment in the last century freed women from households and supported their aspirations for modern housing. We can observe that contemporary people desire to reveal, express, and expose themselves to others. Therefore, the concept of home, paternal home, ancestral land, homeland, and private home will no longer evoke that traditional concept in them. At the same time, one should know and respect the local styles of architecture and house building. Knowing that the relationship between housing and culture will never be the same as in the past, a new logic and research should be established on how to preserve and evolve the native architectural culture in different regions of the country by creating a relationship of another kind. The research surveys the principle of privacy, its historical and phenomenological aspects, and the manifestation in the vernacular residential architecture in Iran; defines the influence of cultural and religious backgrounds as well as climatic conditions on Iranian architectural style. It raises the questions about the sustainability of this principle in modern architectural design in Iran.

BIBLIOMETRIC ANALYSIS OF WATER AT THE INTERSECTION OF ENVIRONMENTAL PSYCHOLOGY AND BIOPHILIC DESIGN

Damla Katuk, Emine Köseoğlu

Keywords: water, biophilic design, environmental psychology, bibliometrics, VOSviewer

Environmental psychology is one of the fields that examine human relationships with nature. Another concept that attempts to describe humans' instinctive connection with the natural world is biophilia. Biophilic design is a field that examines the human-nature relationship. Environmental psychology and biophilic design are the fields that are related to architecture, built environment and natural environment. It has been seen that water can be a common intersection point of both environmental psychology and biophilic design with an architectural approach. Within the scope of this study, water –at the intersection of environmental psychology and biophilic design– is the main focus. This work is a part of an ongoing research on perceptual and affective aspects of water in terms of biophilic design.

This study seeks to explore the research related to water at the intersection of environmental psychology and biophilic design, with a view to identify current research gaps, authors, theorists, keywords, added terms, significant sources, and publications. The bibliometric analysis with science mapping techniques was found to be a fast and the most suitable method for the discovery to be made within the scope of this study. It is aimed to investigate what kind of findings there are in the literature on the approach to water in environmental psychology and biophilic design. Applying the bibliometric analysis method to the collected data can determine which fields are more recent, which authors work in these fields, which keywords are used, and which references can be used. Scopus and Web of Science Core Collection databases were

scanned with the bibliometric analysis using the science mapping techniques. The research was based on a quantitative research design, and quantitative data was collected from the said databases. After scanning the bibliometric data of Scopus and Web of Science Core Collection, data files were transferred to VOSviewer.

The keywords environmental psychology, biophilic design, and water were used. In the documents section of the Scopus database, all fields were scanned with the code ALL (“Environmental Psychology” AND “Biophilic Design” AND “Water”) in the advanced search field. In the documents section of the Web of Science Core Collection database, all fields were scanned with the code ALL=(“Environmental Psychology” and “Water”) OR ALL=(“Biophilic Design” and “Water”) in the advanced search field. A total of 292 documents were identified, of which 139 were found in Scopus and 153 in the Web of Science Core Collection. The analyses for both searches delivered the following findings. Eight analysis types common to both databases were collected according to scan findings in all fields. These descriptive analysis types contained information about the document types, publication years, top 15 countries or territories, top 15 subject areas, top 10 sources, top 10 authors, top 10 affiliations, and top 10 funding sponsors. Moreover, the oldest document in Scopus was dated from 2007, while the oldest document date in the Web of Science Core Collection was dated from 1995.

Further, the study evaluated document types, publication years, top countries, top subject areas, top sources, top affiliations, top funding sponsors, primary authors and co-authorship, author keywords and co-occurrences, citations of documents, co-citations of cited references and cited authors based on the bibliometric data of 292 documents in total collected since 1995. The data was downloaded by scanning with the keywords environmental psychology, biophilic design, and water in Scopus and Web of Science Core Collection. The concepts related to the biophilic design-environmental psychology clusters and the developments over time (current trends) by overlay visualization for the concepts were identified via co-occurrences mapping. The cited authors and cited references related to the biophilic design-environmental psychology clusters were identified via co-citation mapping. The documents’ relationship and the authors’ relationship related to the biophilic design and environmental psychology study areas was determined by citation of documents mapping and co-authorship mapping.

As a result of co-occurrences mapping, current research gaps and concepts were identified based on the findings. In the databases selected for scanning, the gaps determined by the scanned keywords are biophilic design, biophilia, emotional design, perception, architectural design. As a result of co-citation mapping, authors and references were identified. In the databases selected for scanning, the primary authors who can be examined as reference sources determined via keyword scanning are Edward O. Wilson, Florian G. Kaiser, Joye Yan-nick, Terry Hartig, Linda Steg, Rachel Kaplan, Robert Gifford, Roger S. Ulrich, Stephen Kaplan, Stephen R. Kellert, Thomas R. Herzog, Timothy Beatley. Lastly, it was revealed that the concepts derived from water at the intersection of environmental psychology and biophilic design research areas have just begun to be studied and have a growing tendency. In addition, in the approach to the relationship between space and water in architecture, biophilic design has been found to be a more recent field than environmental psychology. Consequently, the concepts identified in this study and especially the new combinations that can be established with the biophilic architecture approach allow to design new research topics.

TRACES OF FORMER MILL RACES IN KRNOV: POSSIBILITIES OF REVITALIZATION AND INTERPRETATION

Juraj Illéš, Viera Joklová, Agnieszka Jaszczak

Keywords: mill race, industrial heritage, extinct heritage, urban revitalization, place-making

The presence of water in various forms ever was and still is a prerequisite for the birth and existence of human settlements. The multifaceted aspects of the communities' relationship to water were dynamically reflected in the characteristics behind the formation of the urban structure in different historical periods and represent specific values for towns and cities. Mill races were an integral part of many towns in the past. But when they lost their economic importance, they were mostly filled and buried underground. Although we can now find them in their original form in a few cases only, their spatial corridors have often been preserved in the urban structure. The research aims to detect the historical trace of the former mill races in Krnov, a small town in the district of Bruntál in the Moravian-Silesian region of the Czech Republic, and investigate the possibilities of their interpretation and revitalization.

Krnov lies in the Moravian-Silesian Region, where the Czech Republic borders Poland. The town lies between the rivers Opava and Opavica, which flow through the Krnov and merge into one stream, the Opava River, continuing towards the Opava town. The town has a rich history associated with textile production. The cloth workers guild founded in 1570 was one of the oldest in Krnov. At the turn of the 18th and 19th centuries, woven woollen cloth-making was one of the most important crafts in the location. And it was the mill races that were an important source of energy and water for manufactories, water-powered fulling mills, spinning, and dyeing, and for driving machines connected with the fabric production. The Krnov textile mills, their buildings, and their premises, even in the poor condition in which they have been preserved to this day, stand as unique testimonies to the history of Krnov. They shape the town's *genius loci*, its specific local identity. The mill races were also integral to this identity.

The research focuses on the identification of the remnants and traces of the former mill races using historical maps, literary and visual sources, and subsequently on the investigation of the state of their current existence in the urban structure, according to current orthophoto maps, real estate cadastre records, and field research. In the first stage, the research focused on identifying the routes of the mill races using historical maps, and historical literary and visual sources. The maps of the first, second, and third military mapping were used. Subsequently, in the second stage, we conducted a survey of the current existence of mill races in the urban structure of Krnov from an urban planning point of view, according to the current orthophoto maps, current records of the real estate cadastre, and our own survey in the field. In the third stage, the results of the research were evaluated from the landscape-architectural and urban planning points of view. Various potential possibilities for the revitalization and use of the spatial corridors of the former mill races to interpret the preserved tangible, as well as intangible and extinct cultural heritage values, were analysed.

The routes of the mill races during the development of the urban structure of Krnov are documented in various historical map sources. Four mill races can be seen on the map of the Imperial Obligatory Imprints of the Stable Cadastre from 1826-1843; these formed a system of mill races in the town and its surroundings in the past. At present, the bed of the Opava River in Krnov is directionally maintained in a constant route by modifications made before 1945. The largest adjustment dates back to 1919, followed by a modification beyond the confluence with the Opavica River from 1988-1989. Of the original four mill races, only two have been preserved to this day, the other two were filled up. Research shows, however, that the footprint of their corridors is legible in the urban structure even today, and its presentation in new forms could significantly contribute to regenerate the urban fabric and revitalize public spaces.

The case study of mill races in Krnov shows the importance of this specific phenomenon in the past and also its importance today. The extinction of the mill race channels from the urban structure of towns translates as the loss of cultural identity, and in the context of current threats of climate change, also as the loss of environmental benefits provided by the blue infrastructure. The Krnov example shows that the municipality of Krnov and its citizens actively initiate activities trying to revitalize and interpret the unused heritage of the mill race system. The mill races represent a historical and cultural heritage, and the presentation and interpretation of their values, even those that have disappeared, can greatly contribute to increasing the quality and attractiveness of urban public spaces for residents and tourists.

ALPINE HUTS: ARCHITECTURAL INNOVATIONS AND DEVELOPMENT IN THE HIGH TATRAS IN THE SECOND HALF OF THE 20TH CENTURY

Mária Novotná

Keywords: alpine architecture, post war modernism, innovations, High Tatras, hut, Czechoslovakia

Nowadays, the topic of buildings in the mountains, especially mountain huts, is very popular among architects. Such a commission is considered a matter of prestige. Was this also the case seventy years ago? Were architects interested in alpine architecture? How did they reflect the huts that had already been built in their work? The post-war reconstruction and recovery could also be seen in the architecture in isolated and exposed locations. While interventions in the first half of the 20th century offered a technical solution rather than an architectural expression, in the second half of the century, architectural trends found their way to the high mountains, even if only to a limited extent or on paper.

The High Tatras became an important recreational centre for both Czechoslovakia and other Eastern Bloc countries. The management of tourism with the preference for mass tourism over individual recreation involved extensive plans for expanding construction activities into the high mountain environment. Neither the planned cable car to the mountain peak Gerlachovský štít, nor the accommodation facilities for thousands under the peaks of the High Tatras eventually became a reality. A mountain hotel was built at the foothill of Gerlachovský štít, with a roof that was supposed to withstand an avalanche. Three architectural teams prepared four studies of a Tatra hut, but none of the designs was completed. The administrative transfer of the Tatras facilities from one state organisation to another was a recurring phenomenon in the period under research.

The paper is organised thematically into chapters representing the prevailing architectural trends of the decade and a hut project illustrating the direction. The focus is on the process of architectural planning against the background of turbulent organisational changes in the tourist facilities management. Therefore, the objects under analysis are the huts that underwent the design process, and not the makeshift and unplanned solutions. The research concentrates on the architectural quality of buildings in unique environments, ranging from a provisory shelter with a chimney and a door to a sophisticated project applying the latest technological, material and design innovations. Another angle is the assessment of buildings with respect to current architectural trends. In addition, the paper studies the typology of mountain huts that adapted not only to the environment and terrain but also to socialist realism, post-war modernism, high-tech architecture and postmodernism.

The hut at Popradské pleso was supposed to reflect the era. Its architects responded to the retreating socialist realism by searching for a form to express the folk traditions. A competition with an unclear outcome resulted in the construction of the hut. The realised building is still valued for its aesthetic qualities and has become an integral part of the iconic place in the High Tatras. Authors have analysed the reconstruction of the burnt-out hut Sliezsky dom (Silesian House) at Velické pleso. The hut, which was once built by tourists from the Silesian faction of the tourist association in Wrocław in 1895, was designed by Czech architect Jaromír Sirotek from Brno. The new Silesian House thus became an example of high-mountain post-war modernism in Slovakia and the whole of Czechoslovakia. The reconstruction transformed the hut into a hotel, which was later absorbed into the state enterprise. The hut gave the impression of being for the upper classes of the classless socialist society.

Chata pod Rysmi is a hut located above the mountain lake Žabie Pleso and below the Váha pass, on the avalanche pathway. The text concentrates on the hut extension that was supposed to solve the problem of insufficient capacity and protect the hut from the destructive force of the rolling snow. It was the only hut in the High Tatras with a spiral staircase. Kežmarská chata used to stand at the mountain lake Velké Biele pleso and burned down in the period of intense mass tourism. Although there were projects for its reconstruction ten years later, none were implemented. The investor could choose between a more conservative but still modern solution by a Slovak design group or Czech innovators. The architects from SIAL in Liberec developed two designs

to create the most energy-efficient hut possible. The chalet at Zelené pleso is not examined as a collage of extensions but as a compact object that reflects the architectural debate. Like the previous one, Kežmarská chata, this project also was not realised.

The last decade under research, the 1990s, did not significantly impact the architecture of the Tatra huts. The post-revolutionary period, with the privatisation and transformation to the market economy, also saw the high-mountain facilities being returned back to the hiking associations. Modernism in the alpine environment was a part of the general architectural trend rather than a result of an order by the state. Phenomena associated with the architects of post-war Czechoslovakia were not applied in the restoration of mountain huts. The high mountain terrains of the Tatra Mountains did not become a place of experimentation with prefabricated panels or typified construction. The huts were either the result of a conservative approach based on the building traditions, with occasional slipping into poorly executed improvisation, or the result of a specific and atypical architectural proposal.

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