Landscape and Ecological Formation of Hybrid Spaces at Revitalization of Postindustrial Landscape of the Volgograd Embankment

N V Ivanova¹, O A Ganzha², V V Prokopenko³

¹Institute of architecture and construction, Volgograd State Technical University, 28 Lenin Avenue, 400005, Volgograd, Russia
²Institute of architecture and construction, Volgograd State Technical University, 28 Lenin Avenue, 400005, Volgograd, Russia
³Institute of architecture and construction, Volgograd State Technical University, 28 Lenin Avenue, 400005, Volgograd, Russia

E-mail: ivanovaninav@mail.ru

Abstract. The landscape and ecological model of civil engineering of hybrid spaces of coastal landscape aimed at providing comfort of vital environment, creation of the greatest possible variety of city activities, permission of environmental, social problems of the city and development of the embankment as self-valuable fragment of well-planned natural landscape will be proved. Research objective is development of methodical bases of the organization of hybrid spaces in the course of architectural revitalization of post-industrial river landscape in the concept of architectural and ecological approaches of development of hybrid spaces of the urban environment. In work the method of the system analysis is used; review of design practice, scientific research and help and normative sources; modeling and experimental design. The analysis of construction of civil objects in coastal strip of the Volga River and their ekologo-esthetic influence on development of public spaces of the city is carried out. Architectural concepts on integration of the socially oriented environment with hybrid spaces of the embankment are presented to city life of Volgograd. The analysis of experience of revitalization of industrial coastal areas has allowed to offer the landscape and ecological principles of design, "tree of properties" with definition of indicator of environmental quality, types and the sequence of stages of formation of hybrid spaces in landscape of the embankment of the city. The developed technique of civil engineering of hybrid spaces allows to use the received offers in domestic and foreign construction in similar environment and town-planning context of revitalization of post-industrial coastal landscapes. Experimental design was supported by the developed model of civil engineering of hybrid spaces of coastal zone of Volgograd.

1. Introduction
Historically it developed that waterways were always city-forming natural component, were used as means of transport communication. The urban areas located near the rivers form prirechny spaces which during the different historical periods had various functionality. In researches it is noted that
prirechny territories of XIX - the first half of the 20th century were considered in most cases as of little use for construction because of seasonal flooding, inaccessibility and were peripheral zones of the city. At the beginning of the 21st century there is reconsideration of requirements to functionality of these spaces, their value is noted and the social role of ecological and esthetic functions increases. Local construction of large housing, business, public and recreational estates is carried out in prirechny territories [1] now. Revitalization of coastal territories, creation of space-planning complexes, systems of public spaces, emergence of hybrid spaces it is necessary to consider in aspect of their landscape ecological organization. Creation of new embankments on site of post-industrial territories is widely applied in the theory and world practice of architectural activity.

2. Problem definition
Research objective is development of methodical bases of the organization of hybrid spaces in the course of architectural revitalization of post-industrial river landscape in the concept of architectural and ecological approaches of development of hybrid spaces of the urban environment.

In the course of revitalization integrated approach for the purpose of preservation of originality, authenticity, identity and historical resources of the urban environment is used [3]. Extent of change of the urban environment in the course of revitalization depends on degree of value of historical and cultural objects [4,5]. Revitalization of city spaces is connected with carrying out reconstruction of objects and emergence of absolutely new objects of different functional purpose which change visual appearance of the city.

In many river Russian cities reconstruction of industrial territories is one of the main directions of development of urban areas. The invalid industrial enterprises are located along the coastline on hundreds of hectares that allows to plan functionally building (to increase distance between residential buildings, to allocate spaces under parks, boulevards and recreational zones, to place all necessary infrastructure facilities and to provide communication with water object). The plants which are historically located along the Volga River (exit to water for the organization of cargo transportation, use of large amount of water for technical needs) became example of the developed enterprises.

3. Theoretical part
The territory of the city has the linear form of planning structure. As the principal planning axis serves the river, urban development is located strips parallel to the principal planning axis. Extent of Volgograd makes more than 90 km along the Volga River. When forming planning structure of the city the natural axis of the river defines orientation of all street network in relation to the river: the direction of the trunk longitudinal mains and formation of cross streets - "exits" on the embankment, to the river [2]. Many sites of the coastal territory are occupied with the operating industrial productions, built up with private households, connected with ravine and beam network of the city, have steep gradient. The city developed along the Volga River without observance of certain system: alternation of sites for industrial purposes and residential quarters.

In 1952 the reconstruction directed to the organization in the Central district of public space between the city and water with giving of the embankment of the smart appearance is complete (the author the national architect of the USSR V. Simbirtsev).

The coastal territory of the city is extended on distance more than 80 km along Volga, has different functional zones: inhabited, green areas, public, recreational, economic and industrial.

The choice of practical decisions on landscape ecologically arrangement of coastal territories depends on the mode of their use. At the same time irrespective of condition of water object and the territory of natural and territorial complex adjoining to it the main requirement to its rehabilitation is performance of the following conditions: maximum preservation of effect of biocorridor and maintenance of ecosystem. The principles of the functional organization of the coastal territory are:

- functional zoning of coastal territories is conducted taking into account their location in structure on the basis of the offered models and on condition of preservation of priority of recreational function proceeding from loading and the value of coastal landscape;
the nature of placement of functions decides by remoteness of coastal territories from intersecting line of the water surface on land surface;

- zoning of coastal territories depends on character of the water area and space interrelation with the city and its environment;

- development of coastal territories is based on the principles of continuity, multilevelness, uniformity of distribution of functions.

- for coastal zones of each type (central, median, peripheral) the approximate balance of territories of inhabited, public and recreational assignment is established [11].

In the last decades emergence in the modern urban environment of hybrid spaces is noted. Construction of constructions of "the mixed use" became world trend for the last twenty years. Advantages of such "functional hybrids" it is possible to call bigger variety of typology of building, increase in its density, formation of more compact city morphotypes creating conditions for development pedestrian and the cycle movements. Examples of city "functional hybrids" are the trade malls, lofts, office parks, complexes combining housing and jobs, housing and hotel apartments, housing and commercial functions, offices, maintenance entities and other variations [12]. Crossing of different structures - natural (landscape) and artificial (urbanistic elements) - has led to the birth of the new direction in town-planning practice - "landscape urbanism" [13]. Numerous hybrid spaces in the context of landscape urbanism have arisen in the different cities - in Spain (zone Madrid Rio, Madrid), China (the park in the coastal territory of Shanghai) Russia (Zaryadye’s park, Moscow).

Hybridization of space and planning structure of the post-industrial, broken, degrading or inefficiently used territories of the cities is one of the urgent directions in town-planning regeneration of the cities [14]. It is not necessary to neglect ecological component in development of high-growth new forms of spaces. The environmental quality of hybrid spaces has to be defined by set of indicators: convenience, multifunctionality, esthetics, environmental friendliness, it characterizes it as the comfortable and available environment.

In the context of landscape urbanism authors [14] have considered structural model which allows to establish "symbiosis of landscape, architecture, art and urbanism", to carry out decomposition of its structural elements and to reveal factors in formation of hybrid spaces in planning structure of the city: ekologo-town-planning and ekologo-esthetic (figure 1).

![Figure 1. Structural model of formation of hybrid space [3] taking into account ekologo-town-planning and ekologo-esthetic factors of the environment.](image)
For evaluating quality of the environment the multi-level hierarchical structure of the properties characterizing quality of the estimated territory - “tree of properties” is constructed (figure 2) which shows interrelation between difficult and simple properties of object. One of aspects of town-planning approach to landscape is the research of its state in the urban environment. The urban environment of life represents combination of artificially created elements and living conditions, cultural environment and elements of the nature. At implementation of ekologo-town-planning assessment of territory of the city at different stages of town-planning design, it is necessary to establish achievement of performance of its functional sanitary and hygienic and esthetic functions. The method of expert evaluations allowing to establish values of coefficients of ponderability for indicators of the properties entering tree is used.

**Figure 2.** Hierarchical structure - “tree of properties”, allowing to carry out environmental quality assessment.

### 4. Practical importance, offers and results of implementations, results of pilot researches

Important action for the organization of new planning structure of embankments of Volgograd was making decision on reconstruction of the coastal territory in Voroshilovsky district, conclusion of rooms of industrial productions out of limits of city line and enhancement of the environment. The site of reconstruction is located in the territory of the former cargo river port and here is planned to create administrative business premises of modern Volgograd. The main objectives of complex development and the concept of development of the territory became: formation of new image of the embankment which could define the strategy of development for the urban environment; identification volume and space and the architectural planning solutions combining high functionality, economic and power efficiency; development of the main thoroughfare along the river as systems of multipurpose communications (the route of city value, promenade, bicycle tracks, parkings). [6, p. 113].

Arrangement of the post-industrial territory of the former cargo port of Volgograd will make state of environment better, promotes reduction of negative anthropogenous impacts; activates functionality of the urbanized spaces, will provide formation of esthetic view of river territories; implementation of the developed strategy will promote also increase in availability of the territory to handicapped groups of the population, the figure 3 [7, p. 119].
Figure 3. Design offer of social and space reconstruction of landscape of the former cargo port of Volgograd.

As a result of design the principles of formation of the harmonious urban environment of territories of the former cargo port are developed for balance of different functions of space (the business public administrative region, housing areas, the equipped embankment and sites of visual and direct contact with the river) [9]:

- ensuring communication of coastal territories with the existing large objects of natural complex of the city and design of uniform system of steady gardening of urban areas;
- divisions of the coastal territory into sites with different functional purpose with design of adaptive green plantings and composition communications with the water area;
- recovery of zones of open visual access to water;
- use of opportunities of man-made and natural relief of coastal landscape for formation of recreation areas, devices of the built-in buildings [10, 8, p. 1009].

The project has carried out the main objective: to integrate the territory of the former industrial hub allocated for reconstruction on the Volga River under development of socially oriented landscape into city life; to create the greatest possible variety of city activities in this territory; design to ensure ecological security of the environment and water space of Volga[15-17](Figure 4).

Figure 4. Model of civil engineering of hybrid spaces of coastal zone of Volgograd.
5. Conclusion
The analysis of experience of revitalization of industrial coastal areas has allowed to offer the landscape and ecological principles of design, "tree of properties" with definition of indicator of environmental quality, types and the sequence of stages of formation of hybrid spaces in landscape of the embankment of the city [18-20].

The developed technique of civil engineering of hybrid spaces allows to use the received offers in domestic and foreign construction in similar environment and town-planning context of revitalization of post-industrial coastal landscapes.

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