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The principles of sustainable development of architectural space of the Temernik River embankment in Rostov-on-Don

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Abstract. The problem of sustainable development of embankments is multifaceted and complex. The article formulates the principles of sustainable development of the architectural environment of the embankment of the Temernik River in Rostov-on-Don. The authors of the article suggest a systematic approach to the organization of the environment in the project to create the embankment of the Temernik River to solve environmental problems in Rostov-on-Don.

1. Introduction

Embankments in Russia appear recreation carrying capacity, which is not fully used. There is no functional development of a territory and waterside improvement, by that having negative impact on city-planning on the whole. A coastline in Russia is 65 thousand kilometers long. Embankments are space-occupying complexes, which occupy urban areas, related to urban development and river- and marine areas. Any site development in coastal territories is of short duration because of man-made and natural factors. Being the objects, which have geographical, ecological, economic and social components, coastal territories are to be in-depth studied in order to ensure sustainable development of their capacity [1].

Urban recreation zones of embankments have very important significance. It is arrangement of urban recreation zones, favorable microclimate, and fall in atmospheric temperature that is especially important for hot districts. The general problems for many cities are as follows: intensive urbanization process and development of coastal territories; expansion of transport infrastructure, loss of natural factors and landscape diversity of coastal stripes and water areas; levelling of architectural and landscape unicity, water levelling; loss of continuity in space development of urban environment; inaccessibility and neglected state of coastal territories; undeveloped territorial and functional resources, insufficient quantity of public spaces, recreation, tourism, physical training and sport, education, creative industries; loss of historic traditions, undervaluation of modern opportunities to bring water areas to urban life; lack of strategies and innovative methods of complex transformation and development of coastal territories within city-planning [1–4].

2. The existing state of the Temernik River in the city of Rostov-on-Don

The conducted researches show, that except for the above-mentioned problems there are serious ecological problems in Rostov-on-Don. As the result of surface water bodies monitoring, carried by Rostov antiplague institute, V. Cholerae O1 was found in the body of the Temernik River, near botanic garden in 2014. This water body was admitted dangerous, as a reservoir and infection

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transmission factor. That is why special preventive activities are needed in order to stop circulation of toxicogenic clones in the water body. The results of long-term biological testing data in the body of the Temernik River confirm that the toxic level of the river is referred to the 4–5th toxicity class, which is ranked as extra- and extremely toxic; and ecological status as poly- and hyper-toxic [5–7].

Silting of the body of the Temernik River significantly reduced its drainage property, by that contaminating groundwater in the vast territory and making groundwater useless for public water supply and domestic water supply. Discharge capacity of the body results in urban area underflooding in low rainfall flood with flood flow of 40–50 meters per second. In more heavy rainfall flood there is real damage of surplus activated sludge to contaminate the Don River. It might cause ecological disaster in the Gulf of Taganrog of Azov Sea [5–7].

3. Results of experimental design

Taking the above-mentioned into consideration, there are enhancement approaches in the Temernik River basin, integration of coastal territories in a functional planning urban structure and arrangement of park and recreation zone offered. In order to integrate coastal territories in a functional planning urban structure, a complex approach considering city-planning, ecological, economic and social aspects is required:

Analysis of the territory to assess current ecological state, to identify functional and specific connections; development of city-planning with regard to ecological and functional factors of the territory.

Consolidation of separated territories. Renewal of man-made frame in natural frame. Arrangement of a linear park alongside the Temernik River, local parklands, green corridors, which create a natural frame, in accordance with the approved general town-planning scheme.

Linear development. Arrangement of a single network of rivers and channels in the territory of Rostov-on-Don (arrangement of city water frame) with regard to the most problematic zones, by that contributing to widening and depth deeping of a river-bed, to its natural purification by means of flow rate increase and to ecological stability increasing. Arrangement of a single system of green planning, local parklands, green corridors, which connect the city and interact with line- and central structure (green city frame).

Implementation of control and monitoring systems, qualitative redistribution of resources in the city in order to achieve balance of nature, to prevent ecological disasters and emergencies related to man-made and natural phenomena. A drainage system: drainage of territories with high ground water table, ground water releasing with holes and arrangement of artificial channels (subterranean, surface channels) in order to minimize flooding and earth flow, to strengthen soil bearing capacity, to decrease contamination of water, lying a river-bed in underground reinforced-concrete channel (northern burial-ground). Due to such water transferring there will be possible to arrange various water bodies in existing parks and public gardens.

Development of local waste treatment plants for reclamation and filtration of ground water before flowing to the river.

With regard to analyzed schemes, approved general plan of water supply and sewerage in the city it is offered to lay holding chambers and suction hoses with shafts, with provided system of sluices, which are connected with storm-water drainage and municipal sewerage to control level of surface water, floodwater and waste water. The above-mentioned measures let surface water draining from streets and ensure discharge of sewerage systems in case of emergency (atmospheric condensation, floodwater, etc.). It shall be realized by means of using sluices, which let drain surface water to holding chambers, from where water shall be gradually (over a particular period of time) discharged to a central collector. It shall help to avoid flooding of residential areas, floods, flood flows and such consequences as resulted from a high level of atmospheric condensation in summer of 2016 in Rostov-on-Don. Such system shall also help to maintain a single water-level in the Temernik River regardless of environment conditions (falls, floods, etc.). The project provides sluices and suction hoses along the full length of the river at a pitch of 2 km.

It is also offered to process sludge deposits into agricultural fertilizer.

It is offered to use a biological module for effective and ecological water reclamation in the river.

Arrangement of linear connections with engineering and transport function. Arrangement and replenishment of transport infrastructure. Introduction of new pedestrian and recreational traffic with residential areas (transport- and communication frame of the city).

Arrangement of a lifting rale line, which let connect several urban planning areas: Voroshilovskiy, Oktaybrskiy and Leninskiy, providing citizens with a possibility to move quickly and comfortably. There shall be also a possibility to have convenient access to the main city facilities: the main railway station and the stadium 'Rostov-Arena'. A route of a lifting rale line is planned to be along the river-bed. It shall not disturb existing buildings and shall not demolish buildings and structures.

It is offered to lay an inland canal by partially using a river-bed. An inland canal is a large synthetic streamflow, which is intended for navigation of tourist boats. A process of natural river purification is quite long and complicated. The offered approach shall decide a problem of river-bed purification. There shall be water crafts, which purify the bottom of sludge deposits and clump of hazardous substances. There shall be also special activities organized to normalize biogenic substance in the river. The important fact is that an inland canal building shall not affect all areas, but leave the most plant life along the river intact, by that saving it.

Arrangement of an inland, shipping canal and a lifting rale line create transport routes, which help to unclog traffic arteries of the city and it becomes possible to organize touristic routes and circular tours in significant places, which coincide with cultural and historical frame of the city. One of the suggested tours goes through Temernitskiy ancient settlement, where there is a monument of architectural hereitage – Surb-Khach.

Arrangement of a bicycle track covered with solar batteries, which provide the park with power supply. Bicycle paths in the embankment are organized in such a way as to provide continuity of bicycle moving in the urban environment and therewith there are no obstructions to pedestrian flow. The bicycle paths are considered to be covered mainly with bright colors in order to help bicyclers to orientate better without motion speed changing.

The conditions for people with limited mobility moving are provided. Arrangement of access ramps and stairlifts with special coverage for people with limited mobility.

Embankments are crossing points of pedestrian, transportation and bicycle flows. One of the main aims was to separate and structure them. Pedestrian flow is closer to water than the other ones.

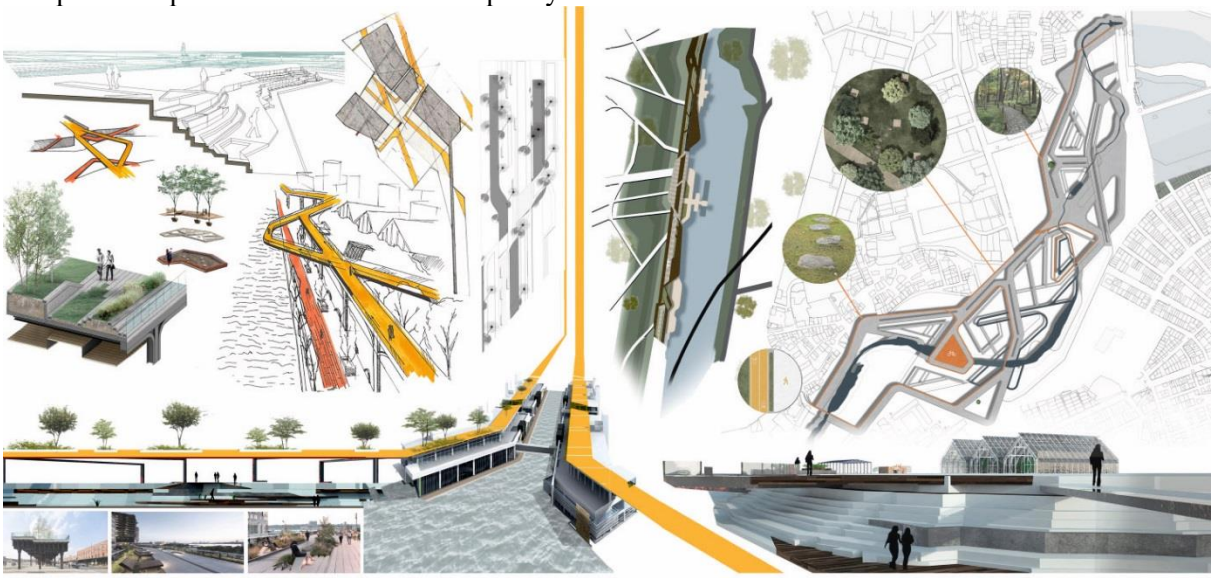
The project uses a principle of spatial continuity that is sequential and interrelated organization of coastal territories as a continuous and maximally extended linear facility in conjunction with re-arrangement and development of adjacent areas. All offered activities are aimed at deciding not only ecological, technical and real problems of the Temernik River and its improvement, but at including this territory to city-living as well. When implementing this concept we shall get the following results: the city is connected by pedestrian green corridors, a linear park of 18 km long and new parklands, which shall significantly improve air control of the city and develop microclimate in the territory of the whole river-bed.

Organization of contract public spaces with service function and public entertainment. After analyzing location of existing educational institutions it is offered to place five eco-stations, which include biotrons, amphitheatres (within the frameworks of the eco-education program), aquarium, water treatments system and open-space accessible roof on the designed site. On the low-level of the building a water-living zoo is located; it is possible to see one floor up through it, by that uniting spaces. Sports areas are also considered (sport frame of the city). It shall contribute to healthy lifestyle, gain in health and psychoemotional state of people. This territory shall be a municipal recreational area and a cultural center of Rostov-on-Don. New traffic arteries might be used as tourist trails. Based on the recommended river control system a system of surface water control system in the whole city area is offered. Providing the city with process water.

Considering the fact, that the seabed of Rostov Sea is anti-drainage it is impossible to drive piles or any other structures. The most appropriate structural solution is to use high-impact cables. It shall help

to use larger space and to redistribute streams of people, to increase variants of resting-places, to connect left and right river-banks.

Consequently, the proposed concept of development of architectural space on the Temernik River embankment in Rostov-on-Don shall help not only to improve a coastal territory, but also to solve many important problems in the city, for example, to improve ecological state of air basin and water basin, to take sporting and cultural behavior to a new level, to extend recreational areas, to solve transportation problem and to increase a quality of life on the whole.



The project to create Temernik embankment in the city of Rostov-on-Don.
The main architect of the project M. G. Sarkisyants

Except for the above-mentioned architectural, city-planning and engineering principles of sustainable development of the architectural space of the Temernik River embankment in Rostov-on-Don it is offered to use modern architectural and artful approaches to arrangement of embankment space, as follows:

To avoid using monumental spaces on the embankment and to arrange comfortable areas for resting and communicating, which are close to nature. It is achieved by using natural environment elements. For example, by combining natural and artificial forms in pitched work. To create idea of transfusion of natural and artificial environment.

When developing architectural solutions of the embankment, special attention is given to contact of a man with water and to arrangement of barrier-free environment. It is mainly related to visual contact without any visual barriers. There is no fencing, but if required natural elements instead of rock or reinforced concrete materials are used to determine boundaries [3, 8, 9].

A modular system is used for building infrastructure on the embankment. A multilevel park, raising above water, is designed within the territory of Rostov Sea [3, 8, 9].

Terraced planning of the multilevel embankment shall add theatrical elements, where urban environment is similar to a stage. An amphitheater, which might be used as cinema-hall or theater, is considered on the embankment. Moreover, body of water, floating stage and space above water might be used as a stage for special events [8, 9].

A proposed linear park is unique, as located along 18-kilometers water body, being within the city limits. Embankment is a linear space; for it not to look the same throughout, different measures are taken to avoid space monotony. For example, combination of transit promenades and leisure destinations, applying geoplastics and different planting. Color is used as one of the main spatial references along the embankment. A promenade of the embankment is considered to be paved with bright colors, combined throughout. It is considered to arrange a surface-mounted pedestrian mall and

terraced areas, located along the park, at a level of +8.000 m. To avoid space monotony significant facilities are arranged. Such facilities shall become symbols of a place. They help to organize space and create cultural continuity: preservation and restoration of historical values, carrying traditions and including historical sites to modern urban environment.

It is proposed to use expanded materials, which prevent from water evaporation and contamination of water, in the project. Natural materials, natural fabric and colors, which are traditional in this region, are used to underline perception of the architectural space as natural surroundings [8, 9].

Compositional arrangement of plantations, visual reference means, hard landscaping is used as aesthetic harmonization aimed at improvement of man visual perception of the embankment qualities. It is planned to plant different sorts of trees by that improving air basin in Rostov-on-Don. It is considered to arrange art spaces, view points, leisure areas, entertainment and leisure centers in the park.

Conservation and restoration of landscape, arrangement of wilderness areas within water protection zone and water area. The project considers conservation of ecosystem and minimum changing of coasting in the process of embankment arrangement. The paths are raised on abutment pieces by that saving natural circulation of atmospheric condensation. A partial load system is applied, when arranging plots and paths on foundation made of gabion [8, 9].

Green covered floating islands, which contribute to conservation of natural flora and fauna, shall be organized on the river. Specially selected plants and water grass are screening large volume of river water, by that purifying it of dirt and harmful elements.

Special solar protection devices, transformable shields, tents and other shelters, pergolas, roofed-in paths are considered as overheat protection. Planting, including wall gardening performs the same function. Sheltering with the designed building and elements, for example, roof projection is considered, when locating zones.

The project of city public space of the Temernik River embankment is elaborated in accordance with the requests of different subcultures and city communities. The space should be dynamically changing and adapting to changes in lifestyle of people, cultural requirements and development of IT technologies, etc.

The project takes seasonal dynamics, year-round adaptability, i.e architectural, landscape and functional organization based on year-round use, development of possibilities for various and optimal use in summer and winter periods into consideration [10, 11].

Water shall perform some functions of the embankment. It makes possible to provide more territory for the embankment, for rest and walks. The project considers arrangement of floating restaurants, floating landing stage and floating modules for swimming and slow fleet station. It is considered also to use waterborne transport as alternative to surface transport.

4. Discussion

Modern architectural concepts and engineering solutions shall emphasize the coastal zone by that making various impression and new perception of a place. Energy conservation, improvement of energy efficiency of buildings and structures in the coastal territories and use of alternative energy plants are prospective.

The Temernik River embankment and the linear park shall become modern architectural, cultural, leisure and multifunctional elements of the city, keeping historical traditions. Moreover, the park is supplied with bicycle tracks, covered with solar batteries, providing the park with power supply and decreasing operating costs.

5. Conclusion

A proposed model of complex development of the Temernik River embankment in Rostov-on-Don is based on the principles, which determine system approach to arrangement of environment. It is necessary to use interconnection of methods and approaches to development of coastal territories for harmonic inclusion of coastal territories to modern structure of the city and city life, sustainable

development of urban environment. The above-mentioned principles of sustainable development of architectural space of the Temernik River embankment in Rostov-on-Don shall let prevent imminent ecological disaster, purify the river-basin and organize a recreational zone, which conforms to ecological requirements.

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