Qualitative Research of Contemporary Architecture and Space of European Cities in The Aspect of Correlation: The Principles of a Sustainable Environment, The Perception of Space and Technological Solutions of Objects

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Abstract. The built environment in modern Europe is undergoing constant change. Changes occur both in terms of functional needs of users of architectural space, as well as in technical and technological requirements of the objects themselves. A particularly important aspect in the study of architecture is the use of modern, ecological building technologies while maintaining such features of the building and space as: identity, cultural heritage, environmental context, aesthetics. Aim of the study is qualitative research of contemporary architecture and space of European cities in the aspect of the occurrence of correlations between the principles of a sustainable environment, the perception of space and the technological solutions of objects. Contemporary realizations of space and architecture show the application of many technologies and principles of a sustainable environment, respect for the natural environment, and the use of analogous systems to those found in nature. It was also observed to adapt the built environment to the changing climate and the effects of these changes. The studies also show the connection of new objects and spaces with the tradition of a given place, as well as taking into account the habits and needs of users.

1. Introduction

The built environment has impact on, among others:

- on the environment (the impact of the object on the environment and vice versa - the impact of the building on the environment, principles of sustainable environment), the main principles of sustainable development assume the highest quality of life of modern users while ensuring appropriate development for future generations,
- aesthetic impact (perception of space by users, aesthetic impact, beauty, cultural heritage, place identity, symbolism), unification of the built environment, loss of diversity of places, creation of a landscape without symbols, symbols, identity,
- technical impact (technological solutions of facilities, durability, usability), saving natural resources, not destroying the natural environment and providing a resistant infrastructure for anomalies of climate change.

The built environment in contemporary Europe undergoes various changes. Changes occur in both areas: functional needs of users of architectural space and technical and technological requirements of the objects themselves. An important aspect in the study of architecture is to examine the use of
environmentally friendly building technologies and whether they contain such features as: the identity of the place, cultural heritage, environmental context, aesthetics. These problems cannot be separated. They are interrelated.

Aim of the study presented in article is qualitative research of contemporary architecture and space of European cities in the aspect of correlation between the principles of a sustainable environment, the perception of space and technological solutions of objects.

From literature it can be found:
- qualitative research: Fross [12, 14], Tymkiewicz [15], Gyurkovich [8],
- space perception: Alexander [1], Basista [3], Zuziak [16], Borsa [4], Gzell [9], Gehl [5], Gumińska [7].
- principles of sustainable development, technological issues of construction: Majerska-Pałubicka [13], Błaszczyński, Ksie, Dyzman [2], Gorgoń [6], [10], [11], Zielonko-Jung [17].

2. Research
The research method consisted in identifying the theoretical criteria based on the theory research and on the research of individual objects and spaces. The issues of qualitative research methods of the built environment were dealt with, among others: K. Fross [12, 14], Ujma-Wąsowicz K. [14], D. Winnicka-Jasłowska [12], J. Tymkiewicz [15] and others. Urban, functional, aesthetic and technical analyses were carried out in the research, using research techniques such as field visits, site and user observation, interviews and similar analyses using POE methods.

3. Correlations in the built space
The research has been divided into particular thematic issues:
- environment, surroundings, impact on the environment
- aesthetics, perception, identity
- technology and technologies.

The following are examples of contemporary European architecture of various types of objects, detailing the above features. An example of an office building with the application of the principles of sustainable development and respecting the surroundings and the cultural heritage is the facility located in Dessau, Germany - Federal Environmental Agency; Office of Sauerbuch & Hutton or Matthias Sauerbruch (Germany) and Louisa Hutton (England). It is an example of an energy-efficient building designed and made entirely digitally, as well as an example of reclamation of contaminated land in an industrial area. It was built on the site of a former factory, which is why the place is referred to as the "Gas Quarter". Some of the factory buildings remained. The winding form is a response to a variety of local spatial and aesthetic limitations as well as the result of a neighbourhood of different quality of space. The form coincides with the sine curve. The colours of the facade correspond with the elements adjacent to the building, trees, pond, warehouses. Through the use of a wide range of coloured panels, the reception of the building is completely different on each side and when you are in the vicinity of the building, the user experiences a completely different experience. The object fits into the historical context through the dimensions of the object, materials and technologies.

There were applied ecological strategies in the facility:
- almost every space is naturally illuminated
- windows (double window system) - it reflects excess light and distracts allow the user to control the room temperature and provide natural ventilation for almost any space. An additional window protects against glare.
- the external facade is almost 40% glazed, the rest is a composition of double-glazed window panels made of larch wood and safety glass, enamelled in 33 different shades.
- the building has four floors, its solid is compact with the yard as an energy buffer.
- clay bricks are made for partition walls between rooms to increase the thermal mass, regulating the interior temperature.
- large roof insulation thickness - \( U = 0.13 \) (R-44), foundation slab - \( U = 0.35 \) (R-16).
- summer / winter ventilation using the division of the building into zones and geothermal energy, (Figure 1).

\begin{figure}
\centering
\includegraphics[width=\textwidth]{image1}
\caption{Office building - Federal Environmental Agency; Dessau, Germany; Office of Sauerbuch & Hutton or Matthias Sauerbruch (Germany) and Louisa Hutton (England.), Photo. Author}
\end{figure}

Another example of office building of Hamburg - Behörde für Stadtentwicklung und Umwelt / BSU (City Hall for Development and Environment). Reduction of energy consumption in a building by combining active and passive measures, enhanced thermal insulation, reasonable transparency and protection from intense sunlight in facades, use of renewable resources like natural lighting, natural ventilation and solar heating, geothermal energy, (Figure 2).

The above example of photos shows using environmentally friendly technologies respecting the context of the environment, as well as the diversity of space and attractiveness, which can lead to building a specific identity of this place.
Example of a department store of a new space built in the context of historical buildings: The Weltstadthaus Commerce House, Köln; Renzo Piano, 2003-2005; Energy Active Breast Building. Technical data proving the application of the sustainable environment principles: 14,400 m² of retail space on the length of 130 m and width of 60 m; Atrium offers views on five floors at 34 m in height; Glass facade 4,900 m² with 6,800 individual laminated panes and 66 beams made of glued laminated wood of Siberian larch; a balanced relation of solar protection in summer and thermal insulation in winter, with a low solar light ratio of 37 percent (EN 410) and excellent thermal insulation (1.1 W / m²K according to EN 673), on the ground floor of the building approx. 1000 m²; iPlus insulation glazing (Interpane); North side facade consists of 4400 m² of natural stone, (Figure 3).

Another example of a new space built in the context of historical buildings is revitalization in the center of Milan, Italy. Multi-family housing City Life Residences in the City Life district of Milan, in the historic Milanese district, Italy, Proje Daniel Liebeskind Architects (2013) and Proje Zaha Hadid Architects (2004-2012).

City Live has a completely unique geometry, which accentuates the tops of buildings, it facilitates the integration of large-scale structures into the rich and diverse surrounding urban tissue. A classic Italian layout of the courtyard of residential buildings was used in courtyard and naturalistic materials with the historic neighbourhood of the Milanese district. A complex of 5 residential buildings is located around the perimeter of an open courtyard connecting to the north with the park. Inner courtyard without car transport (underground parking), with greenery as a social space.

Buildings use state-of-the-art design (ie, the state of the art refers to the highest level of overall development, as devices, techniques or scientific environments achieve at a given time) and are certified according to the Italian A + - CENED class. Sustainable functions include various aspects of sustainable development elements, e.g.: thermo-regulated ceiling radiators, energy-efficient, programmable heating and cooling systems, modern insulation and durable tiles, finely textured, gray Casalgrande Padana facade tiles, corrugated sunblinds made of polymer composite Bamboo Soleils Brise and photovoltaic cells on the roof. CityLive has a completely unique geometry that accentuates the tops of buildings, it helps to integrate large-scale structures into the rich and diverse surrounding urban tissue (Figure 4).
Figure 3. Shopping Center Weltstadthaus, Köln; Renzo Piano, 2003-2005; Energy-efficient curved building, photo author

Multi-family housing City Life Residences in the City Life district in Milan, Italy, Proje Zaha Hadid Architects (2004-2012). Orientation of buildings, taking into account the requirements of environmental protection and comfort - most apartments are directed to the south-east, simultaneously with views from the terraces, towards the city and the public park. The buildings are open to the neighbouring historic district. Both from the new buildings you can see the historical buildings of Milan, as well as from the street space. The new development creates a coherent whole with the already existing buildings. Also, the development of the recreation area is aimed at isolating the inhabitants from wheeled transport, enabling active recreation and fun in the center of a large city. Facade materials - concrete panels and panels made of natural wood. The interiors are open with large terraces. All apartments are equipped with design solutions and plants that can be easily adapted to individual needs.
Figure 4. Multi-family housing City Life Residences in the City Life district in Milan, Italy, designed by Daniel Liebeskind Architects (2013), photo author

Each of the houses is different from the others in terms of size, exposure and layout: from two to large rooms, family apartments and twin-level penthouses, (Figure 5.)

The next example is multi-family housing - revitalization of the old buildings Weltquartier residential quarter in Wilhelmsburg in Hamburg, Germany, IBA Hamburg revitalization (designed by Kunst + Herbert, Hamburg, 2006-2013). In addition to the thermal modernization of residential buildings with their new functional division, the old Energy Bunker bunker was renovated. The bunker has been transformed into a solar collector, with a boiler room in the interior.

Small gardens, playgrounds, internal courtyard, built-in balconies, adaptation to the needs of residents of ethnic minorities, energy savings of approx. 0.40 € / 1 sq m, heating costs increase of 0.13 € / m², the modernization -standard passive house, primary energy demand of buildings has fallen from 300 to 9 kWh per square meter per year, renovated buildings in the "Global Neighborhood" will produce zero carbon dioxide emissions. Residents participated in the revitalization of their district. (Figure 6.)
Figure 5. Multi-family buildings City Life Residences in City Life in Milan, Italy, Proje Zaha Hadid Architects (2004-2012), photo author

Figure 6. Weltquartier residential quarter in Wilhelmsburg, Hamburg, Germany, IBA Hamburg revitalization (design: Kunst + Herbert, Hamburg, 2006-2013), photo author
An example of terraced houses is the settlement Energy - plus - house in FREIBURG-VAUBAN designed by Rolf Disch, 2008; Energy Plus is a building structure that produces more energy than it uses alone; all homes produce a positive energy balance and are CO2-free, built in 2000 and 2005 in the Vauban district of Freiburg, each house's design offers maximum energy efficiency. (Figure 7.)

![Figure 7](image_url)

**Figure 7.** Transformation of former military barracks, ecological and energy-saving construction, Vauban, Freiburg im Breisgau, Germany (designed by Rolf Dish from 2008), 2015, photo author

4. **Conclusions**

Legal regulations as well as the principles of sustainable development indicate the necessity of using ecological, energy-saving materials and construction technologies. The presented examples show the variety of technical and technological solutions referring to the principles of sustainable development. However, all examples combine aspects such as:

- adaptation to users' requirements;
- the identity of the place,
- sizes of objects similar to already acceptable buildings, fitting into the surroundings, divisions into smaller objects, diversity;

Adaptation of buildings to the changing climate through the use of:

- large amount of green, natural water-permeable surface
- natural, harmless materials and construction technologies (natural cooling systems, energy obtained from renewable sources, division of large objects into smaller - natural lighting, ventilation),
- spatial management lowering the temperature of the external space (greenery, elevations of buildings that do not reflect the sun),
- other activities in line with sustainable development.

Contemporary European architecture, despite the necessity of technical adjustment to the changing climatic conditions, retains in the examples mentioned the most important correlations between the natural environment, the built environment and the cultural heritage zone. In the historical context, it is difficult to preserve the identity of space and space. However, you can use (as in the presented examples) appropriate natural finishing materials, colours that are in harmony with the existing
surroundings, dimensions of objects similar to historical buildings, interesting structures and layouts of new buildings. Also by skilfully placing technical elements of facilities such as parking lots, terraces, ventilation, heating, IT systems, etc., shaping recreational spaces, games for children near homes, on a scale adapted to social acceptance (e.g., size of Habitats) it is possible to enter new development into the existing space. Thus, it is possible to preserve the identity of a place, albeit transformed but user-friendly, residents, maintaining cultural continuity.

Certainly, multi-faceted activities leading to the immunization of architecture for climate change will improve the living conditions of its present and future users.

It is certainly not enough to design and manufacture environmentally friendly buildings, but the right combination and integration in project activities.

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