Spatial Voids: Potential Areas for Sustainable Housing in Extreme Metropolis Conditions

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Abstract: The article is devoted to identifying innovative methods of adapting uncomfortable urban spaces for life. Along with the traditional methods of filling urban voids, new sustainable concepts for the use of empty spaces are emerging, involving progressive building and resource-saving technologies. Based on the analysis of a number of modern concepts and implemented projects, the places of potential placement of architectural objects in empty areas of the urban fabric were identified. These include sites near transport highways, areas of dense contemporary and historical development, blind planes of building facades. The applied constructive solutions are revealed: stationary, metabolic, temporary. The research materials can be used for further developments in the field of adapting uncomfortable areas in urban fabric for new sustainable construction.

1 INTRODUCTION

The conditions of contemporary metropolis form an extreme environment that affects the nature of the new architecture. The components of the urban environment that contribute to the emergence of extreme conditions are highways, areas of constrained development, post-industrial sites, abandoned buildings and quarters, and city dumps.

However, despite the obvious inconvenience to life, these areas provide hidden resources for additional housing. In recent studies, urban voids are considered as the base for implementation of the "green urban development" strategy on the example of Seoul, South Korea and become the place for the advanced technologies introduction (Lee, Hwang, Lee, 2015). Emptiness is considered as a positive platform for the emergence of new meanings through architecture (Repina, Kursova, 2022).

The potential of *interstitial* space also lies in going beyond established urban life scenarios and forming new ones (Steele, Keys, 2015; Sokolova, Alexandrova, 2019). In Bhaskaran (2018) study, 'pocket' spaces have the potential to fulfill a public function in the city's fabric and are subsequently divided into *reserve*, *remnant* and *defunct*. Voids can be occupied by objects of culture and art, contain information and advertising (Krasheninnikov, 2015).

Increasing urbanization is fueling migration to metropolitan areas: it is predicted that the world's population will reach 9.7 billion in 2050, 68% of whom will be living in cities (United Nations, 2018). Within the process of urban growth, there is an increase in the agglomeration's territory, densification of the central development, the formation of reserved enclaves of national communities, inevitably creating extreme living conditions (Lazareva, Lazarev, 2020). In contemporary architectural practice, new projects dedicated to the adaptation of uncomfortable urban spaces for life are emerging.

This type of development is closest to the concept of *affordable housing*, designed to rapidly accommodate the vulnerable segments of the population: the homeless, refugees, low-income families, elderly (Davis, 1995). Over the past 40 years, the architectural community has been in prolific contact with municipal authorities to create a favorable and accessible living environment. This is evidenced by the emergence of such high-profile

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projects as Villa Verde Housing by Alejandro Aravena (2013), Star Apartments by Michael Maltzan Architecture (2014) Sugar Hill Development in Harlem by Adjaye Associates (2014) and many more (Fishman, 2018).

At the urban planning level, the creation of affordable and comfortable living environments based on degraded urban areas is associated with the concept of *gentrification*. This process has become widespread in the largest cities of North America, Canada and Europe (Maschaykh, 2015). In Russia, gentrification is mainly associated with the regeneration of the former factory territories. These post-industrial districts in the center of metropolis have strategic territorial value and are attractive in terms of future investment (Ptichnikova, Antufeev, 2022).

Currently, soft regeneration of territories with the inclusion of high-tech housing components that use the potential of energy-saving technologies is becoming widespread (Saprykina, 2020).

2 SOCIOECONOMIC BACKGROUND AND RELATED APPROACHES

According to The Global Risks Report 2023 (World Economic Forum, 2023), the most significant current threat is the *cost-of-living crisis*, which includes rising housing costs. Energy prices in 2023 increased by 46% compared to 2022. Rising inflation, growing mortgage rates and accommodation rents are leading to discontent among the most vulnerable groups of the population. These groups are forced to rent housing at increased prices, limiting themselves to essential goods, which leads to an increase in general social dissatisfaction and ultimately provokes political instability.

In this regard, new economical types of housing will be needed to contribute to the existing infrastructure. In addition to reducing the cost of construction for these types of housing, it is necessary to provide alternative energy systems that will help overcome the potential crisis in the cost of electricity.

The nearest concepts combating this problem are affordable mobile dwellings capable of free movement. Mobile homes have become widespread around the world, especially in the United States, where about 18 million people use mobile homes (Sullivan, 2018). In recent years, mobile homes have gone from being a low-income home to high-tech housing equipped with advanced systems (Saprykina, 2022).

A related approach is the organization of shelters for refugees. Such structures were designed to be transformable and capable of rapid relocation to affected areas (Kizilova, 2023). Currently, there is increased attention to advancing the comfort of such dwellings in order to ensure fast adaptation and inclusion of migrants in social life. Approaches to the organization of temporary refugee living modules are being rethought with the involvement of minimum needed measures for microclimate control in order to extend the use of shelters (Fosas et al., 2018).

This study analyzes new approaches to the use of urban inconveniences, which are affected by adverse factors.

3 NON-OBVIOUS SPATIAL RESERVES OF THE CITIES

Transport routes and dense urban development are unfavorable extreme factors that stimulate the search for creative solutions in architecture.

3.1 Potential of Space Near Transport Routes

The residential building, designed by Hiroshi Kikuchi Architects in Tokyo in 2009, is located in extreme proximity to the railroad tracks and is designed on a complex trapezoidal site (Figure 1). The façade of the house, facing the highway, has the minimum required glass area, while the courtyard inner façade is designed more open. Interior decoration is made using light materials (natural unpainted wood, white plaster) interspersed with color accents. The house has three floors, on the ground floor there is a combined living-dining-kitchen area.

Figure 1: “Oiz House” by Hiroshi Kikuchi Architects. Source: https://www.archdaily.com/779850/oiz-house-

hiroshi-kikuchi-architects?ad_medium=widget&ad_name=category-houses-article-show.

However, in addition to conservative solutions, new radical ones are emerging, such as the project “Heart of the District” by ZA Architects, presented as part of the architectural competition in 2012. The building is suspended above the roadway and fixed between the building facades (Figure 2). The project introduces a new type of hotel with public facilities (laundry, restaurant, gym, beauty salon, exhibition space and shop) open both to tourists and citizens to encourage social integration and interaction.

The suspended part is a community center from which paths diverge to hotel rooms located in the unused areas of historical buildings and offices. Thus, visitors are placed in close proximity to the citizens and can watch the life of the city from the inside.

Figure 2: “Heart of the District Project” by ZA Architects. Source: https://www.archdaily.com/281045/heart-of-the-district-competition-entry-za-architects?ad_medium=gallery.

The building can be included in the system of transport routes, while maintaining full mobility. In the project “Small House on Tracks” by T. Zablotny and P. Maszota, individual houses move along the unused railroad tracks of a shipyard. Thus, the gentrification of the former industrial zone in the historical center of Gdansk is being carried out.

The house is modular and has dimensions of 1.5 x 2.1 x 2.5 m. The structure is based on a steel frame sheathed with plywood wall panels. Each module has a bathroom combined with a shower, a kitchen and a place for work and rest. The interior is equipped with built-in furniture that can be folded into the walls, giving residents the freedom to organize the interior space.

A similar option for organizing modular housing on the site of historical railway tracks was proposed by the Jagnefalt Milton studio for Andalsnes in Norway in 2010.

With the help of the Midjourney artificial intelligence service, architect S. Patel developed a project for capsule dwellings placed under bridges and intended for the homeless. Each cell is designed autonomous, access to them is carried out by scaffolding (Figure 3).

Figure 3: “Pods Underneath Bridges for Homeless Communities” by Shail Patel. Source: https://www.designboom.com/architecture/self-contained-living-pods-vacant-lots-bridges-homelessness-shail-patel-03-20-23/.

3.2 Incorporation into an Existing Dense Development

Historic urban development is uneven and includes voids of partially collapsed buildings that can be filled with interspersed new architectural pieces.

The People's Architecture Office designed the “Plug-In House” in Shangwei Village (Shenzhen, China), located on the shell of a collapsed apartment building that suffered roof damage. This incorporation was a quick and cost-effective solution compared to new construction. “Plug-In House” conserves the historical part of the building, preventing further destruction (Figure 4).

Figure 4: “Plug-In House” by People’s Architecture Office. Source: https://www.designboom.com/architecture/peoples-architecture-office-shangwei-village-plugin-house-shenzhen-china-11-22-2018/.

For ultra-dense urban development, James Law Cybertecture developed the “OPod Tube Housing” modular cylindrical capsules in 2018. The diameter of the cylinder base is 2.5 m, the house area is 9.29 m^2. Economic housing is designed for low-income people and accommodates unused urban voids (Figure 5).

A life-size prototype capsule house has now been implemented. The glass front panel is used as a door and window. The capsule is equipped with built-in linear light sources. Interior decoration is made in light colors. At the rear of the cylindrical module there is a compartment for the bathroom. It is assumed that this type of housing will be used by residents for 1-2 years before moving to a more spacious apartment.

Figure 5: “OPod Tube Housing” by James Law Cybertecture. Source: https://www.dezeen.com/2018/03/16/movie-james-law-cybertecture-opod-tube-housing-micro-homes-water-pipes-video/.

The incorporation of new formations can be painless for historical tissue if temporary structures are used. Thus, in the “Sway” project by Sack and Reicher + Muller architectural collective, shelter-tents on a flexible frame were installed on the roofs of buildings (Figure 6).

Figure 6: “Sway” temporary installation by Sack and Reicher + Muller. Source: https://www.designboom.com/architecture/sway-pavilion-tel-aviv-scaf-sack-and-reicher-muller-eyal-zur-fugitive-structures-08-28-2015/.

Similar tents made of reflective photographic panels were proposed in the “Pop-Up Habitat” project by People's Architecture Office for placement in extreme metropolis conditions: on the roofs of buildings, dead-end streets, under transport routes.

Project “Illuminate Paris!” proposes the installation of temporary mobile shelters made of fabric under the metro bridges of the city. The multifunctional use of fabric cylinders is supposed. They can serve as a temporary accommodation for the homeless and refugees, as well as for holding street festivals or creating additional playgrounds for children (Figure 7).

The bamboo tube construction allows for the formation of a flexible, deployable web of translucent polypropylene.

Figure 7: “Illuminate Paris!” by 1week1project. Source: https://www.designboom.com/architecture/mobile-

lanterns-transform-paris-public-spaces-multifunctional-platforms-1week1project-04-27-2018/.

3.3 Existing Facade as a Canvas

The design of new formations on existing facades forms the postmodern direction of "parasitic architecture", which was a reaction to the over-densification of the urban fabric (Bardzinska-Bonenberg, 2017). In such a case, the new structures take on the character of the replaced ones and continue the ideas proposed by the metabolist architects of the 20th century (Pernice, 2022).

Studio Farmlab proposed the project "Homed" for the resettlement of the homeless in capsules attached to the city facades of New York. A structure in the form of scaffolding is installed on the blind parts of the existing building facades, supporting hexagonal residential modules from the inside (Figure 8). Smart glazing of side elevations of the modules is supposed to be used as a media facade for showing projections.

Each capsule is designed for one person. The interiors of the capsule are clad in light wood, and the multifunctional furniture is 3D printed using a biodegradable polymer. The outer shell of the module is sheathed in aluminum. Typical modules have different layout options: an individual set with a working and sleeping place; shower room with wardrobe shared by 2 persons; coworking block with 2 workspaces.

Figure 8: "Homed" by Farmlab. Source: https://www.dezeen.com/2017/11/21/homed-famlab-parasitic-hexagonal-pods-new-york-homeless-shelters/.

4 DISCUSSION

The study identified the following sustainable approaches to urban void filling:

- Building new structures in close proximity to transport routes, including spaces above, below, between highways;
- *Plug-in* placement, embedding in the historical urban fabric;
- Installation of new architecture on unused blind facades of buildings.

Modern inclusions provide the following design solutions:

- Stationary;
- Replaceable (metabolic);
- Temporary.

5 CONCLUSION

Methods for eliminating non-working voids in the urban fabric, arising from exposure to extreme components of the metropolitan environment, continue to be enriched.

Existing conservative approaches are spreading along with emerging progressive ones that offer a new perspective on urban inconveniences. They form new scenarios of urban interconnections as well as introduce state-of-the-art technologies to metropolis communities.

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