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Visual-spatial dimensions of modern residential buildings, experience of the Nordic region

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Abstract. The visual-spatial dimensions of architecture are constantly changing, architects and urban planners are aware and understand the need for a healthy, active, vibrant public outdoor space, creating viable, economically and rationally suitable living spaces in the urban environment [12]. A comprehensive approach to sustainable architecture and design with a green structure combines a high-quality urban environment. In modern architecture, one of the perspective directions in the development of visual-spatial environment and structural forms is related to the active and continuous synthesis of the design and construction process in the urban environment [13; 4]. In recent years, the tendencies of rationalism and commercial nature based on technological progress have entered architecture and create a need for the architects to purposefully cooperate with the urban planners in the elaboration of development plans. The format of mutual cooperation brings together and rationally balances various dimensions of the urban environment in a compact visual-spatial structure. Thus, the aim of the research is to determine the visual-spatial dimensions of modern residential buildings in the context of sustainable urban development.

Keywords: visual-spatial dimensions, modern residential buildings, multifunctional outdoor space

Introduction

Along with compact visual-spatial structure, one of the tasks of synthesis in architecture is to create a spatially substantive architecture that increases emotional potential by assessing the psychological perception of a person as a user of a living space. The visual-spatial solutions and dimensions of architecture are different – one part was formed according to a certain plan developed for a building complex with a certain architectural idea, while other parts are forming over a larger period of time, gradually developing on the basis of unified composition ideas [13]. Regardless of the scale, balanced and sustainable socio-economic and urban context, the architects ultimately focused on the visual image of the area to be designed and developed. Recent approaches to urban planning promote a variety of development concepts based on the principle that the urban environment functions as a living organism with complex metabolism [17; 4]. Thus, the visual-spatial dimensions of architecture determine the organization of the living space, reflecting the rational planning and interrelationships of functional zones. To form a single spatial form, the spatial structure must ensure the interaction of all functional areas.

Materials and Methods

The informational and theoretical basis consists of an analytical overview of modern residential buildings and their visual-spatial dimensions. To achieve the goal of the research, scientific research sources, publications and monograph materials have been used. To perform the tasks of the research, two scientific research methods have been used: comparative analysis – to study the experience and approaches of the Nordic region in terms of modern residential construction; cartographic method – the research and development of visual graphic materials for the examples of areas analysed and surveyed in the study of Denmark, Norway and Sweden. All images and diagrams used in the study, which do not include references to the sources, are visually developed and created by the author in the process of the study. The research and evaluation of the territories defined in the research has been performed on the basis of scientific research materials, as well as the survey of the territories in nature, performing photo fixations in all the territories included in the research in the period of 2017–2020.

Results and Discussion

Along with compact visual-spatial structure, one of the tasks of synthesis in architecture is to create a spatially substantive architecture that increases emotional potential by assessing the psychological perception of a person as a user of a living space. The visual-spatial solutions and dimensions of architecture are different – one part was formed according to a certain plan developed for a building complex with a certain architectural idea, while other parts are forming over a larger period of time, gradually developing on the basis of unified composition ideas [4]. Regardless of the scale,

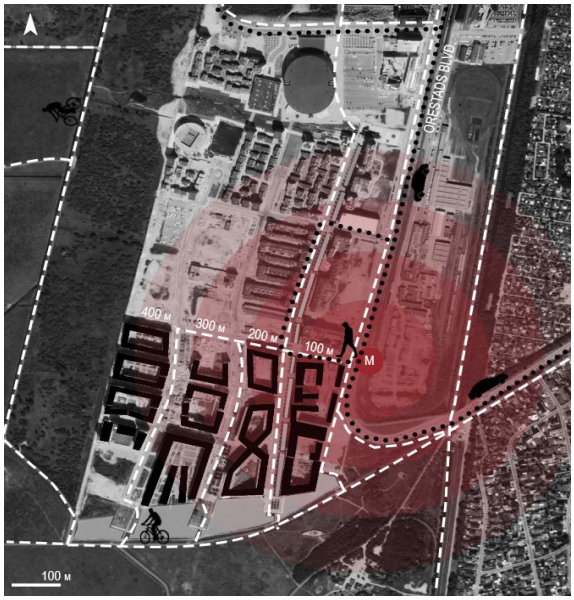

Fig. 1. Ørestad area in the south of Denmark [created by the author, 2021]

Fig. 2. 8 TALLET [photo Una Īle, 2018]

balanced and sustainable socio-economic and urban context, the architects ultimately focused on the visual image of the area to be designed and developed. Recent approaches to urban planning promote a variety of development concepts based on the principle that the urban environment functions as a living organism with complex metabolism. Thus, the visual-spatial dimensions of architecture determine the organization of the living space, reflecting the rational planning and interrelationships of functional zones. Therefore, one of the examples of good practice is the *Ørestad* area in the south of Denmark surveyed in the study (Fig. 1), which is a 7-minute journey by metro from Copenhagen and a 30-minute drive from Malmö. The territory, which is linked to the Copenhagen metro, is being developed according to the currently widespread concept of a compact city [5; 16].

The territory of *Ørestad* was developed by the *Port & City Development Corporation*. The corporation is owned by the city of Copenhagen (51%) and the Danish state (45%). *Port & City Development Corporation*, which is providing port management and urban development, was founded in October 2007. The former *Ørestad* Corporation was established in 1993, when the Danish state set up a new corporation to develop and sell land and to build a metro in Copenhagen, which was connected with high construction costs of the metro [10]. The area of *Ørestad* under study had about 100 inhabitants in 2004, but along with the development of the area, the population increased to 7,500 already in 2012, and the *Ørestad* area generally aims to have a population of up to 20,000, with the possibility of employment for 80,000 people. Based on the elaborated development concept, the territory of *Ørestad* is divided into four zones: *Ørestad Nord, Amager Faelled, Ørestad City un Ørestad Syd* [11]. The Ørestad area consists of many residential and commercial buildings, with their own character and symbolic features of the place, located along the main axis of the composition that follows the metro station. Under the metro and between the buildings, there is a multifunctional public outdoor space developed, so that people can feel free and do what they want. The basic construction scheme is based on a metro one-level solution and is connected with a comfortable environment surrounding by mixed-type buildings. Although the distances between the buildings may seem to be private outdoor areas, they are conceptually designed as open public outdoor areas for walking, which ensures the free flow of people throughout the territory. The visual and spatial dimensions of architecture in the *Ørestad* area are different, the architects have played with different facade solutions, various building shapes and proportions. One of the most expressive visual-spatial forms and solutions in the *Ørestad* area is 8 House or *8 TALLET* in Danish. 8 House is a mixed-type residential building with the area 61,000 m^2 consisting of various types of living space solutions, but 10,000 m^2 – of retail space and offices (Fig. 2).

In 2011, *8 House* won the award as a flagship project in the residential building category at the World Architecture Festival, where the jury highly evaluated a non-traditional architect's solution of combining retail, rowhouses and apartments in one building with elevated 1st floor street levels, providing new access levels in socialization matters. In terms of multifunctionality, 8 House also provides a function of a kindergarten, located on the 1st floor level and consisting of a large closed area for kindergarten children, providing a convenient connection to the living area, equally eliminating traffic jams for transporting children to kindergarten. The Scandinavian green roof association has nominated 8 House as the best green roof in the Scandinavian countries. BIG architects have demonstrated a very clear and conscious use of the green roof, rationally integrating it into the visual identity of the building. 8 House is a 1,700 m^2 sloping roof of moss and succulents, covering the roof surface from the 11th floor to the edge of the water canal [3].

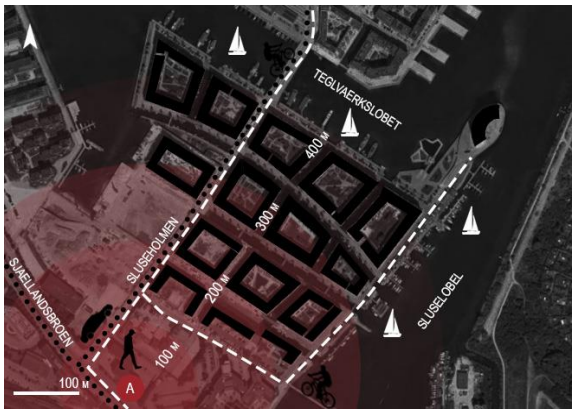

Fig. 3. Sluseholmen area [created by the author, 2021]

Fig. 4. Sluseholmen canal infrastructure [photo Una Īle, 2018]

Fig. 5. Sluseholmen canal infrastructure [photo Una Īle, 2018]

Fig. 6. Sluseholmen residential buildings [photo Una Īle, 2018]

Fig. 7. Sluseholmen courtyard area [photo Una Īle, 2018]

It is strategically located to reduce the greenhouse effect in the urban environment and visually comprehended as an integral visual accent in the *Ørestad Syd* area. The green rood with its sloping shape and roof terraces creates an attractive and mutually coordinated visual and spatial image. A wide panorama of the surrounding area opens from the terrace and form a visual connection with the existing green structure outside the design area. The rest of the newly erected buildings in the territory of *Ørestad Syd* are forming a different visual-spatial residential building with different facade solutions. Designers have used different approaches in spatial solutions, emphasizing both building shapes, proportions through qualitatively designed small architectural forms and details in facades. In general, the mutual location of the construction volume of each residential building has been assessed and carefully considered, creating an easily comprehensible, easily usable urban structure [9; 3].

In the southern port area of Copenhagen, along the *Sluseholmen* Canal (Danish: *Sluseholmen Kanalby*), the construction of a residential building (135,000 m^2) on the *Sluseholmen* Peninsula was completed in 2008 (Fig. 3, 4, 5). The general concept of the area was developed by the architect Sjoerd Soeters and *Arkitema* Architects office, inspired by the artificial island building in Amsterdam. *Sluseholmen* consists of eight inhabited islands with big and small buildings, which architecturally form continuous building blocks [14; 6]. The residential buildings are created in close connection with canals, while bridges, berths and embankments allow residents to access the water. The general plan of the territory and the concept of its development were also designed by the architects' office *Arkitema* together with Sjoerd Soeters. For the *Sluseholmen* area, the authors developed certain architectonic spatial structures, general spatial planning rules, defining the use of specific proportions and dimensions, materials and colours. The area includes 1,350 apartments designed on all eight artificial islands and separated by excavated canals (Fig. 6, 7).

To provide a diverse urban landscape, which has been inspired by Copenhagen architecture already since 1900, public authorities have decided that at least five different designers must be involved in the design of each island. Thus, guided by the defined approach, a cheerful, imaginative set of blocks with mutual visual-spatial differences and accents was achieved in the result.

The analyzed area of *Aker Brygge* (Fig. 8), located to the west of the centre of Oslo, Norway, on the Pipervik fjord embankment, undergo several decades of the visual-spatial change of architecture. Before that, *Aker Brygge* was an industrial site for *Akers Mekaniske Verksted AS* shipbuilding yard, which ceased its

Fig. 8. Aker Brygge, Oslo, Norway [created by the author, 2021]

Fig. 9. Urban places in Aker Brygge [photo Una Īle, 2019]

Fig. 10. Shopping centre area in Aker Brygge [photo Una Īle, 2019]

operations in 1982. Since 1980-1990, the *Aker Brygge* area has been a popular shopping, dining and entertainment area with a top-class residential area that connected Oslo to the forgotten waterfront [1; 2]. Meanwhile in 2010, the area began to lose its visual appeal of urban environment as compared to other areas, but after it was revitalized by *Norwegian Property ASA*, 12 million people are visiting the *Akre Brygge* area today (Fig. 9, 10) [2].

Ghilardi + Hellsten Arkitekter and Space Group Arkitekter worked on the *Aker Brygge* site revitalization project (2010–2014). Conceptually, the goal of revitalization of *Aker Brygge* included the restoration of the existing areas, creating a new spatial structure, restoring vitality of the suburban area, preserving the characteristics of the urban environment integrated into the commercial concept. The structure of the external and internal streets in the *Aker Brygge* area was transformed, unifying them into a single system. Prior to the revitalization process, shopping centres were interconnected by bridges that isolated people from the use of the streets, keeping visitors inside the shopping centres. Thus, the designers conceptually created one diagonal shopping street. The diagonal shopping street was planned with the principle of ‘gaps’, creating the structure of side streets, highlighting four different street outdoor spaces, two of them based on a concept of landscape elements, and the other two with urban art spaces.

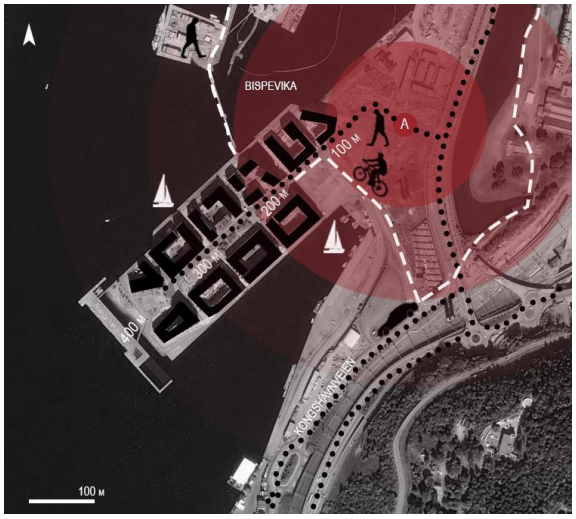

Fig. 11. Sørengautstikkeren, Oslo, Norway [created by the author, 2021]

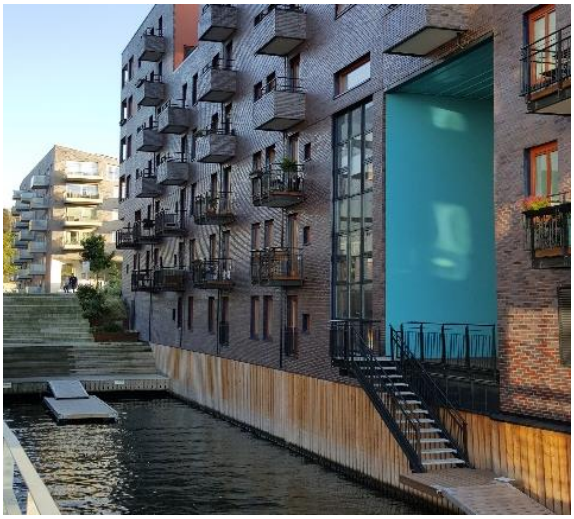

Fig. 13. Sørengautstikkeren canal infrastructure [photo Una Īle, 2019]

Fig. 12. Sørengautstikkeren residential buildings [photo Una Īle, 2019]

Fig. 14. Sørengautstikkeren outdoor café area [photo Una Īle, 2019]

The *Aker Brygge* embankment promenade was upgraded with a new elevation of concrete cobblestones to a common level, the designers provided a new lighting system, elements of public outdoor facilities and various environmental objects. The promenade is designed with a functional approach to the water surface. A functional terrace has been created so that people can enjoy the visual and physical connection with the fjord. The largest boats are far from the embankment promenade in terms of location. The marina has been modernized and made more accessible to the public by adding a new approach and a 15 m wide berth for public events. Nowadays, the revitalized *Aker Brygge* area employs 6,000 people and about 900 people have their homes in the area analysed. The *Aker Brygge* site consists of a total of 13 separate units, 9 of which are divided into 823 owners' units. The owners are linked through a comprehensive employment contract, creating a new area of Oslo that is unique both from national and international perspective. In order to promote cooperation

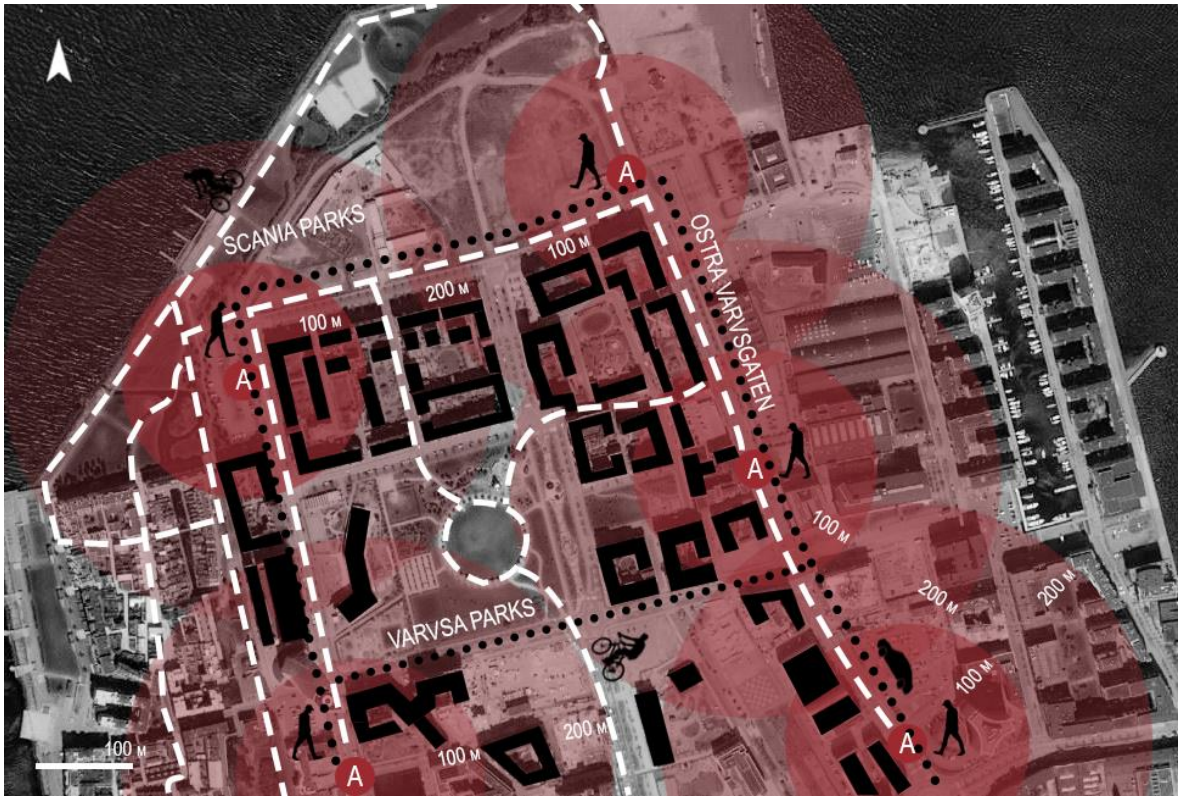

Fig. 15. Västra Hamnen residential area in Malmö [created by the author, 2021]

between apartment owners and the interests of business and culture, several public places for joint events are located in the territory, where the administration of contracts is performed by the joint venture *Bryggedrift AS* [2].

Analysing the visual-spatial dimensions of architecture in *Akre Brygge*, it marks a high-value and high-quality interaction of industrial heritage with modern development trends in architecture. In the *Akre Brygge* areas, where industrial buildings have been preserved, after the revitalization process impact-resistant glass planes have been used in the new building facade solutions to reflect the existence of industrial heritage with modern multifunctional outdoor space, creating an active, vibrant and viable living space for everyone [1; 2]. The visual-spatial dimensions and proportions of architecture in the *Akre Brygge* area are diverse, creating a pleasant and engaging landscape space, saturating it with various accents of green structure and elements of public outdoor space.

Another architectonically expressive residential area equivalent to the *Akre Brygge* area, with a multifunctional outdoor space from the centre of Oslo is *Sørengautstikkeren* (Fig. 11). The artificial peninsula is smaller in scale and proportion than the *Akre Brygge*, but equally rationally and functionally conveniently planned and implemented. Until 2010, the analysed area was a container port, a cruise ship berth and a bulk storage site. The reconstruction of the *Sørengautstikkeren* area was organized by *Sørenga Utvikling* and the Oslo Port subsidiary *HAV Eiendom*. The development and concept of the spatial plan was elaborated by four architects' offices: *LPO arkitekter*, *Jarmund / Vigsnæs*, *Arkitektselskapet Kari Nissen Brodtkorb* and *MAD*. Each architect's office has developed two blocks, but a common building image has been developed in cooperation with each other. The construction activities were in 2009 and completed in 2012. 950 apartments, commercial spaces, including various shops, were conceptually designed. The cost of the apartments sold is one of the most expensive, as they are in the distance of a walk from Oslo city centre. The *Sørengautstikkeren* territory is conveniently designed in terms of its functionality, using water resources for various recreational opportunities, reducing the flow of motor vehicles, ensuring maximum mobility in the area for walking. The visual-spatial dimensions of architecture correspond to the context of the landscape, creating functional areas of both private, semi-private and public outdoor space. The facades are designed with a decorative brick finish, which is created with individual contrasts of elements and expressive addition of colours (Fig. 12, 13, 14).

A visual contrast to the *Sørengautstikkeren* area with a different approach is represented by *Västra Hamnen* residential area in Malmö (Fig. 15), which has developed in recent years next to the *Bo01* residential area, and in 2001, *Bo01* was the site of a European housing exhibition [15]. The *Bo01* residential area is equally notable for its sustainable

Fig. 16. Västra Hamnen residential area [photo Una Īle, 2018]

Fig. 17. Torso [photo Una Īle, 2018]

development and solutions, as well as it is successfully organized and maintained until nowadays. In general, the adjacent territories near *Bo01* are developing not only with new residential buildings, but also commercial buildings are being integrated into the territory. A number of urban planning principles have been implemented and applied in the *Västra Hamnen* residential area.

The *Västra Hamnen* residential area has attracted international attention by its sustainable development principles and approaches. Each next project in the analysed area continues to grow in the implementation of the principles and approaches of sustainable development in the urban environment. The aim of the *Västra Hamnen* residential area (Fig. 16) is to become an important tool in the development of Malmö as a principle of knowledge transfer in the context of the urban environment. Careful planning is being carried out to make a blend of functions, human activities and ideas, thus proving that there is interaction and active meeting of people outdoors. The residential area of *Västra Hamnen* can be described as a mixed functional area layout, in which buildings, groups of buildings, offices, teas-shops and various leisure activities can coexist in one building volume. One dominant exists in the area – *Torso* (Fig. 17), which is a neo-futuristic residential skyscraper in Malmö and is the tallest skyscraper in the Scandinavian countries. *Torso* belongs to the cooperative association *HSB* and its author is a Spanish architect, civil engineer, sculptor and painter Santiago Calatrava. The building is 190 meters high with 54 floors and 147 apartments designed, and the skyscraper won the Gold Emporis Skyscraper Award 2005. In the rest of *Västra Hamnen* area, the visual and spatial dimensions of the architecture are proportional to the human scale proportions, reinforcing and providing high saturation with a functionally comfortable and safe multifunctional outdoor space. The architecture of the residential building is diverse, the same as in the *Sørengautstikkeren* area, with careful consideration of accents and nuances, but *Västra Hamnen* has taken a different approach to the choice of facade materials, with a wider variety of materials, and, except of *Torso*, the height of the other buildings is lower.

In general, the residential structure of *Västra Hamnen* is simple and concise, creating a balance with a multifunctional outdoor space that integrates the principles of sustainable development; each outdoor area has been carefully planned, highlighting the diversity of natural materials, green structure and safe solutions. Not only semi-private areas on the 1st floor level have been designed and implemented for the residential construction, the architects have also appreciated the solutions of roof gardens with terraces for various activities of residents. The scale of the building in relation to the free, green structure, especially the building adjacent to the park, visually decreases, providing a pleasant overview of the landscape in the residential area.

One of the biggest urban development goals of Malmö is to create a mixed city full of vitality and to become a role model for smart climate change. *Hyllie* area is one of such parts Malmö (Fig. 18). Serious expansion of the southern part of Malmö has been planned since the 1960s, but real solutions and development have only begun with the decision to build a metro station in the Hyllie area.

The energy in the *Hyllie* area is produced from renewable or recycled energy sources only, based on so-called smart infrastructure. Due to rapid development, the green surroundings of the area, the location (in the southern part of Sweden) and the functionally convenient travel, *Hyllie* has developed as an attractive area for residents, visitors and entrepreneurs. *Hyllie* Station, the last station in Sweden on the way to Copenhagen Airport and only 12 minutes by train, attracts many residents and merchants thanks to its convenient location. A unique development concept has been developed for the landscape of the *Hyllie* area, which is based on the properties of the green structure [7; 8]. The territory is characterised by the keywords: landscape architecture, architecture and urban planning. Equally, the *Hyllie* area highlights important growth factors in the regional context, developing as the most climatically smart urban area

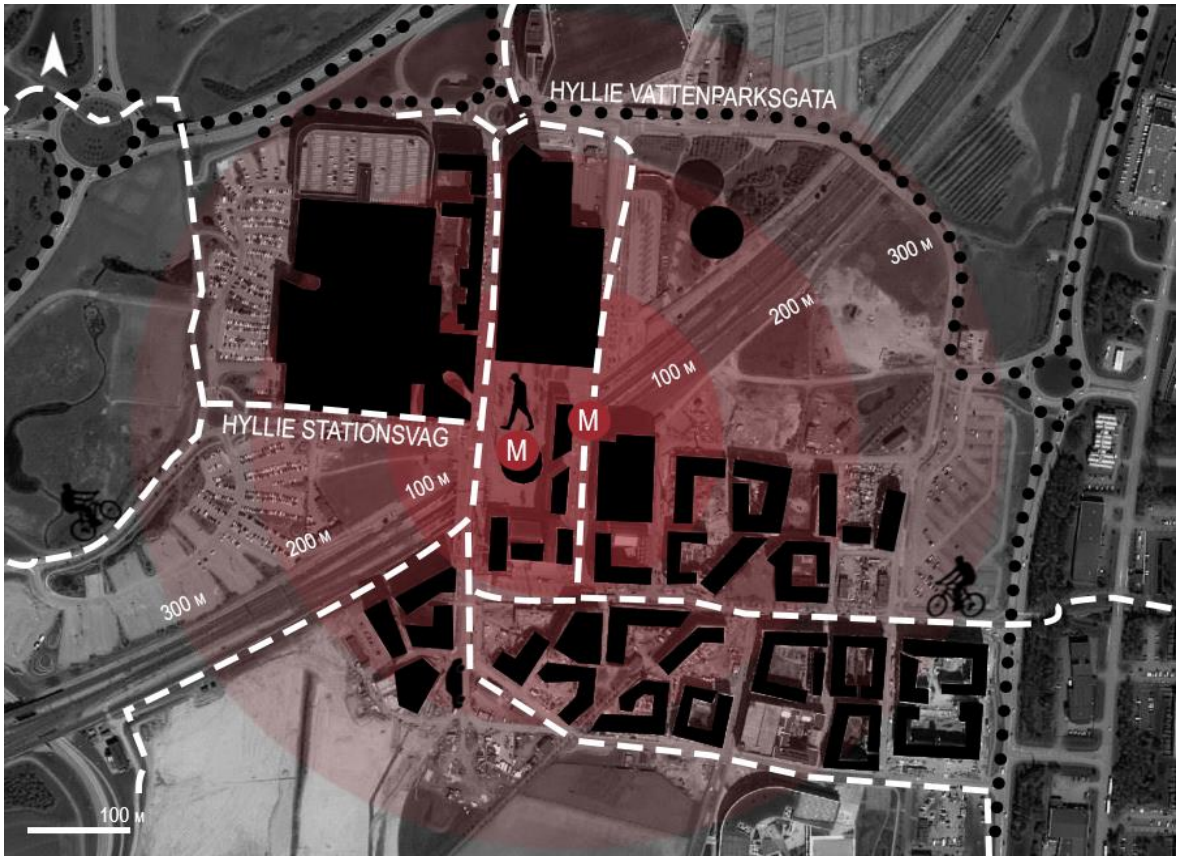

Fig. 18. Hyllie area, Malmö [created by the author, 2021]

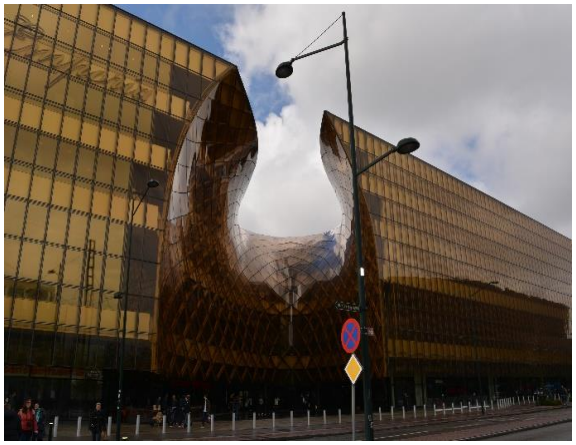

Fig. 19. Emporia shopping centre [photo Una Īle, 2018]

Fig. 20. Multifunctional outdoor space, green roof [photo Una Īle, 2018]

in the Öresund region and setting an example to the world by carefully working on the environmental strategy and climate issues.

The analysed *Hyllie* area is compact and functionally planned in terms of the visual-spatial dimensions of architecture, creating easily comprehensible and easily usable building areas. The principle of mixed building was used, which reflected all the needs of the residents so that they are satisfied and have a desire to stay, to live in the *Hyllie* area. The building structure of the *Hyllie* area is formed by the *Emporia* shopping centre (Fig. 19, 20), the largest in the Scandinavian countries and with a wide multifunctional outdoor space, as well as the Malmö arena and hotel, as well as residential buildings that are rationally and functionally integrated into public buildings.

Conclusions

Evaluating the territories surveyed in recent years, it can be concluded that the visual-spatial dimensions of architecture and the structure of the urban environment are constantly developing and changing, marking certain concepts and principles. Each territory includes quality solutions and multifaceted approaches, thinking about its viability, a healthy and activity-filled living space, which is mutually harmonised with the architecturally spatial techniques. A comprehensive

approach to the development of sustainable architecture and multifunctional outdoor space can be found in all the described areas, which can serve as examples of good practice and systems that can be integrated and developed in the process of revitalization of equivalent territories or in the planning of new buildings and territories. The examples analysed demonstrate that the Nordic region is focused on spatially meaningful and high-quality architecture, including human-scale proportions, emotional potential and psychological perception of a user of the living space. Along with the elaboration of concepts and development strategies, the existing values of the area, such as industrial heritage or green structures or the proximity of water resources, are taken into account and highlighted.

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Kopsavilkums. Arhitektūras vizuāli telpiskās dimensijas nepārtraukti mainās, arhitekti un pilsētplānotāji apzinās un saprot nepieciešamību pēc veselīgas, aktīvas, dzīvīgas publiskās ārtelpas, veidojot dzīvotspējīgas, ekonomiski un racionāli pilsētvidē piemērotas dzīves telpas. Visaptveroša pieeja ilgtspējīgas arhitektūras un dizaina veidošana ar zaļo struktūru, apvieno kvalitatīvu pilsētvidi. Mūsdienu arhitektūrā viens no perspektīviem vizuāli telpiskās vides un strukturālo formu attīstībās virzieniem ir saistīts ar aktīvu un nepārtrauktu projektēšanas un būvniecības gaitas sintēzi pilsētvidē. Pēdējos gados arhitektūrā ienāk racionālisma un komerciāla rakstura tendences, kas balstītas uz tehnoloģisko progresu un rada nepieciešamību arhitektiem, kopā ar pilsētplānotājiem mērķtiecīgi sadarboties attīstības plānu izstrādē.