Features of modern methods of forming embankments

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Abstract. This article analyzes the functional urban development of embankments, identifies features used in the creation of recreational forms along, and offers suggestions as to functional planning organization.

Results. The main result of the study is to identify the primary methods of organizing embankments. Modern practice, characterized by the use of new technologies and materials, attracts people with their aesthetics and unique possibilities for spending time on the embankments.

Findings. Significant results were obtained for the design process in determining characteristics of organization along the embankment zone and integration into the urban environment. A variety of opportunities for the organization of the environment were being considered to create a comfortable atmosphere. Such factors as transport accessibility and safety of pedestrians, functional location of objects, proper arrangement of lighting and landing systems, creation of a unified environment throughout the area while maintaining natural and ecological balance are taken into account.

Keywords: embankment, spatial environment, landscaping, recreation area, coastal area, public space.

1 Introduction
From ancient times, people preferred to settle near water bodies: rivers, lakes, or seas, because water is the source of life. Water bodies often move through, around or along cities, creating divisions and embankments on either side. The embankments play a great role in cities, as they are places of mass recreation. Embankments may be located in different environments, but their functional organization remains adaptive, able to be used for many functions such as a port, beach, parking place, transit zone, or recreation zone. Recreation zone organization consists of a variety of functions: viewpoints, children’s and sports grounds, information stands, pavilions, open-air cinemas, rental shops, hotels, art installations, benches, swings, carnival rides, landscape plantings and park areas. Food points could also be organized in recreational areas, to encourage extended stay.

2 Materials and methods

2.1 Stages of the formation of embankments
Urban analysis of the design area is carried out at the beginning of the coastal improvement process. During which, the design area has to be considered from the perspective of its urban planning, legal, and natural characteristics. The following parameters have been established for considering coastal areas that have to be taken into account while determining the boundaries of comprehensive landscaping plots and the composition of the optimal and minimum necessary set of landscaping elements, in order to clarify the characteristics of the plots: coatings, small architectural forms, non-capital objects, etc. Each of these characteristics determines the parameters for considering embankments, establishing differences and specificities of each type of coastal area and formulating requirements for the comprehensive improvement [1].

Comfort and safety of coastal areas are provided by:
– creating conditions for residents’ everyday rest;
– building a cycling infrastructure with safe and well-coordinated cyclist and pedestrian connections;
– creating an accessible environment for people with limited mobility, including not only people with disabilities but also children, parents with baby carriages and other groups of people who have difficulty moving in an urban environment;
– building sports and playgrounds, recreation zones for residents, dog walking areas, provided with waste bins, etc.

Complex improvement of embankments includes:
- organizing comfortable access to facilities located in recreational areas.
- creating integrated public spaces intended for organizing leisure and communication, arranging exhibitions, expositions, presentations and other types of activities.
- creating conditions for the temporary parking of visitors’ vehicles.
- organizing a comfortable visual environment for people’s daily short-term rest, etc. [2].

The functional purpose of the land plot, the presence of habitats and the growth of valuable natural objects, should be taken into account while carrying out landscaping work on coastal areas. Materials of natural origin should be used during the work; soil sealing and the construction of new roads outside the existing road-path network should be excluded [3].

2.2 Inclusion of embankments in the urban environment

An issue within cities is that in most cases there are no recreation and entertainment centres or walking areas, leaving the embankment territory undeveloped. As a result, people move to more developed areas. It is necessary to enliven embankments: to create parks, squares, to equip the embankments, attracting people into these areas [4].

The embankments’ functionality should satisfy the user interests of all social and age groups.

The problem of arranging embankments is becoming more and more urgent in the modern world. The embankment is the ‘face’ of the city, it emphasizes the city’s individuality, creates favourable conditions for pedestrians. The space of the embankment has the potential to be providing visual and auditory comfort, to become a place for the active and healthy recreation of residents [5].

Embarkments have always attracted various groups of residents, and these areas should be tailored to increase their interaction.

The use of new technologies and materials that attract people with their aesthetics and unique opportunities for spending time on embankments is typical of modern practice. For example, night lighting not only increases the time spent by people on the embankments, but also helps to navigate the pathways [6]. Such materials as wood, stone, concrete or asphalt may be used for embankment coating. Stylistic embankment design concepts should be created only after the right choice of colours and textures of materials has been made [7]. Landscape harmony and both interior and exterior of surrounding buildings should be considered while designing. Long-lasting materials, suitable for coastal environments, requiring minimal maintenance are desirable. Wood can be used in small architectural forms, different types of seats and benches, canopies and pergolas [8].

Small architectural forms do not look like independent objects in modern space scenarios, they can be included in the scenario of the environment, merging with nature. The scale of the embankment is also worth taking into account. For example, the area of buildings, structures, and car parks on the embankments within small cities should be limited [9].

Awnings should be installed, given the seasonal weather conditions. The embankment space could be transformed into an ice rink during the winter season.

The comfort and safety of pedestrians and cyclists are one of the embankments main design criteria. The location of both rental points and bike parking needs to be considered while creating bike routes. Features of people with limited mobility also need to be taken into consideration by installing ramps with a safe slope [10].
Embankment zoning will make the area easier to navigate. For example, places for active and passive rest should be separated. Sporting areas or playgrounds should be separated from parking lots, pavilions, cafes and shops. Embankment infrastructure information points should be set in the entrance area as a meeting point.

Floating platforms as an additional output onto the water could also be implemented. This method has been successfully applied recently, creating space for outdoor cinemas or stage events during city holidays, festivals, etc.

Greenery plays a significant role in the comfortable space creation process, as it serves as a noise or visual barrier to urban exposure.

Embankments’ development is becoming more and more noticeable every year as modern materials are being used for their creation.

Harmonious space for relaxation could be created if the design choice was appropriate. If there were some disadvantages to the landscape, then the right design approach could hide them completely. Additionally, the absence of a distinct separation of traffic and pedestrian flow is clearly apparent. A shortage of sidewalks or excessive narrowness, as well as, the presence of various obstacles, restricts the movement of people. Speaking of obstacles, things such as lighting posts, public transportation stops, kiosks, and organized or spontaneous parking lots, are often found in the way of pedestrians forcing them to enter the roadway. The most blaring examples of this case are service stations placed along embankments, which can only be bypassed by stepping into the traffic lane. It is important to understand that different categories of the population have different requirements for comfort and safety. For example, the presence of bollards and fences along pedestrian paths, as well as, the absence of ramps or tactile surfaces, can be an obstacle for representatives of mobility challenged groups. The lack or absence of utilitarian lighting on the embankments is also an important problem. An integrated approach to lighting would allow the display of spatial composition, creating a safe and attractive environment in the dark.

2.3 Contemporary development

Currently, the embankments are mainly given to heavy traffic. As a result, there is a lack of social magnets and recreation areas for public events. But the need for recreational and public spaces on the embankments is extremely high. Residents’ attempts to improve coastal areas by themselves confirm this fact. But the main problem is that this leads to unattractive and unsafe playgrounds, places for walking and training dogs, and the organization of spontaneous recreation areas.

Nowadays, a lot of attention is being paid to the coastal areas’ improvement. The emphasis is shifting towards a sustainable system creation at the current stage of society’s development. Saving the balance of the natural environment is becoming a key need. Design priorities are also shifting towards creating a comfortable environment for pedestrians and cyclists. At the same time, the importance of transport and industrial functions decreases, and the recreational significance of the embankments rises to the forefront. The permeability of the areas needs to be ensured, and the connection between adjacent areas and the river improved.

Several projects implemented in the past few years serve as excellent precedents. The Crimean embankment project is a continuation of the 10-km long pedestrian and bicycle zone, originating in Vorobyevy Hills. A landscape park with transit-sports functionality replaces the highway. The area of traditional artists’ vernissage is being preserved in the specially built pavilions.

The reconstruction of Crimean embankments has completely changed the existing landscape. The movement of vehicles was withdrawn from the area and a recreation zone was created. It was created to be the logical continuation of the Pushkin embankment of Gorky Park. Comprehensive landscaping affected the entire Crimean embankment: a pedestrian network was formed, trees were planted, and small architectural forms were placed. As a result of the comprehensive landscaping, the embankment acquired a new look and became comfortable for residents. This could be seen by a large number of visitors not only on weekends, but also during weekdays.
Crimean embankment was a typical post-Soviet public space, before its reconstruction: spontaneous trade, parking, transport then eventually abandon. The design was of little use for leisurely walks or for travelling through. At the same time, the best ideas applied in park embankments in the 1930s were not forgotten during the reconstruction of embankments [21]. Creating conditions for maximizing connections between people and water was one of them. Nowadays, such modern architectural and artistic tools such as: creating tanning beaches, summer cafes and open spaces for social events are solving the problem [22]. The history of river area development shows how attitudes towards them have changed: from consumerist, when natural resources were exploited mercilessly; to creative, with an awareness of the need to preserve and create a sustainable environment that will allow these areas to be used without harming the environment and saving them for future generations [23].

![Crimean embankment before the reconstruction of 2012](image)

**Figure 1.** Crimean embankment before the reconstruction of 2012

![Crimean embankment 2013](image)

**Figure 2.** Crimean embankment 2013
3 Results and Discussion

3.1 Domestic and foreign experience

The industrial era has left an extensive negative legacy: degraded natural landscapes along coastal areas, abandoned ports, industrial buildings and structures, and the inability for people to access water bodies.

In world practice, much attention is paid to the issues of regeneration of coastal areas and the "return" of the river to residents [24]. When forming the public space of embankments, factors such as location in the urban environment, traffic flow, whether the embankment is convenient for the entire range of users, or whether it is possible to put into operation, are taken into account [25]. In order to implement an integrated approach to the improvement of coastal areas, a number of countries have developed standards for improvement.

An important component of foreign standards is the competent determination of the spatial boundaries of the embankment, which includes adjacent streets. There are specific differences in the creation of a profile in the standards for beautification within different countries, however, they are united in the pursuit and formation of public spaces that are comfortable for people [26].

The next step to designing coastal areas is to determine the set of elements used in landscaping, depending on the type of embankment. The following groups are distinguished: paving, lighting function, gardening, small architectural forms, non-stationary pavilions, etc. The requirements for coatings are the same, they must be practical, aesthetic, and meet environmental requirements that are safe for people with limited mobility. Gardening is one of the most important components for the formation of external architectural and artistic appearance of the city [27].

The objectives of developing all the studied foreign standards are to create a comfortable and safe environment, the formation of public spaces close to nature, the organization of a green corridor along the coastline, and interconnections with other areas. Standards of foreign countries are not a set of ready-made solutions for design. They determine the basic approaches and principles for the design of integrated landscaping of coastal areas [28].

The standards of improvement are based on the formation of the embankment environment and the elements of development for improving the territory are taken into account [29]. Foreign countries are based on clear zoning of transverse profiles and include requirements for a minimum set of elements.

The domestic experience of comprehensive improvement today is developing in two directions: practical and theoretical. Practical experience includes the development and implementation of integrated landscaping projects for individual territories. At the same time, many completed projects are implemented at a high level, using quality materials, but at the same time, landscaping may not meet the requirements of comfort and safety.

Comparing domestic and international experience, it can be stated that we are currently lagging in the development of standardization tools and the implementation of new approaches in the field of integrated improvement of embankments along coastal areas [30].

4 Conclusion

Currently, there is a problem with the development of landscaping embankments. Priority of coastal areas is given to vehicular transport and there is a need to improve the environment of the embankment areas for other use types. A review of the historic formation of embankment territories has shown that the function of embankments has changed through different periods. At present, social and environmental functions have gained importance, although the preservation of traditional functions is still maintained. A comfortable environment on the embankments is created by working on planning structure, design, and taking into account the flows of transport and pedestrians.

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