Green Spice for the Megacity and Urbanization

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Abstract. The project novelty of the world's urban development trends is associated with new approaches to the organization of the modern human life environment. Issues of integrated development of territories with the organization of different types of public spaces in the natural environment are solved at different urban planning levels. Residential and office clusters with new forms of socio-cultural and recreational scenarios represent a modern design in which objects do not have visible borders between nature, architecture and the human environment. This is a new type of hybridization of a building with an environment where nature and technology, education and entertainment, history and modernity combine and complement each other. On the other hand, increasing risks on the planet from floods, hurricanes, fires and droughts force specialists to adapt to these changes and learn how to control them through new design technologies. Therefore, the emergence of "hybrid objects, blocks and spaces" is not accidental and is associated with a change in perceptions about the level of environmental sustainability and comfort of living for people of different ages and social status in large cities. Depending on the social order and location in different parts of the city, hybrid facilities have a strong impact on environmental change when using green building technologies and offer citizens a variety of activities in a harmonized environment. They have a powerful scientific resource in working on the aesthetics and ecology of the city, as their typological structure affects the indicators of environmental sustainability by forming a new green and blue infrastructure of the city. Due to the high interest of specialists, hybrid objects and spaces deserve careful study, as they affect not only the quality of the urban environment when using the tools and technologies of architecture, landscape and design, but also the issues of urban management and climate change in the near future.

1. Introduction
The terms "hybrid space", "hybrid object", and "hybrid quarter" [23] have not been studied in Russia. The emergence of new terminology without revealing the scientific novelty of such objects, as well as their impact on the sustainable development of territories with design features in the Northern countries, makes it difficult to integrate new technologies, including green ones, into our Russian cities. The scientific literature already discusses the integration of architecture and nature through structures and surfaces [12], the preservation of natural components and areas of nature in the structure of urban areas [14, 4, 15] on the principles of sustainability [5], urban regeneration [1]. Issues of sustainable development of territories are considered from the point of view of landscape design and reconstruction of different types of urban spaces [8, 9, 13] based on the principles of sustainable urbanism [7], renovation of residential areas in the contour of water areas [2] with different types of
Therefore, it is necessary to search for a scientific method not only for describing the typological structure of hybrid objects, but also for a new model of urban development, where the building structure and components of the urban landscape are means of identity and sustainability of the environment in different parts of the city [9, 10, 11]. It should be added that increasing risks on the planet from floods, hurricanes, fires and droughts force specialists to adapt to these changes, learn to control them through new design technologies [6, 16, 17]. In these conditions, the term "Blue-Green infrastructure" (BGI) of cities begins to work in a new way, shifting the focus to the socio-cultural scenario of the development of spaces in a natural sustainable environment. Due to new social, economic and environmental challenges on the planet, it is necessary to take a fresh look at the processes of hybridization of buildings with the environment through new green technologies. The goal is the sustainable development of territories over time and in the interests of future generations. Therefore, the topic of this article is of interest to a wide range of professionals.

2. Methods

The purpose of this work is to understand the experience of the world practice of designing hybrid objects and determine their typological characteristics depending on the social order and placement in the urban fabric. The research objectives include determining the typological characteristics and ways of hybridization between: building design and technologies, landscape and technologies, and building, landscape and technologies. The research is based on the identification of patterns of placement of hybrid objects of different typological structures and their impact on the green and blue infrastructure (BGI) in different parts of the city, its stability. The analytical approach involves comparison with similar objects both in the world and in Russia for further forecasting and development of hybrid models in our cities. Hybrid objects where the architecture and landscape, including the social scenario of the space and the economic profitability of the object, are transformed both individually with changes in typological characteristics, and are integrated with sustainable components of nature by technological means. It is necessary to divide the studied projects by the dominant feature into architectural ones where the main carrier of changes is the shape, shell and construction of the building, and urban planning ones – in them, the typology of the landscape plays a special role in the integration between the landscape and technologies. In the second group, hybrid objects with different forms of relief profiling are of great interest: from areas with elevations and depressions to the absence of changes in the terrain. The latter option offers a wide range of possibilities for using part of the construction debris in the formation of the hill body as an example of introducing environmental technologies at the landscape level. Artificial landforms change the visual and aesthetic characteristics of the environment, scale the space, and help create a new recreational scenario. For a comprehensive study of interest is the new theory and the evolution of the mechanism of hybridization, using components of different nature with "blue and green" technology first, at the level of architectural object, then only landscape change ecological characteristics and aesthetic qualities of the urban environment.

As a result of urban planning and landscape planning in the XXI century, the most interesting group of objects covers the integration between architecture and landscape by means of aesthetic eco-technologies in order to obtain hybrid multifunctional architectural and landscape objects with new scenarios for the development of the urban fabric and indicators of environmental sustainability against various urban risks. Modern examples of this theory are the architectural and landscape projects such as Hangzhou Cloud Town Exhibition Center (Hangzhou, China) [6], Semaphore by Vincent Callebaut architects [6], Sota-School of the Arts [5] and shopping center “Orchard Central” (Singapore, Singapore), as well as Potsdamer Platz (Berlin, Germany) and Kampung Admiralty (Singapore, Singapore) [5] and many others. The presented examples are interesting for specialists and comprehensive scientific study in terms of indicators of the new hybrid architecture and eco-sustainable landscape.
Hybridization of properties between building design and technologies. The first group of architectural objects is characterized by BGI solutions depending on the way of integrating natural components on horizontal and vertical surfaces: roof landscaping – the project Hangzhou Cloud Town Exhibition Center (Hangzhou, China), the external green facade and balconies – the projects Oasia Hotel (Singapore) [5] and Semaphore by Vincent Callebaut architects, as well as the internal green component – the project Sota – School of the Arts (Singapore), collecting rainwater from the building surfaces and filtering it at different levels as part of the social design of the environment on the site - the project of Shopping center “Orchard Central” (Singapore). Most of the presented green technologies have long been successfully mastered in cities with different climatic conditions, including those with a harsh climate, such as in Finland. First of all, we are talking about green roof structures with different types of use and high indicators of improving environmental sustainability at the site and in its surroundings. It is the design of the exploited and non-exploited roofs that allows the primary collection and distribution of rainwater (typology of blue and green building infrastructure) on the surface with its subsequent filtration at different levels of the object, moving and using the volume of water to maintain the created landscape (table 1). Examples with vertical integration of natural components suggest changing the structure of a building for mounting different types of frames with vertical landscaping and creating external and internal niches in order to integrate trees and shrubs of different sizes and diameters of the crown.

Table 1. Typological architectural solutions depending on the method of integration of natural components

| TYPE | INTEGRATION OF NATURAL COMPONENTS | BGI architecture SOLUTIONS |
|------|----------------------------------|----------------------------|
| SCALE OF THE STRUCTURE – SEQUENCE OF RAINWATER COLLECTION | Hangzhou Cloud Town Exhibition Center (Китай) (<www.archdaily.com>) | Green roof |
| | Oasia Hotel, Singapore (photo by author) | External green facade |
Semaphore by Vincent Callebaut Architectures ([www.archdaily.com](http://www.archdaily.com))

**Green balconies and the geoplastics (artificial elevation change)**

| Semaphore by Vincent Callebaut Architectures ([www.archdaily.com](http://www.archdaily.com)) | Green balconies and the geoplastics (artificial elevation change) |
| Sota – School of the Arts, Singapore (photo by author) | Internal greenery |
| Shopping center “Orchard Central”– Singapore (photo by author) | Rainwater collection and filtration |

In-depth analysis of the presented examples of changing the structure of a building, its vertical and horizontal surfaces for different types of integration of nature components and rainwater collection based on environmental technologies, there is an understanding of a new typological feature of blue and green infrastructure - the typology of blue and green building infrastructure (GBI-A, where A Is Architecture). GBI-A is an additional part of the General definition of BGI, based primarily on the components of the natural blue and green infrastructure, water characteristics, and landscape of a particular place. The more typological architectural solutions, depending on how the natural components are integrated (the typology of the blue and green building infrastructure), are integrated into the building structure, plus part of the landscape on the approach to the building, the higher the overall BGI indicators of the specific location.

So, all objects of GBI-A have high potential to improve aesthetics and environmental quality targeted urban areas, especially the historic center, setting new social and environmental scenario of the Central part of the city with the topographic elements of green architecture.
Hybridization of properties between landscape and technologies. If at the next stage we consider the urban context at the level of the city landscape, then the second group of objects may include projects in which landscape sustainability, recreation, and a new socio-cultural scenario are also given increased attention. However, the landscape in them does not act as a "field for compositional decoration", but as the main typological unit of the urban fabric that can, with the support of the latest green design technologies, return the urban environment not only to a state of ecological balance, but also support sustainable urban development of territories for many decades to come with a special multifunctional scenario in the organization of public spaces. So for the second group of objects is characteristic of BGI solutions, depending on the typology of the landscape and selected environmental technologies [2]: urban bio-reservoirs – project of Boulogne-Billancourt (Paris, France), urban gardens – the example of the project Potsdamer Platz (Berlin, Germany), urban trees in the system to filter rainwater, and open channels for movement of rainwater to the Assembly–project of Banker Boulogne (Paris, France), rainwater harvesting and storage volume of the water reuse project of the Bill & Melinda Gates Foundation Campus (Seattle, USA) [7].

The presented examples clearly demonstrate technological techniques for collecting, distributing, and transporting rainwater, as well as step-by-step filtration of surface water, which creates a whole series of different scenarios for the ecological development of the territory, including social adaptation of the technological idea of recreating a natural biotope as part of a public space with different functions (table 2).

Table 2. Landscape Typology depending on selected environmental technologies

| TYPE | OPPORTUNITIES FOR INTEGRATING ENVIRONMENTAL TECHNOLOGIES | BGI landscape SOLUTIONS |
|------|---------------------------------------------------------|-------------------------|
| THE LANDSCAPE LEVEL IS A SEQUENCE OF RAINWATER HARVESTING | The residential quarter of Boulogne-Billancourt – Paris, France (photo by author) | Urban bio-reservoirs |
| | | |
| | Potsdamer Platz – Berlin, Germany (photo by V. A. Nefedov) | City garden |
When analyzing the presented examples of landscape typology, depending on the selected environmental technologies, there is also an understanding of a new typological feature of the blue and green infrastructure - the typology of the blue and green infrastructure of the landscape (GBI-L, where L is the landscape). GBI-L is an additional part of the General term BGI, when technologies are integrated with the components of the natural blue and green infrastructure, water and landscape characteristics of a particular place to restore the natural ecosystem and fill it with components of the second "man-made nature" to imitate natural biotopes. This is a very interesting scientific and project work not only with the biotope of the site, but also with water – rain, surface and underground – with the global goal of restoring the balance of the natural environment in areas of the urban fabric with the possibility of resisting environmental disasters and climate changes. Therefore, all GBI-L objects have a high potential to improve the environmental quality of the environment where there is a reserve of territories (vacant lots, in the near contour of natural territories, plots of post-industrial zones), setting a new social scenario for development in the middle and peripheral parts of the city.
3. Results
Unfortunately, only natural characteristics and water areas, although they are the typological basis for the analysis, subsequent maintenance and development of blue and green infrastructure, but today only the natural basis of the landscape as an urban ecosystem or part of it "does not cope" with the problems of urbanization, urban growth, population migration and climate change. The landscape needs to be supported by new environmental technologies and urban design directions in order to preserve natural areas and recreate the components of the "second" nature with modern scenarios of social, cultural and economic life. Therefore, a third group of hybrid objects appears, where properties and typological characteristics are hybridized in three directions between the building, landscape and technology.

Hybridization of properties and typological characteristics between a building, landscape and technology. The emergence of a landscape with hybridization of properties between its typology, socio-cultural scenario and construction technologies is associated with a new type of objects with public spaces that provide stability to the urban environment, interesting social life of a person in the city, as well as the return of natural biotopes to the urban fabric for recreation, leisure and climate risk management. In world practice, there is a tendency not just to return nature to cities, but to create a natural landscape, following the principles of humanistic architecture and environmental design. This approach implies focused work with the natural biotope of the selected urban area, deep knowledge and understanding of the dynamics of the development of green components, or work with artificial bases to simulate natural diversity (table 3).

| Table 3. Buildings’ integration with the typology of artificial and natural landscape |
|---|---|---|
| TYPE | OPPORTUNITIES FOR INTEGRATING ENVIRONMENTAL TECHNOLOGIES | BGI A+L SOLUTIONS |
| Buildings’ integration with the typology of artificial and natural landscape | I GROUP – LANDSCAPE LEVEL | }

![Triumphal Square – Moscow, Russia (photo by author)](image)

Integration in the near contour
| I GROUP | Natural biotope for medium and long distance availability |
|---------|-------------------------------------------------------|
| Park am Nordbahnhof – Berlin, Germany (photo by author) |

| II GROUP | Integration of the transport object with the urban landscape |
|----------|-------------------------------------------------------------|
| Bogota's Bicentenario Park - [www.archdaily.com](http://www.archdaily.com) |

| II GROUP | Integration of the transport object with the urban landscape |
|----------|-------------------------------------------------------------|
| Covers Brooklyn Highway in Landscaped Waterfront Park - [www.archdaily.com](http://www.archdaily.com) |

| II GROUP | HYBRID URBAN SPACE - Multipurpose architectural and landscape object |
|----------|---------------------------------------------------------------------|
| Zaryadye park – Moscow, Russia (photo by author) on an artificial basis |

**II GROUP – THE ARTIFICIAL BASE**
4. Discussion
The analysis of modern world design practice allows us to draw the first conclusions that there is a hybridization of functions and social development scenarios in new urban development projects, a shift towards the design of sustainable architectural and landscape objects that have a compact or dispersed effect on changing the quality characteristics of the urban environment with environmental priorities. Three groups of hybrid objects have a great potential for use in different parts of the city.

5. Conclusions
For an urban center with a shortage of territories, it is important to use hybrid objects of the first group with the addition of frames for vertical gardening to green roofs. This technique, using frames both with the building and independently in the near availability loop, will allow you to compactly change the aesthetic and environmental characteristics of the environment and scale the space on the approach to the building. The second and third groups of hybrid objects support the middle and peripheral parts of the city by their typological characteristics and methods of interaction of the building with the environment.

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At the current stage of urban planning forecasting and design, it is safe to say that the "typology" of blue and green BGI infrastructure has changed under the influence of new green construction technologies that mimic natural processes. Hybrid objects and spaces integrate natural areas and the "artificial" environment in their structure, recreated as components of the "second nature" by means of modern green technologies both in the construction of the building and in the surrounding landscape. Therefore, in the typological structure of such objects, there is an integration between architecture and landscape, modern technologies and planning characteristics of territories.

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