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Sustainability Trends Reflected in the Architecture of the European Examples

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Abstract. In modern architecture, one of the leading trends are striving to obtain the most economical energy-efficient building. Eco-development focuses on contemporary use, inter alia, the technological and material solutions that meet the conditions in most of the existing laws by using renewable energy sources. These findings apply primarily to new objects. Old, historical already existing superstructure is treated in a manner less demanding adaptation to environmental conditions, mainly on the behaviour of the aesthetic. This can be disadvantageous for these properties due to increased operating costs, and thus the loss of attractiveness. At work, an attempt was made on the basis of the analysis of the literature and documentation shoot made "in situ" possible use of latest technological developments to both the renewal of the historical buildings of the central areas of European cities through the renovation of an existing building or the emergence of subsidiary buildings while preserving the cultural values, aesthetic or symbolic objects, the environment. Analyzed examples show possibilities of adapting new and upgraded properties both to your power requirements, green and to the context of the existing built environment and cultural heritage.

1. Introduction

The basic trends in the construction industry are focused on low-energy passive construction, combining environmental, social and economic aspects, i.e. sustainable development.

Legislation exists for low carbon construction, but the exception is existing, historic buildings. There are difficulties (mainly technical and economic) in these facilities to adapt them to energy requirements, mainly due to the preservation of the image and aesthetics of the object. These factors influence the level of quality of these objects as well as the low economic, social and ecological attractiveness of the space in which they are located [18].

Modern ecological technologies will increasingly enable the fulfilment of ecological conditions occurring in historical and new historical objects. If we assume that "architecture (...) is a set of skills, know-how, fundamentally related to human condition itself" [Krier L. (2011), 11, p. 249], urban spaces reflect social, economic and technological development. Urban spaces are transformed, transformed [15, p. 53-56, others] functionally and aesthetically.

The aim of this paper is to present the prevailing environmental trends, adaptive transfiguration [15, p.105] in the contemporary architecture of European cities. Particular attention has been paid to the problem of correlations occurring with the use of new technologies, pro-ecological materials and adaptation of new and modernized facilities to the existing environment, its aesthetic and cultural values.

These values vary to a great extent under the influence of new technical and technological developments, shaping a cultural identity that is also transformed.

The problem has been analyzed by analysing selected objects of contemporary European architecture.

2. Main assumptions and goals of eco-development

Sustainable development is a socio-economic development based on respect for resources [21].

The main assumptions of eco-development are: not causing damage to the environment, taking into account natural conditions, protecting basic ecological processes.

The objectives are, inter alia: to maintain the ecological balance, as well as the unspoiled environment present and future generations, to ensure a certain quality of the environment.

The above assumptions influence the architectural tendencies of the shaping of the newly built and already existing space. The following characteristic features of urban development include the following: low energy construction, structure of the building with respect to nature and energy saving, building appearance and aesthetics reflecting the nature and characteristics of energy saving, "naturalistic", ecological image, high quality of space / objects.

For full optimization of the building process and the entire "life" of the building, many countries apply methodologies to assess them for compliance with sustainability criteria [1, p. 84-104]. The multi-criterion ecological certificates, which verify the degree of adaptation to the ecological criteria, are certainly influencing the appearance of newly built buildings.

At present in Poland, energy certificates are usually received by newly-established commercial buildings, such as office buildings, shopping centres, less frequently used multi-family residential buildings and refurbished buildings are not usually covered by this procedure.

3. Selected ecological solutions

The following technologies and building materials are used in eco-development solutions [8, p. 166; 6, p. 130]:

- green walls, buildings with vertical gardens, such as the American pavilion, World Expo 2015, Milan, Italy;
- technologies that use chemical reactions to clean the atmosphere, such as the concrete facade of the Italian pavilion at the World Expo 2015 in Milan, Italy;
- technologies that use chemical reactions to control light, change the shade of any window, block UV and infrared rays; Shade rooms such as SPD SMART WINDOWS in the US Pavilion, Expo 2015 World Expo, Milan, Italy;

BI technology - microcalines - micro algae for energy generation and light and shadow control in a building in Hamburg, IBA, Germany; Ventilation and solar heating;

- shaping the structure of objects using natural phenomena such as natural lighting, natural ventilation, geothermal energy such as office buildings in Germany, Hamburg and Dessau.
- use of building components that limit energy consumption eg reinforced thermal insulation;
- use of natural and environmentally friendly materials, intelligent building materials;
- reducing energy consumption in the building by combining active and passive measures;
- reusing -reducing the environment taking into account the whole life cycle of the building, with the reuse of materials in subsequent constructions [15, pp. 57-62].

4. Pro-ecological solutions - examples

The development of environmental protection not only increases the thermal insulation of the outer partitions of the facility, the use of basic energy production systems from natural sources, reproducible but primarily suitable for ecological assumptions shaping the structure of the building, using natural ventilation, environmentally friendly materials,

Also an important factor in shaping ecological architecture is to adapt it to the existing environment and user needs (quality, aesthetics).

As a criterion of analysis, the division of objects into new, newly created in a particular historical context and the modernization of historical objects was adopted.

5. New development

An example of a new facility with a variety of environmental solutions is the Hamburg Municipal Office for the Environment and Development (2013, Sauerbruch Hutton Architekten, Berlin). The reduction in energy consumption in the building is achieved by combining active and passive means: enhanced thermal insulation, reasonable transparency and protection from intense sunlight in facades, the use of renewable resources like natural lighting, natural ventilation (fragmentation of the facility for better natural lighting and easier ventilation) Powered by solar, geothermal energy.

The object is in the surroundings, despite its large dimensions (human scale preservation), but with a variety of form of solids and interesting, non-monotonous aesthetics of the façade.

a) b)

Figure 1 a) Reducing glazing, good, enhanced thermal insulation and dismemberment body of the building; Municipal Office of Development and Environment, Hamburg-Wilhelmsburg, Germany, 2013 (arch. Sauerbruch Hutton Architekten, Berlin); b) courtyard building; A. Gumińska, 2015.

Another example of the use of renewable energy resources is the Energy-Plus estate in the Vauban district of Freiburg, built between 2000 and 2005 by Rolf Disch.

Energy Plus is an object that, thanks to the use of modern technology, produces more energy than it uses, all homes gain positive energy balances and are free of CO2, with maximum energy efficiency.

The Energia Plus complex consists of smaller series of buildings. At home there are spaces used by residents in different ways, for example green spaces, recreational spaces, business objects and similar functions (use of reusable and recyclable materials), [4, 16].

6. New buildings in the context of historical surroundings

An example of an energy-efficient building designed and digitally executed is the headquarters of the Federal Environment Agency in Dessau, Germany (2005, projected by Sauerbuch & Hutton - Matthias Sauerbruch, Germany and Louisa Hutton, England), reclamation of contaminated land in this industrial area on the site of the former Factory "Gas Quarter" leaving part of factory buildings. The irregular, curving form of the object is a response to a variety of local constraints and a neighbourhood of varying degrees of space quality.

The façade's colours correspond to the surroundings of the building, ie the elements adjacent to the building, buildings, trees, pond, warehouses. The object fits into the historical context by using a non-homogeneous body of the building (the projection of the object coincides with the sinusoid curve), dimensions (corrugated facade, heterogeneous shape, covered courtyard), and colour materials.

Figure 2. Energy settlement - plus - house built in 2003-2008, prof. Rolf Disch, Vauban, Freiburg, Germany, the object

The following environmental strategies were applied:

- every space is naturally lit,
- one (double window system) - reflects excess light and dissipates allow the user to control the temperature in the room and provide natural ventilation for almost any space, additional glass protects against glare.

The exterior facades are almost 40% glazed and the rest is a composition of double glazed window panels made of larch wood and safe glass enamelled on 33 different shades:

- the building has four storeys, its solid is compact,
- clay bricks are made to the partition walls between the branches, to increase the thermal mass, regulate the interior temperature,
- single insulation thicknesses: roof -U = 0.13 (R-44), foundation plate -U = 0.35 (R-16),
- the theatre acts as a climate buffer and regulates the temperature, and also calms the noise from the neighbouring railway station,

The underground water serves as a seasonal warehouse,

- solar panels mounted on the roof,
- ventilation system: night cooling by means of motorized ventilation panels on the façade and the removal of warm air through the atrium roof; Geothermal air intake, a 5 km long tube heat exchanger, allowing air to cool in summer and heated in winter,

Other ecological materials: Tinned Copper, cellulose insulation was incorporated into the prefabricated, external larch [3].

An object with applied technologies and pro-ecological materials fit well into the existing environment. Despite various technical and aesthetic solutions, the building introduces new quality into the degraded space, transforming it into a friendly, largely sustainable development of public spaces, [20].

An example of the next solution for the degradation of post-industrial spaces may be the conversion of harbor docks into the HafenCity housing and service district in Hamburg (IBA-DOCK project, Han Slawik arch., Hamburgplan and Kees Christiansee / Astoc studio development plan, Herzog & de Meuron Between 1990 and 2025, 5,500 dwellings and 40,000 new jobs, 12 thousand inhabitants).

The use of traditional, correlating with the historical environment of finishing materials, similar to the existing building size of new buildings, convenient walking routes, variety of buildings, attractive land development, as well as energy-saving, diverse technical solutions. These factors influence the activation of degraded port docks, both social as well as aesthetic as well as economic.

Also, shopping centers in urban centers, in addition to adapting to the context of the existing built environment, are adapted to environmental requirements. An example of such an adaptation could be the Kö-Bogen Shopping Center connecting the city park to the historic city center of Düsseldorf (Studio Daniel Libeskind and Architect Daniel Libeskind AG, Zurich; 2013).

a)

b)

c)

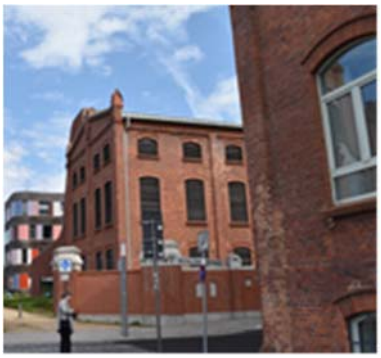


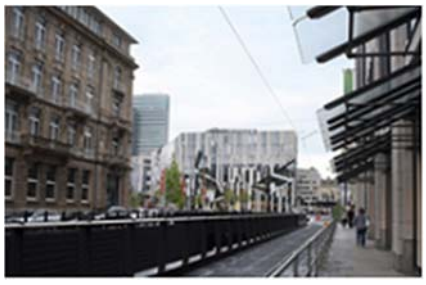
Figure 3 a) "Naturalistic" buildings - an object entered in the spatial context, object structure, materials and technologies meet the requirements of sustainable development; DESSAU, GERMANY - Federal Environmental Agency, Headquarters Federal Environment Agency; Office Sauerbuch & Hutton or Matthias Sauerbruch (Germany) and Louisa Hutton (England), Germany;
b), c) Historical context object; A. Guminska

The object, despite the use of modern materials, different composition of the solid and the façade, fits into the historical context with its dimensions, aesthetics and solid structure.

The so-called. "Hanging gardens" placed in indentations in the body of the object, corresponding to the surrounding building. Thanks to the use of multi-lenticular technology in the illumination of the object, the luminaires give homogeneous, light-free, at 40% less energy than conventional solutions.

The use of green solutions in the green areas on elevations enriched the quality of the object and "connected" it with the neighbouring park,[3].

a)



b)

c)

Figure 4 a) "Naturalistic" buildings in the historic center of the city, referring to nature by introducing plants on the facade, Shopping Centre Kö-Bogen in Düsseldorf. Studio Daniel Libeskind and architect Daniel Libeskind AG, Zurich; 2013, Germany;
b) Whole building; c) Façade detail; A. Gumińska, 2015

Another example of a shopping center located in the historical center, referring to its ecological trends through its construction structure, is the Weltstadthaus, Köln, Renzo Piano, 2003-2005. An energy-efficient curvilinear building with a shopping area completely illuminated with natural light. Curvilinear glass atrium with a plan size of 130 m at 60 m and 5 floors (34 m) was used. The glass facade is made of laminated glass (on the ground floor, plus glazing, Interpane) and Siberian larch wood glued laminated wood. There is a balanced relationship of sun protection in summer and thermal insulation in winter, with a low coefficient of sunlight (37 %) and excellent thermal insulation (1.1 W / m²K). The northern side facade is made of 4400 m2 of natural stone.

Also in modern architecture, you can see the adjustment of multifamily housing to ecological requirements.

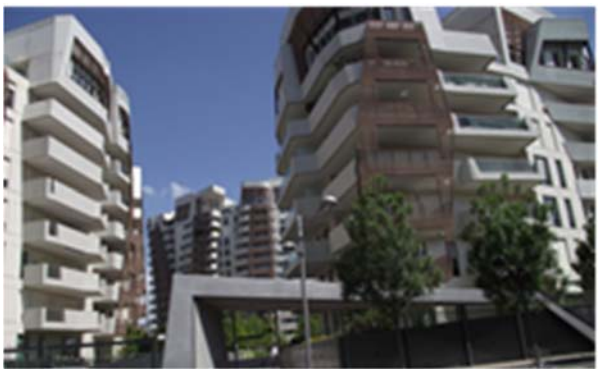
Examples include two housing estates of the City Life Residences in Milanese historic district, Milan, Italy (Proj. Daniel Liebeskind Architects, 2013 and Proj. Zaha Hadid Architects, 2004-2012).

The multi-family buildings of Daniel Liebeskind Architects have a completely unique geometry that accentuates the tops of buildings, encouraging the integration of large-scale structures into the rich and varied surrounding urban fabric.

The buildings are open to the neighboring historic district by opening the interior with extensive terraces. Each home is different from the other in terms of size, exposure and layout: from two rooms to large family suites and twin-level penthouses. All apartments are equipped with eco-friendly construction solutions and plants that can be easily adapted to individual needs. The following façade materials were used: concrete panels and natural wood panels (conglomerate).

In the plan of the settlement used the classic Italian layout of the courtyard of housing. The complex of 5 residential buildings is located around the perimeter of an open courtyard connecting the north with the park. The inner courtyard is deprived of car transport (underground parking), with greenery as a social space.

Also, the development of the recreational area is aimed at isolating the inhabitants from wheeled transport, allowing active leisure and fun in the center of a large city. From both new buildings, you can see the historic buildings of Milan as well as from the streets. The new development creates a coherent whole with already existing buildings. This complex received the Italian CENED C + energy certificate.



a)

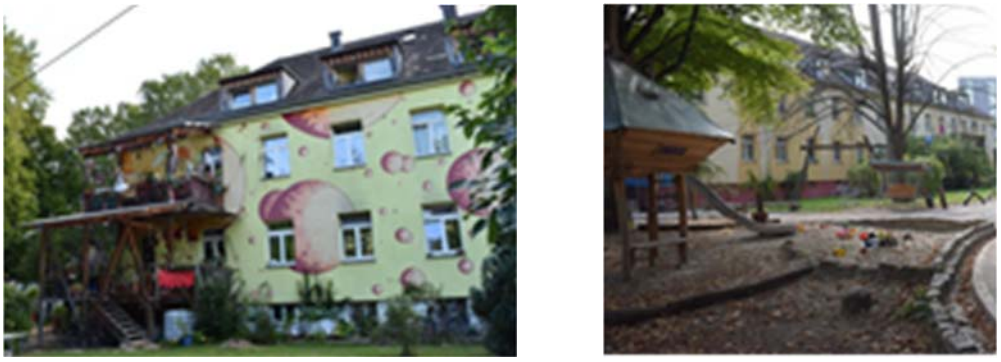
b)

Figure 5 a) City Life Residences in Milan's historic district Milanese, Italy, Proj. Daniel Liebeskind Architects (2013); b) Façade detail; A. Gumińska, 2015

7. Modernized buildings

"*We make the world we want*" [4, Disch R., Plus energie haus] - is the direction in shaping architecture in Vauban, Freiburg im Breisgau, Germany. Example of transformation with active participation of residents since 1993 Former military barracks of 38 hectares for a residential complex with no traffic, with public transport with preferred low-carbon, passive and energy + homes.

The houses are passive and Energy +, naturally shaped green areas, houses without cellars (limited to the traffic), limited traffic (mainly public transport, cycling, garages outside the settlements), small community communities (typical Habitat) Frequent use of photovoltaic panels, naturally developed playgrounds for children, use of natural building materials, also from recycled to small architecture.



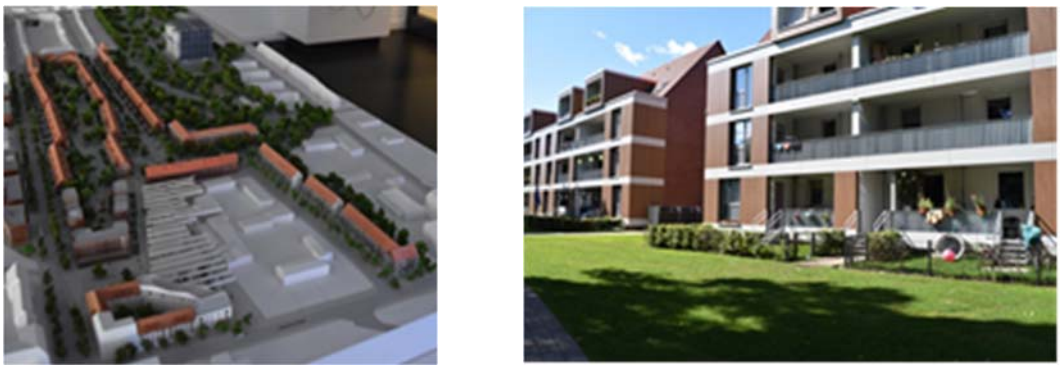
a) b)

Figure 6 a) The transformation of the former military barracks, ecological and energy-efficient construction, Vauban, Freiburg, Germany (proj. Rolf Dish, 2008), modernized facility; b) Playground; A. Gumińska, 2015.

Another example of the revitalization of existing buildings and historical space, including energy efficiency, is the Weltquartier housing development in Wilhelmsburg, Hamburg, Germany, IBA Hamburg (Kunst + Herbert, Hamburg, 2006- 2013).

Residents (ethnic minorities) participated in the revitalization of their neighbourhood, adapted to their needs the buildings and spaces between them, creating places for fun, recreation and work.

Many elements in line with environmental trends, such as small gardens, playgrounds, interior prosocial courtyards, built balconies, windbreaks, thermal insulation of buildings (passive house standard, zero carbon dioxide emissions), transformations of dwellings. Despite the increase in heating costs, the primary energy demand of buildings has declined considerably from 300 to 9 kWh / m2 per year (energy savings of approx. € 0.40 / m2). The old bunker was converted into an Energy Bunker solar collector, with a boiler room inside.



a) b)

Figure 7 a) Welt Quartier residential area in Wilhelmsburg, Hamburg, Germany, IBA Hamburg revitalization (Kunst + Herbert project, Hamburg, 2006 - 2013), complex model (Dark red, new buildings, bright red - modernized existing Buildings), energy bunker; b) New supplemental facilities upgraded existing buildings; A. Gumińska, 2015.

8. Conclusions

Pro-ecological social awareness, the state of the environment, legal regulations point to the need for environmentally friendly materials and technologies in the construction industry. These directions reflect the way in which the architecture of both the newly created and the modernized one is shaped. An important factor influencing the reception of space is the way of entering into the context of existing development and correlation with existing space.

Selected examples show great possibilities of adapting various types of objects to both environmental requirements and problems related to aesthetics, cultural heritage. They are not a replica of already existing buildings, but they introduce a new aesthetic and technological quality to previously degraded spaces.

In the historical context, it is difficult to preserve the identity of the place, the cultural heritage of space.

However, it is possible to use (as in the examples given) appropriate natural finishing materials, colours in harmony with the existing environment, dimensions of objects similar to historical buildings, interesting structures and layout of new buildings taking into account ecological conditions and also referring to the context of the environment in which they arise.

Also by skillfully placing technical elements of equipment such as car parks, terraces, ventilation systems, heating, IT, etc., recreation space, playground for children near the houses, on a scale adapted for social acceptance (e.g. size of Habitats) it is possible to enter New development into existing space. An important element of urban space is also its compensation (building correlation with the environment, [7]) which influences the quality of space and reception by users.

Thus, it is possible to preserve the identity of the place, though transformed, with variable aesthetics but user-friendly, inhabitants, preserving the cultural and social continuity of space and architecture, and the high quality of this space.

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