

Urban infrastructure of large city environments in Uzbekistan

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Abstract: Social and various high concentrations create a number of unconditional advantages. The natural and artificial components of the urban environment are increasingly converging. The process of degradation is approaching a critical point where it may spiral out of control. The biosphere becomes unmanageable. Cities are undergoing rapid transformations. A new, humanistically-oriented model is emerging. Stimulating human society in a co-evolutionary mode (joint evolution) is tied to nature. Urban development continues. Environmental degradation, therefore, transforms into a focus on sustainable urban development and ecological considerations within the concept. These arise as a result of transformations directly related to immediate needs. The role and significance of reconstructing the urban environment lead to changes in the socio-economic conditions, which, in the modern world, shape the material and spatial environment surrounding humans, reflecting its diversity and rapid changes.

1. Introduction

In the growing era, urbanization and the rapid growth of populations in large and major cities lead to the increasing complexity of human living environments in cities. According to forecasts, the majority of the world's population will live in cities. As a result, most people will spend their time in urban environments. This, in turn, will result in psychological issues and certain changes. For millennia, the natural world has provided the foundations for human life. However, despite several negative factors, the trend of urbanization as a dominant force in the development of civilization will persist. The urban environment is shaped by the influence of people's desire to work together. The city offers a unifying space. It is connected by a single living area, bounded by the masses of people and a shared rhythm of life. From this perspective, cities become attractive hubs for people, transforming into appealing localities. Gradually, the places where people live and actively

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interact dissolve personal isolation. Cities are becoming increasingly centralized information and social hubs, without which humanity cannot progress [1,4]. Socialization and various forms of high concentration have created a number of unconditional advantages. However, this also disrupts the optimal balance between types of human activities. The natural and artificial components of the urban environment are becoming increasingly intertwined. The critical threshold at which the biosphere may become unmanageable is approaching.

2. General Information

In different regions and times, ancient human societies achieved this stage of urban development. Such settlements often had relatively stratified structures. In some cases, functional differentiation of structures began to define the characteristics of the area and prompted zoning practices. Enclosed residential areas were also a widespread form of housing. The distinctive feature of these settlements is their clearly defined and often fortified boundaries. These could include embankments, ditches, walls, and other structures. At this stage of development, a living environment began to emerge. The simplest use of natural conditions involved utilizing fortified environments as the main boundaries of the settlement. Initially, conditional borders were created in the form of channels for water flow. Subsequently, complex defense systems made of stone and wood, including walls and beams, were developed. The characteristics of forming a living environment gradually changed in accordance with natural factors [2,3].

The initial criteria for shaping the urban environment included the following dimensions:

- Occupied areas with clearly defined boundaries;
- Continuously changing through the historical process of development. These boundaries began to be referred to as urban boundaries. For historical cities, gradual evolutionary changes were characteristic.

Any urban area is characterized by two main indicators:

1. A natural foundation.
2. A layout and construction created during the urban planning process.

The combination of these factors shapes the urban environment. The aim has always been to create favorable conditions for the stages of civilization's development. For the population, the urban environment was, first and foremost, designed considering human needs. Improving the state of the urban environment reflects its ongoing processes, i.e., satisfying basic human needs (utilitarian, psychophysiological, aesthetic, etc) [5]. At the same time, the world has long ceased to be exclusively urban. People now inhabit vast, continuous environments encompassing all types of settings and lifestyles, from densely populated urban centers to suburban areas, rural zones, and natural landscapes. Figure 1 illustrates how cities and villages have been designed to align with natural environments.



Fig. 1. The division of cities and villages into living systems across different zones.

One of the fundamental needs of humans is the connection to the natural environment. Therefore, a critical element of an urban area is its natural foundation. This forms the physical and geographical characteristics of any city's position. The physiographic location of a region is determined by the boundaries of natural zones and its morphological features. This includes terrain, proximity to water reservoirs, rivers, lakes, forests, and other natural elements. The primary components of a city's natural potential include the urban planning network, topography, soil characteristics, and wind patterns. It is also important to consider factors like the region's solar regime, the presence of natural green areas, water zones, and more [6].

3. Problem

The increase in population size and density, as well as the growth of settlements, has led to environmental degradation and increased epidemiological risks over wide areas. In many industrial regions, unfavorable sanitary and hygienic conditions have begun to emerge. This required the development of specific organizational methods. Functional zoning of urban areas was used to create sanitary protection zones near industrial enterprises. Initial attempts to improve city formation were linked to improving architecture and urban infrastructure.

The functional areas of a city include:

- The center;
- Residential zones;
- Industrial zones;
- Recreational areas.

This marked the first attempt to define and identify the relationships and interactions between these components. For urban architecture, it became necessary to create components for housing, work, and recreational activities. This is connected to the development of urban planning infrastructure [2]. Efforts are being made to create an urban environment. Various methods of restructuring the environment need to be considered. Such restructuring involves the creation of urban architecture and urban planning infrastructure. Urban architecture and urban planning reconstruction include infrastructure improvements. It is necessary to not only design new streets in the city but also consider surrounding areas. During the process of urban organization, medieval and ancient streets were removed in all planning directions. This new network incorporated a boulevard system that expanded around the city.

The emergence of new key services such as water supply, sewage systems, and gas lighting supported the following:

- Public transport;
- New middle-level services;
- Schools, hospitals, colleges, barracks, prisons, and additionally, public parks and forests;
- The introduction of new administrative systems for the city.

Efforts are being made to improve the quality of the urban environment. Attempts were made to introduce geometry into the planning process. However, it should be noted that the functional purpose of open architectural spaces became more diverse during the process of sustainable urban development. By the late 19th century, many historical squares became multifunctional.

As a rule, they began serving the following functions:

- Religious, administrative, business, trade, decorative, aesthetic, and more. Their architectural and artistic styles were altered in accordance with changes in the architectural design [3].

4. Objective

It should be noted that, over the course of human development, urban civilizations have become the dominant living environments. The population continues to grow. As a general trend of development and growth, cities are increasingly experiencing deteriorating living conditions [7]. Degradation disrupts the ecological balance of urbanized environments. Natural disasters and various issues related to city formation can impact the environment. From this perspective, it becomes essential to find new approaches to shaping their architecture and urban planning forms. This, in turn, requires the search for unconventional solutions to improve the functioning of complex integrated systems in urban environments. In such conditions, scientifically grounded approaches to optimization appear most feasible. These approaches integrate the systematic development of architecture, urban infrastructure, and the urban environment [8]. In areas where new perspectives on development are needed, whether due to rapid growth or stagnation, functional changes, or transportation conditions (e.g., the creation of a new tram line), the implementation must address the following:

Such changes will inevitably lead to certain transformations in the urban environment.

The following diagram illustrates solutions that integrate cities with the natural environment. Today, it would be appropriate to design cities following the structure shown in this diagram.



Fig 2. Increasing demand for the environment and architecture: Effective solutions are achieved through artistic understanding and definition. The dominance of the anthropogenic environment, coupled with ecological and aesthetic degradation and the lack of natural elements, has led to a growing desire to incorporate natural elements as much as possible into cities and villages.

Ensuring the full consideration of all aspects of inter-city relationships and the environment in construction and design is possible. This work is based on studying the urban environment as a system. Architectural and urban planning objects are considered systemic, which allows for their differentiation [11]. The surrounding reality is described as a holistic entity, relatively autonomous and constant, characterized by functional and territorial connections. Using a systemic approach not only opens up the possibility of studying the characteristics of the urban environment, but also the architectural and urban infrastructure, as well as its improvement, considering its main typological features. The approach to solving systematic-ecological urban planning issues is also discussed [5,10].

A systematic approach to improving urban formation should enrich the aesthetic potential aimed at preserving the historical foundations and development of the environment. The ecological approach allows for studying the urban environment as a system. This enables their differentiation and the identification of their subject. The ecological approach also facilitates the creation of the need to achieve this.



Fig 3. Example of reconstructing a transport-pedestrian street with a reduced width of the roadway to "calm" traffic movement: a - Street view before reconstruction; b - Street view after reconstruction.

5. Analytical method

In the major cities of Uzbekistan, nearly 1 million people reside. The structure of the urban environment in these cities follows general development patterns. Due to the pace of urbanization, new social and administrative factors in the market economy cause negative effects, leading to the development of urban planning activities. The living environment in the largest cities of Uzbekistan is steadily deteriorating. The main problem in Uzbekistan's largest cities is ecological. The high concentration of technogenic objects contributes to environmental pollution. The main sources of air pollution in cities are transportation, energy systems, and non-compliance with urban planning requirements. As a result, noise, vibrations, and electromagnetic pollution in cities are formed. Noise pollution is common in all major cities. Most of the population is susceptible to noise-related illnesses, and constant noise pollution must be prevented.



Fig 4. A city that has emerged in recent years in the largest cities of Uzbekistan as a result of functional development.

Currently, the deterioration of air quality is also dangerous for the health of the urban population. The spatial organization of the largest urban structures is most evident in cities with the lowest growth rates. The increase in the volume of housing construction, commercial enterprises (office buildings), trade, and high-efficiency entertainment complexes lead to investments in large and major cities, complicating their development. In large regional cities, the urban planning process is a systemic operational process. Instead of a well-functioning city process, the environment and the acquisition of square meters occur. Excessive congestion leads to the inevitable loss of the attractiveness of historical city centers, which are the most attractive for investment [8]. Creating green spaces, car movement, parking areas, and their relationship with profitability is confirmed by many examples in real estate. Haste in appropriation and implementation (through privatization) is unique from a business perspective. Without understanding this, through their actions, they consciously or unconsciously encourage it. Where public interests and complex urban planning issues are typically ignored in areas [9]. The permanent population of urban and rural areas in Uzbekistan is shown in the following table. The permanent population of urban and rural areas in Uzbekistan to date is shown in the following table.

6. Result

It should be emphasized that all the improvements mentioned above determine the formation of landscapes and recreational objects. Improving the urban environment and

increasing its quality are directly related to reducing the impact of factors that negatively affect the comfort requirements. For human life, it is necessary not only to preserve nature in the urban environment but also to create a system. When considering landscapes and recreational objects, it is important to take into account their ecological and aesthetic characteristics. Based on the research results, an analytical model will be developed. The need to introduce new large-scale landscape and recreational infrastructure in the city is highlighted. The reconstruction of existing landscape and recreational objects is based on the principles of forming solutions related to the environment, landscape, urban planning, and aesthetics [13]. A new approach to creating a leisure environment will help optimize landscape architecture objects. It is necessary to organize leisure time for the population of Uzbekistan. It is known that organizing optimal leisure for the population is a reflection of national wealth. It is an indicator of the prosperity and high culture of the country. It has been proven by scholars that organizing leisure activities effectively is essential [14].

Neighboring residential areas are essential for functional use. They are areas that should be separated by dense green space buffers to isolate them from noise and contact with spectators, providing short-term relaxation for older population groups. These areas are used for children and residential buildings. Public spaces in the living environment are used by people for communication and relaxation. Typically, these are green spaces located within or near residential buildings (e.g., squares, parks, fields, etc.). The natural environment of the city serves as a real foundation for personal development. In countries, the rational organization of recreational activities is marked by the well-being of society.

As of January 1, per 1,000 people

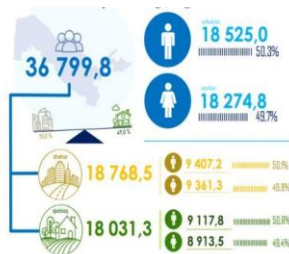


Fig 5. It is reported that as of January 1, 2024, the average population density was 82 people per square kilometer in the republic. The highest population density is in Tashkent city, Andijan, and Fergana regions, while the lowest figures are found in Navoi region and the Republic of Karakalpakstan. 40 mini

Population density dynamics As of January 1, the number of people per 1 square kilometer, in people.

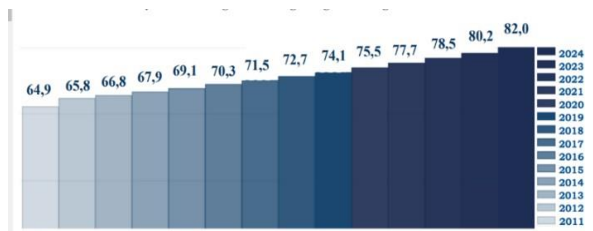


Fig 6. The region with the highest permanent population is Samarkand, with 4.2 million people residing in the region. Additionally, the population is relatively high in Fergana region with 4 million people, and in Kashkadarya region with 3.5 million people.

Large cities: There are 162 districts and 118 cities in the Republic of Uzbekistan. More than 42% of the country's population lives in cities. The largest city in Uzbekistan is the capital, Tashkent, with a population of 2.3 million people

The natural environment of Uzbekistan's major cities requires the use of urban planning solutions presented in this image for personal development.

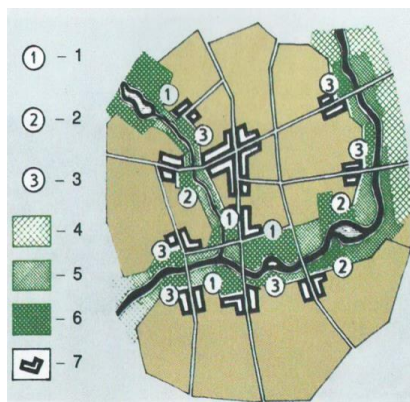


Fig 7. The natural-ecological framework of the Mogilev city area: 1 - Gardens of urban significance; 2- Gardens of planning districts; 3 - Residential parks; 4- Landscaped areas.



Fig 8. The neighboring residential area of "Novaya Borovaya" in Minsk city: 5 - Improved green spaces; 6 - Park areas; 7 - Community centers.

Therefore, the issue of organization must be resolved based on the level of relaxation of the population in the natural environment. The formation of this environment needs to be improved in all major cities of Uzbekistan, as it has several key aspects. For example, the architecture and urban infrastructure of Tashkent city are not compact enough. Due to the intensity of transport and pedestrian infrastructure, transit through the center can create an uncomfortable environment. This leads to a deterioration in the ecological indicators of the city center. Additionally, it does not include pedestrian streets and pedestrian zones in its structure. The industrial infrastructure needs to be modified because many of its objects require reconstruction due to their cessation of operations, and these should be repurposed. Residential infrastructure usually has poor ecological and aesthetic indicators, requiring extensive reconstruction. The results emphasize that the function of nature conservation is carried out by the national significance biological reserves and the national significance landscape reserves. To meet the growing tourism and recreational needs, the city should increase the variety of leisure and relaxation spaces for guests to choose from [7,15].

Recent issues in urban renewal:

The urban renewal program can be interpreted through the completely opposing views of various stakeholders. According to the current approach of the speaker, it can be structured using synonyms that carry different meanings. In Europe, large regions and cities have different responses based on their local history, societies, culture, and traditions. As for the development described above, Central and Eastern European countries express their own unique development path and specific issues regarding urban renewal.



Fig 9. Urban restoration is about creating places where people still want to be: Modern landscape and urban planning objects and complexes, consisting of ensuring ecological sustainability and improving the environment.

Green areas and water zones in cities perform a variety of functions, including environmental regulation, recreation, protection, and aesthetic purposes. The natural-ecological framework should be purposefully shaped and developed with the city's territorial growth and development: new parks, artificial water bodies, and watercourses should be created. The restoration and rehabilitation of ecologically valuable but degraded natural complexes should be ensured.

The solution for the Minsk agglomeration can be seen in Figure 9.

First and foremost, it is important to improve the connection between residential buildings and recreational and tourism areas around the city. To achieve this, linear parks, park roads, and a network of bicycle and pedestrian paths have been created, linking Minsk's residential areas with tourist and leisure zones at the shortest distances. Additionally, to distribute leisure spaces, the recreational areas around the city are interconnected. In existing cities, opportunities for forming the natural-ecological framework and territorial development are generally limited. Reserve rivers, marshes, peatlands, ravines, and other areas with complex terrain unsuitable for construction are some of the restrictions. The development should include the incorporation of ecologically-oriented residential complexes, which can be created both in historical environments and new ones [4]. This results in the uneven distribution of landscape elements in the city's structure. Overall, Uzbekistan's architecture and urban infrastructure must adequately account for spatial development needs.

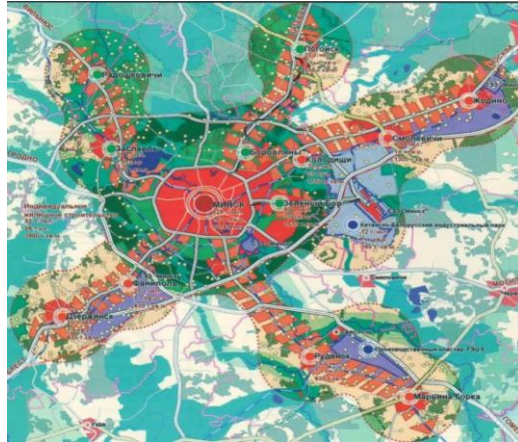


Fig-10. The placement scheme of forest parks surrounding the Minsk agglomeration (Greater Minsk).

The main directions of architecture, considering spatial factors, should address the following human needs in urban planning and infrastructure development:

- Physical-physiological and psychological aspects: The need to harmonize anthropogenic (human-made) and natural components.
- Technological environment: Creating a comfortable environment that factors in temperature, humidity, open space conditions, and the creation of a sense of security (protection from harmful elements). The environmental impact is a clear direction in both space and the surrounding environment.
- Functional-utilitarian aspects: The architecture and urban infrastructure must include essential functional blocks, in accordance with their architectural solutions, available across all types.
- Spiritual-aesthetic aspects: Aesthetic qualities expressed through positive scale and plasticity. Environmental surfaces and other elements contribute to the creation of an individual artistic vision [15].

7. Conclusion

1. In relation to the above, the improvement of urban formation in the largest cities should meet specific requirements for Uzbekistan's architecture and urban infrastructure.

2. The development of architectural formation in Uzbekistan's major cities should be carried out considering urban infrastructure. In the city, pedestrian movement is the primary mode of transport. As pedestrians, we can experience our environment without the disturbances caused by high-speed movement in cars. Only pedestrians can be in direct contact with the urban environment, thereby enriching it.

3. In this case, the "urban environment" becomes the "interior of the city." The perception of a well-developed urban area is unified. How the characteristics of the city's interior spaces are perceived largely depends on the viewer's focus. The change in the relationship toward accepting a part or the entire external or internal space brings about a distinctive task in the design process.

4. This is linked to the integrity of emotional and artistic impressions associated with the open urban space. The "perceptual basin" of the urban environment can hardly be artistically organized without using urban design tools and elements.

5. Cities are constantly evolving, with social-cultural, economic, ecological, scientific, and technological changes filling the urban environment with new meanings.

6. Modern urban planning is characterized by the ever-growing complexity of social,

industrial, transport, and engineering-technical infrastructure in cities.

7. In the 21st century, the concepts of goals and place have significantly changed. As cities evolve, the requirements for the urban environment are constantly changing.

8. Modern urban planning stands out for its humanism. For an individual, their needs must be met by the urban environment.

References

- [1] Alferov, I. A., Antonov, V. L., Lyubarsky, R. E. *Formation of the Urban Environment [Text] (Example of Kharkiv)*. Moscow: Stroyizdat, 1977. – 105 p.
- [2] Balandin, R. K., Bondarev, L. G. *Nature and Civilization*. Moscow: Mysl, 1998. – 391 p.
- [3] Voskresensky, I. N. *Harmony and Ecology: Ways of Integration. Landscape Architecture. Design.*, 2004, No. 3, pp. 66–74.
- [4] Gozak, A. P. *Compositional Problems of the Interaction Between Architecture and Natural Landscape (Example of Contemporary Architecture in Finland, Sweden, and Norway)*: Abstract of Candidate of Architecture Dissertation. Moscow, 1971. – 20 p.
- [5] Votinov, M. A. *Renovation and Humanization of Public Spaces in the Urban Environment*: Monograph. Kharkiv: Kharkiv National University of Urban Economy named after A. N. Beketov, 2015. – 153 p.
- [6] Votinov, M. A. *Formation of Urban Agglomerations in the New Socio-Economic Conditions of Ukraine. Scientific Bulletin of Construction*, Kharkiv: Kharkiv National University of Building and Architecture, 2012, No. 71, pp. 68–74.
- [7] Percik, E. N. *Geo-Urbanistics: Textbook for Higher Education Students*. Moscow: Publishing Center “Academy”, 2009. – 260 p.
- [8] Shukurov, I. S., Khatamov, A. T. *Engineering Preparation of Urban Areas*: Textbook. Tashkent: “Iqtisod-Moliya”, 2018.
- [9] Khudayberdiyev, A. *Transport and Engineering Improvement*. Textbook. Samarkand: “Turon Nashr” Publishing, 2022.
- [10] Akram, I., & Zuhra, K. (2022). Problems and Prospects of Transport Development in Samarkand. *Global Scientific Review*, 3, 19-22.
- [11] Gutnov, A. E., Lezhava, I. G. *The Future of the City*. Moscow: Stroyizdat, 1977. – 126 p.
- [12] Jencks, C. *The New Paradigm in Architecture (Translated from English)*. *Project International*, 2003, No. 5.
- [13] Denis, Z. E. *Methodology and Methods of Socio-Economic and Geographical Research*. Riga: Zinātne, 1980. – 262 p.
- [14] Zabelina, E. *Search for New Forms in Landscape Architecture*. Moscow: Arkhitektura–S, 2005. – 90 p.
- [15] Potaev, G. A. *Planning of Settlements*: Textbook. Minsk: RIPO, 2015. – 304 p.