

ABSTRACT

to the doctoral dissertation Tolegen Zhaina Zhanaikyzy on the topic «Architectural and urban planning principles of formation secure environment within smart city» for the of Doctor of Philosophy (PhD) on the educational program 8D07311 - «Architecture»

Contemporary challenges in improving the populations living standards through the usage of digital technologies, as well as creating a conditions for the transition to a fundamentally new trajectory development - the "Smart" city, are relevant for Kazakhstan. The creation of a comfortable environment and high-quality infrastructure are considered in the strategic development plans of Kazakhstan-2025, 2050 [1]. The priority of regional policy isto ensure managed urbanization, the compliance of Kazakhstan's cities with international safe city indices, and to develop in the context of the global smart citytrend. Ensuring a favorable living and living environment in the implementation of architectural, urban planning and construction activities are described in Chapter 2. Article 7. The rights of citizens to a positive environment for locality. Law of the Republic of Kazakhstan dated July 16, 2001 No. 242 About architectural, urban planning and construction activities in the Republic of Kazakhstan" [2].

Research rationale: Architectural and urban-planning principles are the key factors for the formation of a safe urban environment in the smart city system. Global urbanization and the rapid rate of growth of the urban population in the whole world intensify the relevance of the study of urban security and methods of architectural and urban planning solutions. The formation of a safe urban environment depends on various aspects. This work is devoted to the analysis of criminal, ecological, infrastructural, and seismic safety solutions by architectural methods. Review and analysis of theoretical studies revealed an interdisciplinary approach in solving the problems of criminal, environmental, infrastructure security based on the principle of "protective space". Architects, town planners, sociologists, criminologists, writers took part in the study. As a result of joint work in project activities, a number of architectural and town-planning principles of creating a safe urban environment were developed, and a new direction - crime prevention by means of ecological design (hereinafter CPTED) was developed. The criteria of this direction have proved their effectiveness until now and are considered relevant for use in the process of designing and reconstructing the environment of modern cities.

Social and economic, scientific and technical processes of society development actively influence to the organization of urban environment. The rapid spread of informational digital technologies and the imminence of the dynamic development of the smart city system around the world pose new challenges for architects, urban planners, designers and builders in the matter of creating a safe environment.

At the present stage, the concept of "smart city" has become widespread as a new dimension of using digital technologies to create a comfortable infrastructure and improve the quality of life of people in cities by creating a safe urban environment. As the main means of protection, they see the use of electronic or mechanical systems of video surveillance, access control, as well as the strengthening of building structures, etc., sometimes replacing compliance with the requirements of spatial and planning characteristics of buildings, architectural and town-planning principles of the formation of a safe urban environment, which are relegated to the background. Emphasis on the maximum use of information and technological means in the aspect of ensuring safety in the urban environment, without paying due attention to architectural and town-planning techniques, leads to large financial costs when using them. Analysis of the world experience of building new "smart cities", in which information technologies play a primary role, demonstrates high financial costs in maintenance. Therefore, new "smart cities" face the problem of solving the main task - populating the city with people. According to experts, this problem is related to the superiority of economic priorities and the lack of consideration of the potential user, context, regional features, as well as the financial capabilities of the country's citizens. Therefore, in the prospective development of "smart cities", the main criterion is the user account, the participation of citizens in the formation of a safe urban environment. One of the innovative methods of solving this problem is a digital three-dimensional model of the city. The digital three-dimensional model, which is actively developing all over the world, is a new trend in the formation of a safe urban environment and a "smart city" system. Despite the variety of terms: "digital double", "virtual double", "cyber city", the developed models have a common goal - to increase comfort qualities and ensure safety in the urban environment. The digital three-dimensional model allows you to test promising proposals for the transformation of the urban environment, the introduction of new architectural objects, design elements, etc. In the functional process of the digital three-dimensional model developed in this study, the participation of city residents, specialists of various fields is assumed: architects, designers, sociologists, criminologists, IT-specialists and many others. The choice of participation of specialists of different profiles may be different, depending on the goals, tasks, directions of research, ideas that need to be implemented or solved in the structure of the digital three-dimensional model of the city. The interdisciplinary feature and functional capabilities that allow testing scientific developments and project proposals will make the digital three-dimensional model of the city the main conductor in the development of the "smart city" system in Kazakhstan.

The concept of developing a "smart city" system, improving the quality of life in cities are relevant for Kazakhstan. At present, the population is growing in all cities and towns. This factor increases at a special tempo during the school season, in cities where a large number of higher and secondary educational institutions are concentrated. As a result, these cities are becoming the center of attraction for construction companies that are actively building residential and public buildings in these areas. Large tempo and construction amount of residential and public buildings contributes to the complication of architectural and planning solutions,

compositional perception by residents of a dynamic urban environment. This process can lead to visual discomfort, disrupt video ecology, reduce the aesthetic quality of the area and the urban environment as a whole. Particular attention is required to the issues of spotify construction and their height ratio in relation to existing buildings, this often leads to a violation of the aesthetic panorama, insolation, quality and comfort of the courtyard space of existing buildings. There are problems associated with the infrastructure of residential areas of the post-Soviet period, which until now occupy a significant part of the urban area. Unfavorable factors include the presence in the spatial solution of residential buildings of deaf, not visible ends, poor natural lighting in the entrances, the lack of comfortable public spaces, etc. This category mainly includes buildings built in the post-Soviet period and occupy a significant part of the urban area. Most of these residential properties are rented out and subject to frequent changes of tenants, which exacerbates the problems of lack of social control, creating discomfort for both residents and pedestrians.

Another important factor in substantiating the relevance of this topic is the necessity for the cities of our country to comply with international safety indices. The core of the indexes is to create maximum opportunities for walking, reducing dependence on road transport and contributing to people's daily lives. The UN in a real model of sustainable development of the city outlined the main directions of urban planning, this is the creation of an environmentally friendly and affordable urban infrastructure [3].

Therefore, the promotion of alternative architectural and urban planning visions and solutions for the formation of a safe urban environment is of particular relevance for Kazakhstan. The concept of a digital three-dimensional model developed in this paper, using architectural and urban planning principles for solving criminal, environmental, infrastructural, seismic safety, will make a significant contribution to creating comfortable conditions and improving the quality of life of Kazakhstanis in cities. And, it also contributes to the qualitative development of the "smart city" system in Kazakhstan. The main idea of the developed digital three-dimensional model is based on the concept: "protective space", "social urbanism", "smart city".

Subject of inquiry: Urban realm contextually in a safe "smart city" system

Research Question: Architectural and urban planning techniques for designing a safe urban environment, usage-based of new technologies.

Study purpose is Mastermind an architectural concept for a digit three-dimensional city model that promote a secure environment using architectural and urban planning methods and the qualitative development of a smart city system in Kazakhstan.

Research objective:

- to study and analyze theoretical and practical research on the organization of a safe urban environment;
- to identify architectural and urban planning methods for solving criminal, environmental, infrastructural, seismic, of the safety of the urban environment;
- to study and analyze the features of the architectural and planning solution of the principles of security in modern smart cities;

- to analyze the process of development of the "smart city" system in Kazakhstan;
- to study and analyze the functional features of "digital twins";
- evaluate the architectural and compositional solutions of the area and their ability to ensure criminal, environmental, infrastructural, seismic safety;
- to develop an architectural concept of a digital three-dimensional model of the city for the conditions of Kazakhstan.

Level of subject knowledge: Theoretical aspects devoted to the influence of technological progress on the formation of new trends in architecture and urban planning, as well as the aesthetics of perception: - writings of the authors where the theory of crime prevention describes and develops by means of architecture and environmental design:

Zitte K. [4], Gideon Z. [5], Lynch K. [6,7], Corbise L. [8], Gutnov A.E. [9], Glazychev V.L. [10, 11], Ikonnikov A.V. [12], Rappaport A.G. [13], Sabitov A.R. [14], Stepanov A.V., Ivanova G.I., Nechaev N.N. [15], Lezhava I.G. [16], Glazychev V.L. Goltz G.A. et al. [17], Zabelshansky GB, Minervin GB. [18], Gail Ya. [19].

Theoretical and practical studies on the design of a comfortable and safe urban environment: Jacobs D. [20], Jeffrey R. [21], Newman O. [22], Wood [23, 24], Angel E. Sh. [25], Crow T. [26], Patricia and Paul Bratingham [27], Ronald W. Clark and Patricia Mayhew [28], Polyantseva E. [29], Pomorov S.B. [30], Akhmedova A.T. [31] and others.

Analysis of ecological aspects of safety based on work: Corbusier L. [32], Aronina J. [33]. Bolshakov V.V., [34], Sadvokasova G.K. [35].

Architectural aspects of design seismic buildings: Arnold K. and Reiterman R. [36], Ishodzhanova GR [37].

The relationship between intellectual systems and architecture in the context of the "smart city" was studied by the authors: Sergio M., Sukanya K., Torsten S. [38], Sharma and Swati R., [39], Vangelis A., Elias T., Henrich C. Pöhls, Adam K., Alessandro B., [40], Uday C., Arindam B., Jenia M., and Sushobhan M. [41], Mady M., Asmaa I., Mohamed F. [42].

The scientific novelty of the research lies in the development of an architectural concept of a three-dimensional digital city model using architectural and urban planning techniques for organizing a safe environment in accordance with the context of a "smart city" for the conditions of Kazakhstan.

The personal contribution of the author of the study consists in conducting a complex architectural and compositional assessment of the security of the urban territory of the city of Almaty, in the development of an architectural concept of a digital three-dimensional model, strategies for ensuring security and algorithms for architectural and compositional solutions of urban spaces for the qualitative development of "smart cities" in Kazakhstan.

The reliability of scientific research results is confirmed by graphic presentation and scientific-practical systematization of the collected material, research of archival photo and video sources.

The methodological basis of the research is a complex approach, which includes:

- study and analysis of literary sources, project works dedicated to the design of a safe urban environment taking into account criminal, ecological, infrastructural, seismic aspects of safety;
- comparative analysis of approaches to creating a safe environment in the "smart city" system;
- theoretical analysis of the world experience of using a "digital twin" of a city as an innovative architectural and urban planning method of organizing a safe urban environment;
- mapping of urban space that does not meet the criteria of criminal, environmental, infrastructural, seismic safety;
- description of the concept and functional features of the developed digital three-dimensional model for the conditions of Kazakhstan;
- a description of the methods of interaction between citizens and a digital three-dimensional model;
- graphic modeling of algorithms of architectural and compositional decisions of the structure of buildings, courtyard spaces, streets, open spaces of the district to solve criminal, ecological, infrastructural, seismic safety aspects;
- construction of a digital three-dimensional model of the city, providing security in the environment by architectural and compositional methods.

The scientific hypothesis lies in the assertion that the three-dimensional digital model of the city is an innovative architectural method and a new platform for testing architectural and urban planning techniques that solve various security aspects in the smart city system. environment.

Research frames.

1. The study is limited to the study of architectural and town-planning methods of organizing criminal, ecological, infrastructural, and seismically safe urban environments. This work is focused on architectural and compositional solutions that influence the improvement of comfortable conditions and the formation of safety in the urban environment.

2. Chronological boundaries include research on crime prevention, means of architecture and environment design, starting from the 60s. XX century currently, including modern principles applied in the context of the "smart city".

3. Geographical boundaries make up the territory of the city of Almaty.

4. Architectural boundaries include all types of residential, public buildings and open urban spaces.

Final research paper defence is carried out:

1. A complex of analytical schemes of architectural and town-planning means solving aspects of criminal, ecological, infrastructural, seismic safety in the urban environment;

2. Analytical scheme of architectural and compositional solutions of criminal, ecological, infrastructural, seismic safety in the "smart city" system;

3. Graphic scheme of the results of the safety assessment of the architectural space of the Almaty city district;

4. Functional diagram of a digital three-dimensional model;
5. Scheme of algorithms of architectural and compositional solutions, contributing to the solution of criminal, ecological, infrastructural, seismic safety of the urban environment;

6. Graphic visualization of the architectural concept of the digital three-dimensional model, which contributes to the formation of a safe urban environment and the qualitative development of the "smart city" system in Kazakhstan.

Scholarly importance: The results obtained will expand the existing range of architectural and urban planning methods for organizing a safe urban environment, give a new impetus to the development of innovative, interdisciplinary scientific research dedicated to improving the quality of life in cities, and contribute to the qualitative development of the smart city system in Kazakhstan.

Practical significance: The results of the study can be used in the development of "digital twins" of the cities of Kazakhstan, implemented in educational programs in the areas of "Architecture", "Design", "Construction", "Criminology", "Sociology", "Ecology".

Evaluation of results: The main provisions of the dissertation were reported at the international conference indexed in the Web of Science databases:

- "Review of studying methods for the problem of safety in the urban environment", (Croatia, 2022)

Research results are published in: (14)

- according to the materials in the international conference-5;

- in the materials in the international conference - 1;

- in scientific and practical publications included in the list of recommended KOKSON, MNiVO - 4;

- in international journals - 3;

- in journals indexed in the Scopus - 2 database (Civil Engineering and Architecture, "Architecture", P 62%, CiteScore - 1, 2022; Civil Engineering and Architecture, "Architecture", P 62%, CiteScore - 1, 2023), Astra Salvensis, P 94%, 1918.

Implementation of the research results:

- published textbook: "Design of a safe urban environment", Textbook. Almaty: Publishing house "Construction and Architecture" IOC, 2020 - 81 pages (co-authored with Naizabekov N.S., Nauryzbayeva A.S.);

Scope and structure of the study: Scope and structure of the study: The thesis consists of an introduction, three parts, a conclusion, a list of references - 136 titles, the number of pages - 129 and 4 appendices.

MAIN CONTENT OF THE WORK

The first section "**Theoretical foundations of architectural and urban planning solutions for aspects of urban environment safety**" examines theoretical and practical research on the organization of a safe urban environment. The features of architectural methods for solving criminal, environmental, seismic, infrastructural security of the urban environment are analyzed.

Conclusions on the first section:

1. Theoretical studies and practical examples of the organization of a safe urban environment prove that architectural and design project methods can be moderators of people's behavior in space.

2. The interdisciplinary nature of the concept of "protective space" and the principle of crime prevention through ecological design (CPTED) have had a significant impact on the modification of spatial solutions of residential and public buildings and urban open spaces.

3. The main criteria of the principles of "protective space" are the achievement of open, flowing, natural control spaces in the architectural and planning solution. And, also an increase in density due to the organization of functional diversity, the creation of urban spaces that contribute to the expansion of the boundaries of social interaction, i.e. meetings and communication of random people.

4. Volume, height ratio of buildings allow solving environmental problems related to ventilation, insolation, temperature regulation in residential quarters. In combination with greening, they help purify the air, create a comfortable microclimate, and also increase the aesthetic value of the urban environment.

5. The creation of comfortable conditions in park and recreational city areas is based on the concept of "protective space". In this aspect, the concept of "ecology of human behavior" is considered. This concept emphasizes the importance and leading role of "ecological behavior" and social responsibility of a person in the formation of all aspects of safety.

6. The development and use of pedestrian sidewalks as a full-fledged public space where people can spend their free time will also contribute to the formation of a safe environment, including the elimination of criminal hazards.

7. The configuration of buildings, the quality of the construction works and the construction materials used have a great influence on the design of earthquake-resistant structures. Modern technologies - API and BIM have an effective effect in the design of earthquake-resistant buildings with an original visual solution.

8. Another important aspect is the influence of architectural and compositional decisions of buildings in the city system on the formation of open spaces. Open spaces or recreational areas of the city territory can be considered as reserve zones necessary for use during earthquakes or other emergency situations.

In the second part "**Modern principles in organizing a safe architectural environment in the "smart city" system**". This section examines the architectural and urban planning principles used in the "smart city" system, which contribute to the organization of criminal, environmental, infrastructural, seismic safety in the urban environment.

1. An analysis of development and implementation of the concept of "smart city" allowed to determine the widespread use of ICT. Creating a comfortable and safe environment is one of the main requirements in organization of "smart city". Architectural and urban planning solutions for the urban environment aimed at solving various aspects of security are in attendance of using digital technologies.

2. Six main criteria that define a smart city are defined: "Smart Management", "Smart People", "Smart Life", "Smart Mobility", "Smart Economy", "Smart Environment". Focus on one of these criteria allows you to define the city as "smart". The experience of building new "smart cities" is faced with the problems of settling the city, which are associated with large financial costs in maintenance (the example of Palava, Songdo).

These factors exacerbate problems of inequality, both in terms of lack of access to ICTs and the ability to live in newly built cities (example: Palava, Songdo).

3. Specialists in various areas for prospective types of "smart cities" set the task of clearly defining the direct user, consider the needs / customs of the country. The urgent issue is the need to test various innovations, the search for new ideas in creating a comfortable urban environment for a person using digital technologies. In this regard, the use of a digital three-dimensional model of the city seems to be one of the innovative methods for solving the tasks.

4. The implementation of the smart city concept in Kazakhstan is being developed in the context of the above six main smart city criteria. It is planned to create a single virtual communication space and an artificial intelligence laboratory on the basis of the Creative Industries Park.

5. The Department of Architecture and Urban Planning of Almaty has introduced a three-dimensional automated geographic information system, which includes a 3D map of the city of Almaty, as well as passports of residential and administrative buildings. Also, developed 2D-in which there is an information about the design codes of buildings, streets, as well as passports of residential, administrative buildings and their status. It is planned to develop a digital passport, which will allow you to quickly respond to emergencies.

6. However, the analysis of ensuring criminal, environmental, infrastructural, seismic security demonstrates the fragmented nature of the implementation of this task. There is no single platform that would allow for a comprehensive assessment and resolution of security aspects relevant to Kazakhstan. Especially in terms of considering the opinions of users - a civil-oriented approach.

7. The use of "digital twin" technologies confirm their effective practical and research role in urban planning in the system of smart city planning and development, considering national strategies and priorities for creating a comfortable, safe environment. A digital three-dimensional model can be an exact analogue, a "double" not only of a city, but also of individual buildings or territories.

8. Digital 3D models can be an invaluable tool in creating a safer urban environment when actively collaborating with citizens. In this context, it is necessary to carefully study the issue of participation of citizens in solving security aspects using a digital three-dimensional model.

9. The assessment of the safety of residential and public spaces on the example of the city of Almaty confirms the relevance of the issue of transforming the urban environment in accordance with the criteria of "protecting space", as the most effective method in eliminating the criminal danger by architectural means. Identified violations of insulation and ventilation of urban space. Lack of collection points during an earthquake. The study of infrastructure safety determined that pedestrian sidewalks do not meet the criteria for comfort.

In the third section «**The architectural concept of a digital three-dimensional model of a safe city for the conditions of Kazakhstan**», describes the architectural concept of a digital three-dimensional model developed for the conditions of Kazakhstan. The functional features of the developed digital three-dimensional model are revealed, algorithms of architectural and urban planning methods for solving criminal, environmental, seismic, infrastructural security of the urban environment are compiled.

Conclusions on the third section:

1. The main idea of the architectural concepts of a digital three-dimensional model for the conditions of cities in Kazakhstan is based on the concept of "protective space", "social urbanism", "smart city" and is aimed at solving problems related to aspects of criminal, environmental, infrastructural, seismic security.

2. The social significance and influence on the person of the architecture of the urban environment as a space of social connections is brought to the fore to create conditions for involving people in direct contact, emphasizes the importance of the idea that the city should be "open". The design of the urban environment as a space for human-to-human interaction, the acquisition of new cultural practices is substantiated.

3. The social aspects of the digital model are based on the creation of a safe urban environment with the participation of citizens. In the implementation of this idea, it is proposed to be based on the methods of "social urbanism", IP-spaces, "temporary urbanism", which are able to unite and rally all members of society. Another social function of the digital twin is to attract investors to improve urban voids, reconstruct and restore unfinished urban facilities, abandoned, non-residential cities of Kazakhstan.

4. The digital three-dimensional model of the city contributes to the effective solution of the criminal, environmental, infrastructural, seismic aspects of security, thanks to a function that provides a close relationship between urban architects and citizens. The organization of IP space in all residential and public buildings will increase inclusive accessibility.

5. As a result of the analysis, a scheme of algorithms for architectural and compositional solutions for creating a safe environment was drawn up for integration into the developed digital three-dimensional model of the Almaty city district. Schemes can be a guide for practicing architects and students, as well as a material for the choice of citizens. Architectural and compositional solutions are proposed for urban objects: house, yard, street.

Conclusion

The research found that the digital three-dimensional model of the city is an innovative architectural method and a new platform for testing architectural and urban planning techniques that solve various aspects of security in the smart city system. At the present stage, the digital revolution covers all areas of human activity. The widespread introduction of information and communication technologies provides comfort, increases safety and facilitates the living conditions of a person, but it also reduces the space for physical communication between people. Therefore, for specialists dealing with the problems of the city, architects, urban planners, sociologists, builders, the question of finding new ways to use digital technology tools is acute. Digital technologies should serve for human development, the creation of favorable living conditions, and not be considered as an achievement solely from the standpoint of the cost-effective functioning of the service sector, reducing the costs of maintaining the urban economy and optimizing the infrastructure of public space. It is the person who should stay in attention of concepts, plans for the development of the city and urban planning as an unconditional priority. A characteristic feature of the modern urban environment should be its social orientation. The city is a space for life, for communication, self-improvement, social interaction of all its inhabitants. Therefore, the participation of residents in the management and planning of the city is urgently needed, and it is especially important that the person uses technology, and not technology uses him.

The research also confirmed that the architectural and urban planning principles for the formation of a safe environment in the "smart" city system are at the stage of active search for conceptual, experimental, alternative means of solving the problem. The architectural concept of a three-dimensional digital city model developed in this study is able to contribute to the formation of a safe environment using architectural and urban planning methods and the qualitative development of a smart city system in Kazakhstan.

The study proposes a digital three-dimensional model as an intelligent sustainable approach to building a smart city and ensuring safety at every stage of development. This implies the use of intellectual solutions that improve the life of citizens. The digital three-dimensional model is accessible to a wide audience through open IP-spaces. Citizens can interact with the digital three-dimensional model and actively participate in the life of the city.

With the help of a digital three-dimensional model of the city, architects and urban planners can analyze the current situation, forecast the construction of new facilities and implement programs for the renovation of buildings and public spaces, cities. The ability of the developed concept of "digital twin" to integrate knowledge and methods from different branches of science stimulates the development of interdisciplinary research in Kazakhstan, as well as the attraction of foreign specialists. This theoretical concept of a three-dimensional model is presented as the main tool in urban planning, architectural and urban planning, in management, in the educational and research process of specialists of various directions. These are architects, urban planners, sociologists, criminologists, specialists in IT technologies and urban residents.

A feature of the application of digital models of three-dimensional objects is the analysis of the inclusion of completely new architectural objects in the existing context, the identification of the harmonious harmony of their spatial and visual characteristics, height ratio. This analysis is also applicable to other structures: parks, roads, water bodies. And, it is also used in the assessment of visibility, insolation of buildings and territories, the scheme of traffic flows on this site, criminal safety, in emergency situations. The advantage is the possibility of accounting for the results of public hearings and consultations and their qualitative implementation.

Thus, the 3D model of thematic research can be used as a dynamic decision-making system in the field of architecture, environment and urban planning.

Prospects for the development of scientific and practical research on the creation of a safe environment, contributing to the improvement of the quality of life in cities, are connected with the practical implementation of a three-dimensional digital model using the developed strategy for ensuring safety with architectural and town-planning methods. Further expansion of the interdisciplinary basis for the study of safety aspects with the possibility of integrating the obtained data into a three-dimensional digital model. To study architectural-compositional solutions of the empty space of the city, which is the main indicator for the organization of a well-developed and comfortable environment. And also implementation of research results in the content of educational programs for students and undergraduates in the following directions: "Architecture", "Design", "Urban Planning", "Criminology", "Sociology".

List of publications for the point of dissertation:

1. Tolegen Z., Assylbekova A., Yussupova A. et al. Stories Of Improvement Of Quality Of City Life: Architectural Aspects // Turkish Journal of Computer and Mathematics Education. – 2021. – Vol. 12, Issue 12. – P. 1158-1168.

2 Tolegen Z., Nurpeiss M., Myrzakhmetova S. et al. Agricultural Product Safety: Vertical Farm Project Concept // Turkish Journal of Computer and Mathematics Education. – 2021. – Vol. 12, Issue 11. – P. 947-950.

3 Amangeldikyzy R., Nauryzbayeva A., Tolegen Z. et al. Folk Art Crafts Of Kazakhstan: The Concept of Renovation of Industrial Buildings // Turkish Journal of Computer and Mathematics Education. – 2021. – Vol. 12, Issue 12. – P. 1169-1175.

4 Imanbayeva Zh., Trofimov V., Popov Yu., Amandykova D., “To the issue of humanization of urban spaces in Kazakhstan” // “Bulletin of KazGASA”. –Almaty, 2022. – No. 2 (84). – P.124-134

5 Imanbayeva Zh., Myrzakhmetova S., Kostsova A., Mugzhanova G., “The concept of universal interior design of public spaces in Kazakhstan // Bulletin of KazGASA”. –Almaty, 2022. – 2 (84). P.–12-18.

6 Tolegen Zh., Nauryzbayeva A., Amandykova D., «Artistic Interpretation of Public Areas: Experiences in Interior Design» // Bulletin of KazGASA”. –Almaty, 2022. –№4 (86). P. 4-10.

7 Tolegen Zh., Pomorov S.B., Isabaev G.A., "The role of a three-dimensional digital model of the city in organizing a comfortable environment Bulletin of KazGASA". –Almaty. – 2022. –No. (84). – P.123-126

8 Tolegen Z., Kaltay N., Mukhtarova A. et al. Review of studying methods for the problem of safety in the urban environment // Proceed. Internat. res.-pract. conf. «Problems of formation of a comfortable object-spatial environment of cities. Issues of architecture, construction, design». – Opatija, 2022. – P. 1-7.

9 Tolegen Z., Issabayev G., Yussupova A. et al. Architectural and Compositional Concepts of Environmentally Safe Urban Arrangement // Civil Engineering and Architecture. – 2022. – Vol. 10, Issue 3. – P. 1036-1046.

10 Tolegen Z., Usama K., Karzhaubayeva S. et al. Assessment of Safe Access to Pedestrian Infrastructure Facilities in the City of Almaty // Civil Engineering and Architecture. – 2023. – Vol. 11. – P. 351-371.

11 Tolegen Z., Moldabekov M., Koshen K. Roles of public ethnocultural spaces in Kazakhstan // Astra Salvensis. 2018. – Vol. 6, Issue 1. – P. 761-774.