Perspectives of green infrastructure in the city’s color design-code

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Abstract. Green infrastructure can influence the coding of urban space. The second stage of urban planning design is based on technological solutions that make it possible to obtain an urban biotope. That is, a biotope with imitation of natural processes and colour implementation. The colour appears from the history of the place, and carries social-semiotic features into the renewed urban environment. Stormwater is also used in urban biotope, passes through the territory, is preserved and diverted to a man-made biotope with a conceptual load, especially in the architectural environment. Thus, an interdisciplinary approach is used, combining architecture, city planning, urban environment and landscape design.

1 Interdisciplinary cooperation for urban environment design

An urgent problem of cities is the development of the spatial environment of human habitation in accordance with sustainability. To ensure sustainable long-term development of the urban environment, it is necessary to use green infrastructure (hereinafter – GI), which will help to improve the quality of life in it with minimal means. The implementation of GI should be carried out at all levels of design. In our article, we will consider in more detail GI as a distinctive feature in the visual perception of the urban environment.

The design of the environment in the ordinary meaning is a kind of decoration, the placement of benches along the street and the arrangement of exits for strollers near the intersections. But design should be a powerful tool for improving the urban environment. For this, the design of the environment must be understood as the organization of life processes (from people to plants) through the pulsation of spatial structures, which will be performed by architectural methods and urban planning techniques.

Creating an urban environment is a complex, versatile, unusual kind of creativity, so it is natural to use an interdisciplinary approach for this process. The design of the environment is located between architecture and urban planning. This is evident from the very structure of the city. Let’s consider the spheres of specialists’ activity in these three areas (Fig. 1). The diagram shows that all three specialties are related to the components of sustainable development of the urban environment: social development and integration, sustainable economic growth, protection and rational use of the environment.

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Fig. 1. Spheres of expert activity in environmental design, urban planning and architecture.

The sphere of architecture, urban planning and settlement is considered as one of the projections of the socio-political, economic and socio-cultural entire, as well as a tool for managing the future, managing urbanization.

The management of urbanization processes is a complex dynamic system that includes a managed system (city planning, agglomerations and other planning systems) and a management system (project, scheme, design process, area of knowledge).

The main feature of the urbanized system, which determines the need for its allocation as an independent system object, is its large inertia, and therefore a large time horizon. This feature is determined not only by the long service life of buildings and structures, but also by the fact that various elements of the planning structure arise at different times on a steadily preserved main frame.

A specialist in urban planning is responsible for this framework. He has an interdisciplinary set of knowledge and skills necessary to ensure the development of urban and non-urbanized territories. This is the I level of design with a general layout of the territory, setting out functions and places for them. Creating the spatial environment in the city according to the planned functions is the task of an architecture specialist. This is the II level of design, with methods for its creation.

Fig. 2. An interdisciplinary approach to creating an urban environment.
The third level of design consists in the further organization of life processes in the city. This is a task for an urban environment design specialist who determines the users of spaces, chooses the assets for the highest-quality implementation of environmental interaction between objects of an artificial environment that conveys the place’s spirit (Fig. 2).

2 Place’s spirit. Visual perception of the urban environment

What is the "place’s spirit"? If we turn to an explanatory dictionary, we can distinguish two meanings of this phrase. The first is "in accordance with something", the second is consciousness, thinking, mental abilities; the beginning that determines behavior, actions [5]. "Place" – arises from the act of creativity and residence, as a result of which an idea of the order of the universe, the harmony of the world (Table 1). Based on the analysis of literature, it can be concluded that the main components of the concept of "place’s spirit" are: landscape, man, architecture and history (Fig. 3).

Table 1. Analysis of the literature on the topic "components of the place’s spirit".

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<thead>
<tr>
<th>Author</th>
<th>Christian Norberg-Schultz</th>
<th>Kevin Lynch</th>
<th>John Ormsby Symonds</th>
<th>Christopher Day</th>
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<td>architectural forms</td>
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Thus, the "spirit of the place" is the basis for the development of architecture and cultural uniqueness of the populated area. This peculiarity helps to "identify" the place, residents feel at home, and also attracts tourists.

Fig. 3. Components of the place's spirit.
The place’s spirit is inseparable from the visual image of the city, because the city does not exist by itself for a person: all objects of urban space exist as elements of events significant to him and as elements of the citizens’ life world. The visual environment has a character that gives signification and meaning to the visual fragments of the city.

Since the visual image of the city is formed mainly on the basis of the architectural environment, it makes sense to consider its perception. Architecture is the main environment of citizens and becomes a support in reading information. The perception of architecture also depends on the perception of the natural landscape it placed in.

The process of visual perception decodes the signs and colors expressed in objects. Consequently, the construction of a visual image is the process of isolating individual fragments of reality, giving them meaning, ordering, and detecting invariants of form.

Another aspect of the architectural environment perception is a kind of aesthetic activity, which is expressed in the city perception as an aesthetic value, accompanied by aesthetic experience. Aesthetic perception is influenced by a person's life experience, taste and value orientations. The artistic and figurative aspect of the city perception that complements it is the process of comprehending composition and artistic form, and through them — figurative expressiveness due to the "place's spirit" and "completeness of the environment appearance".

Thus, the "spirit of the place" is a long-term phenomenon created over centuries. It contains the original meaning, which should be preserved in architecture and transmitted to the future. A necessary condition for the existence of the phenomenon of the "spirit of place" is the spiritual filling of space in order to evoke emotions and feelings in a person.

Architectural environment city perception occurs from different planes of space, and the most familiar position for human perception of the city - the level of human eyes, when passing. Consequently, the perception of the city and its center, as an integral visual environment, is determined by the structure of traffic along the main roadways.

3 Green infrastructure as a new city's visual environment

Green infrastructure (GI) should be used to decipher urban space in the design code system. The need to introduce design codes has become apparent simultaneously with the growing popularity of ergonomic and beautiful public spaces. The main elements of the design code are a palette of colors and subordination to a specific logic.

It is also a tool for the formation of an interconnected stylistically unified comfortable and safe architectural and artistic environment of the city, which includes the external surfaces of buildings, urban landscape, elements of navigation, information and advertising on the territory of the city.

The first stage of implementation is to determine the location of the GI in the city. Urban space in the conditions of the dominance of linear highways needs "pulsation" in the context of the "spirit of the place". Usually, green spaces in the city are remnants of nature after urbanization. GI will not only increase the number of trees on the streets, but also transform their appearance. The color of the plants will help in this. Consideration of the seasonality of blooming, color and size of plants, together with their transpiration characteristics, will become a distinctive feature of every highway in the city.

That is, a man-made biotope with imitation of natural processes and color-dimensional embodiment of the place's spirit will manage stormwater and enhance the identity of the city's architectural environment (Fig. 4). The color arises from the history of each place and brings socio-semiotic features to the updated urban environment. The second stage of urban planning design is based on technological solutions that allow obtaining an urban biotope. The technological method that ensures the viability of plants depends on the location of the GI elements.
Fig. 4. Authors' project proposal for the mounting of man-made biotopes.

Permeable coatings are an important addition to bioremediation technologies. Such paving allows precipitation to pass vertically through solid surfaces, which reduces stormwater runoff, improves water quality by filtering pollutants in the subsurface layers and helps restore the natural hydrological balance in the territory by replenishing groundwater reserves. Permeable pavement surfaces usually include penetrable concrete, porous asphalt and paving stones.

Permeable pavement is commonly used on roads, trails and parking lots where light vehicles move, as well as sidewalks and driveways in residential neighborhoods. Permeable coatings are designed to replace impermeable areas, and not to drain storm water from other impermeable surfaces. The use of this method should be part of the overall stormwater management system and should not replace other methods.

The authors propose to use several variants of storm water systems, which will provide comprehensive protection of buildings and open areas from excess water. Line-rain drainage and point-storm drainage – are designed to solve various problems (Fig. 5). The first type of drainage is needed to remove excess precipitation, the second – for a large volume of stormwater. These two systems do not exclude each other, but complement each other and are mounted together from polymer materials. The throughput of pipelines made of polymer materials, other things being equal, is higher than the throughput of pipes made of other materials (concrete, steel, etc.) due to lower roughness. When designing them, it is necessary to provide additional load on the collector.

Fig. 5. Technological mounting of permeable coatings in the parking lot and pedestrian zone with authors' project proposal for the mounting of stormwater systems.

4 Color design-city code

Let's consider a territorial example of visual perception of urban space. Since 2021, a phased improvement of Leninsky Prospekt and Vernadsky Avenue has been carried out in Moscow.
These are main streets with bicycle and pedestrian traffic, a large number of cars and public transport. The width of the streets within the boundaries of the red lines ranges from 40 m to 100 m. However, the changes did not affect engineering communications and additional parking spaces for cars, due to which stormwater is managed in the world urban planning practice.

According to design solutions and field surveys, it turned out that the dividing strip with vegetation is above the road level, and this solution prevents the collection of rainwater in areas of green spaces, since there is no organized drain. There are about 90% of impenetrable territories in the area under consideration, which is why water flows do not accumulate in green areas, but go into the storm drain.

Also, during the field survey, special attention was paid to the visual perception of the street. The wires that spoiled the aesthetic appearance were removed underground into special pipes in the process of landscaping. Unfortunately, the location of underground utilities is not known for sure, which may also make it difficult to introduce elements of green infrastructure into the operated city's linear structure facilities.

The carried out landscaping did not affect the design of the urban environment in any way. Holly-leaved maples and spiraea, which were planted on the dividing strips, did not increase the recognition of the avenues studied. The same plants are growing all over the city. It was this condition that became fundamental when choosing a place to conduct research.

The avenues chosen for the study are named after V.I. Vernadsky and V.I. Lenin. They are well-known outstanding personalities of their time, who made an invaluable contribution to the science and development of the Russian state.

V.I. Vernadsky is a Russian naturalist and philosopher, who developed several ideas at the same time. First of all, it is the idea of time. Time is a universal characteristic and manifests itself in absolutely all spheres, but in different ways. Another idea concerns the problem of cosmic life and "acquires significance not only for the scientist, but also for the philosopher, and for every educated person."

In our perception, the romantic shade of outer space is most often located in the blue-blue color palette. For us, the sky is a manifestation of the cosmos with a great variety of shades beyond verbal description, from turquoise and emerald to dark blue and purple depths. The color of time is actually the color of movement, and the faster an object moves, the hotter it is, which means red and the slower it is, the closer it is to purple.

V. I. Lenin is a Russian political and public figure, revolutionary, creator of the first socialist state in history. As the main organizer and leader of the October Revolution of 1917, V.I. Lenin "painted" it red, after which the Red Star became considered a symbol of the future, of moving forward.

Thus, adjacent and intersecting highways have a similar place's spirit in the historical aspect, landscape, architectural development of the Soviet era. Let's express this in a new color design code (Table 2).

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Table 2. Authors’ color design-city code.
**Fig. 6.** Authors’ example of color design city-code in Moscow.
The authors also propose to cover the sidewalk with permeable materials and apply a slope of 1% to divert stormwater into the projected drainage systems. Line-rain drainage along the entire border of the roadway and green spaces will capture most of the precipitation.

To increase the speed of drainage, small slopes of green spaces will be created, which will additionally absorb the excess of stormwater overflowing through the grid. Thus, the sidewalk will be dry, and excess rain surface water can be accumulated by green components: from lawn and compositions of cereals and meadow crops to arrays of shrubs and trees with different attitudes to flooding. The result of color design city-code in Moscow is shown in Figure 6. The streets have become more pleasant to perceive due to the color filling with plants and permeable coatings. The environmental sustainability of the urban environment has also increased with new social scenarios for the use of streets have been added in accordance with the place’s spirit.

5 Conclusions

Thus, in our study, when analysing the territory, we can conclude that dry biotope will take over the load of storm water absorption for an unsettled territory. The article presents a man-made dry biotope with decorative plants according to the type of natural landscape. By copying the structure of a natural biotope, stormwater will pass through the territory, be preserved and diverted by a man-made biotope, which also carries a color load in the architectural environment of the city. Thus, an interdisciplinary approach is used, combining architecture, urban planning, urban environment and landscape design.

References

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