

ABSTRACT

for the thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy (PhD) in the educational program 8D07311 – «Architecture» by Yuliya V. Onichshenko on the topic: «Shaping the adaptability of architecture in regional conditions»

Architecture in the process of civilization development has always served as a tool for human adaptation to the environment. Natural and climatic, socio-economic, cultural and historical conditions formed a wide variety of architectural styles, types of buildings and structures. Each stage of the society's history is marked by new architectural achievements that have become answers to the challenges of modernity through the adaptation of machinery and construction technologies, constructive and functional solutions, artistic and imaginative searches to the main task of human existence - the formation of a comfortable living environment.

Best design practice, responding to existing ones, as well as in an attempt to respond to possible future demands of society, demonstrates a number of innovative examples that change or refute the achievements of traditional architecture.

The research corresponds to the implementation of important international and state programs, including the UN Sustainable Development Goals, the Strategic Development Plan of the Republic of Kazakhstan until 2025, the Concept of Sustainable Development of the Republic of Kazakhstan for 2007-2024, etc. [1, 2]. The provisions of the dissertation research correspond to the goals and objectives of the grant scientific and technical research project for 2023-2025. AR 19680138 «Regional identity as a factor of sustainable development of architecture of independent Kazakhstan in the context of globalization» commissioned by the State Committee for Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan.

The relevance of the research.

The topic of formation of architecture adaptability to existing and newly emerging challenges is undergoing a new reflection in connection with the increasing aggressiveness of anthropogenic impact on the natural complex in the post-industrial era, when the world is faced with large-scale political, socio-economic, environmental problems.

The world of human-built objects replaces the natural environment and forms a conflict situation where the global ecosystem cannot reproduce to create favorable living conditions. Research published in 2017 notes that the volume of man-made materials (which includes building materials and structures), exceeded the volume of all living organisms on planet Earth. This alarming fact, recorded by scientists, actualizes the problem of recycling large arrays of artificial materials, since the resources of our planet are finite. And the main «suppliers» of artificial objects are architecture and construction: buildings and structures, urban neighborhoods, regional settlement systems invade the environment and create a world parallel to

the natural one.

Modern trends in the development of architecture are aimed at the formation of a sustainable world, in which the already existing artificial objects must meet the real conditions - to be as durable, environmentally justified, structurally safe and functionally acceptable as possible.

World science offers various options for solving these problems, one of which is the adaptability of architecture. The concept of «adaptation» in relation to architecture has always existed as a process of adjustment to the proposed circumstances of the terrain.

Currently, there is no general theory of adaptability of architecture, except for individual works studying fragmentary properties of adaptation, such as, for example, dynamic shaping, kinematics, interactivity and others, which confirms the need for the formation of a holistic theoretical framework.

According to the general definition of N. Negroponte and other authors, adaptability is a category of architecture that demonstrates the ability to change its form, constantly reflecting its surroundings.

The concept of «adaptability» is an interdisciplinary, integrative category, which is applied in biology, physiology, anthropology, geography, philosophy, economics, culturology, law, linguistics, cybernetics, psychology, sociology, architecture and other sciences. Having a general scientific status, the concept of «adaptability» has not yet received a clear, universally recognized definition, as usually happens when the concept is used in more than one field of knowledge.

Kazakhstan, being a part of the global system of relations in different sectors, strives to support and contribute to the study of modern methods, concepts, trends in the formation of adaptive qualities of architecture in specific natural and climatic conditions. Scientists of Kazakhstan synchronously with foreign researchers are looking for solutions to problems that have not only global but also local character, to which can be attributed the problems of adaptability of modern architecture.

Our dissertation research is a reaction to the critical situation of «overloading» the environment with environmental, technological, socio-cultural problems related to architecture and requiring the search for ways of further adaptive, consistent development of the material-spatial environment.

The boundaries of the research: temporal - cover the long process of man's adaptation of artificial environment to natural and climatic conditions - from elements of ancient traditional systems to the beginning of the XXI century; geographical - areas of human civilization development in different historical periods, including modernity, in which important processes - «triggers» of architecture development under the influence of natural, climatic and technological conditions took place. Special emphasis in the work is made on the modern territory of the Republic of Kazakhstan.

The object of the research - architecture of buildings and structures based on innovative approaches of design and construction, aiming at sustainable development and adaptation to the conditions of global transformations in the world and in the local territory.

The subject of the research - principles of adaptation of modern architecture by interpreting architectural-planning and volume-spatial solutions based on the use of advanced constructive-technical and technological achievements, as well as new artistic and figurative constructions and concepts in the conditions of Kazakhstan.

The aim of the research is to determine the adaptive capabilities of modern architecture in natural-climatic, socio-economic, cultural-historical conditions of different regions in the context of global aspirations for sustainable development in the XXI century.

In accordance with the set goal, it is necessary to solve the following main **tasks**:

- to reveal the mutual influence of anthropogenic and natural factors in architecture on the basis of studying the traditions of adaptability of architecture in historical retrospect;

- to reveal the peculiarities of architecture adaptability formation in modern conditions;

- investigate the structural-technical, functional-planning and artistic-imaginative aspects of adaptive qualities of architecture;

- to prove the significance of adaptability as a general factor in the formation of living environment in modern conditions;

- to determine the modern principles of adaptation of architecture to the regional conditions of Kazakhstan for sustainable development.

Extent of study of the topic

The research is based on the results of scientific works, practical experience of domestic and foreign scientists, whose work can be grouped into several aspects:

- the theory of adaptability in architecture (Negroponte N., Vitruvius M., Ingels B., Gideon Z., Jenks C., Pfammatter U. etc.);

- practical implementation of the concept of adaptability of architecture (architectural bureaus and companies - Foster+Partners, Fondazione Renzo Piano, Skidmore, Owings & Merrill, Zaha Hadid Architects, Bjarke Ingels Group, etc.);

- flexibility of spatial forms, typological features of adaptation of architectural objects, dynamic shaping, structural and technical stability of buildings in modern conditions (Soviet scientists and scientists of post-Soviet countries - Anisimov L.Yu., Barkhin M.G., Bartold V.V., Generalov V.P., Generalova E.M., Gidion Z., Ginzburg M.Ya., Glazychev V.L., Gutnov A.E., Gaiduchanya A.A., Gale Ya., Jenks Ch.A., Ikonnikov A.V., Saprykina N.A., European and American – Ban Sh., Fuller R.B., Hadid Z., Hoberman Ch., Jencks Ch.A., Jantzen M., Koolhaas R., Schumacher P. etc.);

- methods of designing the architecture of sustainable development (Esaulov G.V., Isabaev G.A., Lebedev Yu.S., Ryabushin A.V., Tabunshchikov Yu.A., Tetior A. N., Shilkin N. V., etc.);

- methods of adapting the architecture of open spaces (Gagarina E. S., Zaleskaya L.S., Mikulina E.M., Lynch K., Lunts L.B., Nikolaevskaya Z.A., Sycheva A.V., Teodoronsky V.S., etc.).

- practical and theoretical works on the formation of the theory of adaptability of architecture (Ito T., Nicoletti M., Safdie M., studies of the Barletta School of

Architecture, etc.);

The dissertation analyzes the studies of adaptive qualities of architecture reflected in the works of Kazakhstani scientists (Abdrasilova G.S., Abilov A.Zh., Akishev K.A., Auzhanov N.G., Balykbayev B.T., Baypakov K.M., Baitenov E.M., Basenov T.K., Glaudinov B.A., Glaudinova M.B., Duisebai E.K., Izodzhanova G.R., Kapanov A.K., Kisamedin G.M., Kozbagarova N.J., Kosmeridi S.G., Mendikulov M.M., Montakhaev K.J., Rakhimzhanova L.S., Samoilov K.I., Sadvokasova G.K., Tuyakbaeva B.T., Tuyakaeva A.K., etc.).

As a result of studying the extensive theoretical base, we have identified a significant gap in the field of theoretical provisions on the formation of adaptive architecture in accordance with the Sustainable Development Goals, which have not been considered by anyone in Kazakh architectural science until now.

Scientific novelty of the dissertation research: in comparison with previously published works, this dissertation for the first time explores new aspects of the adaptation of architecture to modern conditions in the context of various resistances (functional, constructive, technical, artistic and figurative); the latest information on methods of ensuring the adaptability of structures in modern architecture of Kazakhstan is introduced into scientific circulation.

The work considers adaptability as the most important category in modern conditions of architectural practice and creativity. The definition of the concept of "architectural adaptability" is proposed, the essence of the adaptation process is described and the main factors and means of mutual adaptation of structures and the environment are given, as well as a list of principles of adaptability of architecture is formed.

The reliability of the scientific results of the study is confirmed by approbation in publications, face-to-face presentations at international conferences; information obtained in the course of personal correspondence with the world's leading architectural companies, as well as interviews with the authors of projects for the adaptation of architectural structures and specialists in related fields (engineering solutions, innovative construction technologies, reconstruction of buildings and complexes), the use of modern computer graphics programs, artificial intelligence systems in the process of scientific and practical systematization of material, conducting a questionnaire the survey, the development of graph-analytical tables of the study.

Research methods:

- the method of empirical research was used at the stage of collecting and analyzing scientific literature, photo and video information;

- the abstract-logical method was used to clarify the essence of the basic concepts, definitions and categories in the study of approaches to architecture and construction;

- the method of system analysis and synthesis made it possible to analyze the features of constructive-technical, artistic-figurative, socio-economic, environmental, cultural-psychological and other adaptations of architectural structures in the world and in Kazakhstan;

- the method of sociological research in the form of a survey of respondents

(mainly engineers and architects) was conducted using a questionnaire in the period from December 2022 to February 2023;

- the method of full-scale survey was applied in the process of studying architectural objects of the cities of Kazakhstan (Almaty, Astana, Turkestan, Taraz); Kyrgyzstan (Bishkek); Azerbaijan (Baku); Italy (Florence, Rome, Venice).

Research hypothesis: adaptability is an integral property of architecture, in connection with which the study and identification of patterns, the development of a theoretical basis for the adaptability of architecture to modern conditions in the context of globalization contribute to the sustainable functioning of material and spatial structures and objects in the process of forming the living environment.

The following new provisions are submitted for protection:

- substantiation of the definition of «adaptability of architecture» as a process of adaptation to changes caused by natural, climatic and anthropogenic factors;

- determination of the direct connection between the development of civilization and architectural adaptations to new conditions in the form of the influence of anthropogenic factors on the change of architectural approaches;

- analysis of modern technologies in the context of adaptation of buildings to external conditions and interaction with the environment through kinetic elements, climate control systems and energy-saving solutions;

- identification, as a result of a comparative analysis of the existing construction practice, of nine types of «sustainable» buildings with the definition of their main characteristics: energy-efficient buildings with minimal energy consumption, passive, bioclimatic, intelligent, «healthy», environmentally neutral, «green», circular and functionally flexible buildings;

- offering basic solutions based on the analysis of the «pandemic» architecture, the need for emergency adaptation to global challenges;

- identification and disclosure of the features of the main types of adaptations in architecture: functional and planning, constructive and technical, artistic and figurative;

- identification of regional factors in the formation of adaptive architecture based on the study of structural, technical, functional, planning and artistic aspects of the architecture of Kazakhstan from the middle of the XX century to the present;

- introduction into scientific circulation of the latest information on methods of ensuring the adaptability of structures in modern architecture of Kazakhstan;

- development of principles for ensuring adaptability of architecture in modern conditions of Kazakhstan for the purpose of sustainable development;

- development of the resulting scheme demonstrating the relationship between traditional and innovative methods of architecture adaptation at different stages of human development;

The scientific and theoretical significance of the dissertation is:

- in the study and systematization of a large volume of theoretical works devoted to architecture in conditions of dynamic environmental changes, variability of spatial forms, comfort of functional planning solutions, structural and technical stability of buildings, artistic and figurative identity in modern conditions;

- in a critical analysis of global theories and hypotheses related to the formation

of adaptability of architecture, on the basis of which modern principles of adaptation of architecture to the regional conditions of Kazakhstan are formulated;

- the results of the research can be integrated into the disciplines of higher educational institutions according to the educational program «Architecture».

The practical significance of the dissertation: the conclusions obtained as a result of the research can be used in design practice in the development of structural, technical and functional planning solutions for buildings and structures aimed at adaptive use; in projects of reconstruction, rehabilitation, repurposing of functional purpose, strengthening regional identity.

Approbation and implementation of scientific results:

- participation in research work within the framework of the project of grant funding of the Committee of Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan IRN AP19680138 «Regional identity as a factor of sustainable development of architecture of independent Kazakhstan in the conditions of globalization»;

- presentation with the report «Architecture of Astana: the potential of adaptive technologies in modern constructions» in the section: «Modern problems of architecture and professional education» at the international scientific-practical conference «Modern trends in architecture, design and urban planning, in the framework of the First Eurasian Symposium of Architecture», Urbanism and Design. Bishkek, May 26, 2023;

- presentation on «Sustainability of architecture as a conceptual basis of Norman Foster's projects» at the XIX international scientific-technical conference materials and energy saving technologies constructions of optimized energy potential. Poland, Czestochowa, 17.11.2022;

- presentation «Adaptation of architecture to energy efficient concepts (on the example of the Commerzbank building in Frankfurt am Main) » at the international scientific-practical conference «Architecture and urban planning of Tajikistan: yesterday, today, tomorrow». Dushanbe, 14.09-25.10.22;

- Presentation «Adaptability of architecture in Toyo Ito's projects as a reaction to the changeability of the world» at the 79th All-Russian Scientific and Technical Conference «Traditions and Innovations in Construction and Architecture». Russia, Samara, 19.04.2022;

- presentation «Architectural Monuments: Symbiosis of Tectonics and Form» at the International Scientific and Practical Conference named after V. Tatlin. V. Tatlin. Russia, Penza, 17.02.2021.

MAIN CONTENT OF THE WORK

The introduction substantiates the relevance of the topic, the degree of development of the problem. The object and subject of the study, the aim and objectives are highlighted, information about the source base of the thesis is presented, research methods for different stages of the work are defined, the aspect of scientific novelty, theoretical and practical significance is reflected.

In the first section «**Adaptation as a condition for the origin and development of architecture in the process of human evolution**» analyzes the

concept of «adaptive architecture» as a process and result that allows buildings to interact with the environment and transform in accordance with new conditions. The made scheme «*Influence of natural-climatic and anthropogenic factors on architecture in different epochs of civilization development*» demonstrates the interrelation of civilization evolution with the growth and qualitative changes of anthropogenic factors. Traditions of architecture adaptability to natural and climatic factors are revealed. Climatic models and principles of vernacular architecture adaptation using local materials are defined. Traditional «passive» and energy-saving technologies and approaches, which became prototypes of modern energy-efficient solutions, are presented in the compiled scheme «*Engineering and technological traditions of adaptability*».

The connection between the development of civilization and architectural adaptations under the influence of anthropogenic factors is revealed: in the XX century, technological progress and consumer society exacerbated environmental problems, which revived interest in traditional construction methods adapted to different climatic conditions. The scheme «*Prerequisites and peculiarities of formation of adaptability of architecture in modern conditions on the example of dome houses of N. Khalili*» presents an innovative approach of synthesis of traditions of architectural forms and elements in modern conditions, which was generalized and applied by architect Nader Khalili in extremely hot climate of Iran.

Six conclusions are drawn from the first section.

In the second section «**Innovative factors in the formation of modern architecture**» analyzes the technological and structural-technical achievements in modern architecture. The scheme «*Technological evolution in architecture of XIX-XXI cc*» is compiled, with five stages of development of the relationship «building technology – architecture», which show how technology has shaped architecture from the mid-19th century to the present day, offering solutions for sustainable development, ecology and new methods of design. Four groups of forms in modern architecture, distinguished by compositional characteristics, are identified and presented in the compiled analytical scheme «*Compositional Adaptation of Building Technologies in Modern Architecture*». The approaches to the adaptability of architecture through the introduction of kinetic elements and microclimate control systems, presented in the scheme «*Tectonics in modern architectural solutions*», are defined. The influence of the «*Concept of Sustainable Development*» on the architecture of the XXI century is investigated. The structure of formation of «sustainable» buildings of nine types, presented in the scheme «*Main characteristics of sustainable buildings in modern practice*».

Adaptability as a general factor of life environment formation in modern conditions is studied. It is revealed that the adaptation of existing buildings through their repurposing and modernization is a strategic solution to ensure sustainability in the conditions of oversaturation of anthropogenic mass of material structures on a global scale. An analysis of «post-catastrophe», including «pandemic» architecture as an example of emergency adaptation to global challenges is presented. The identified adaptive solutions are presented in the scheme «*Adaptive Solutions of Post-Catastrophe Architecture*».

Six conclusions are drawn from the second section.

In the third section «**Modern principles of architecture adaptation to regional conditions of Kazakhstan**» Functional-planning aspects of modern Kazakhstani architecture adaptation are revealed on the example of objects in Astana and Almaty. On the example of planning adaptation of TSUM the development of public buildings and expansion of functional zones in response to socio-economic changes is revealed. Examples of adaptation of AHBC objects show the transformation of industrial buildings into modern office and residential complexes with preservation of historical features. The example of the Nurly Tau complex represents a multifunctional office space adapted to changing uses. The main types of adaptation include heritage conservation, repurposing, renovation and restoration. Structural-technical, ecological factors and innovative technologies in architecture are identified on the examples of architecture of XX and XXI centuries (hotel «Kazakhstan» in Almaty, shopping and entertainment center «Khan-Shatyr», «Palace of Peace and Concord», mixed-use complex Talan Towers in Astana). Structural and technical aspects of adaptation that increase the sustainability and energy efficiency of buildings in extreme climatic conditions of Kazakhstan have been identified. The main types of adaptation were identified: heritage preservation, repurposing, reconstruction, overhaul and restoration. Structural and technical aspects of adaptation in the conditions of Kazakhstan are identified, emphasizing unique approaches that ensure the resilience of buildings to extreme climatic conditions and increase their energy efficiency.

Artistic and figurative aspects of adaptation are revealed, including historical allusions, local interpretations, new reading of identity meanings, digital morphology of forms on the basis of Artificial Intelligence algorithms. The scheme «*Generation of AI images taking into account regional conditions of Kazakhstan*» presents architectural images of buildings generated by Artificial Intelligence on request to create artistic solutions taking into account earthquake resistance, multilayer thermal insulation, autonomous ventilation and adjustable facade elements adapted to the conditions of Kazakhstan.

The results of the survey (more than 300 respondents related to the architectural and construction sphere) conducted as part of a scientific study to identify the adaptive qualities of modern architecture in natural-climatic and technogenic conditions of different regions of Kazakhstan are presented, the demand of society for quality construction of buildings and structures in accordance with the requirements of comfort and safety is revealed. The tendencies of adaptability development in modern architecture of Kazakhstan are revealed, which are based on 10 detailed interviews with architects, engineers, specialists of related professions and personal correspondence with transnational architectural companies (Foster + Partners, Fondazione Renzo Piano). Based on the research and analysis of the current state of the problem of adaptability of buildings in Kazakhstan, we have identified six principles, according to which the process of mutual integration of architecture and the needs of the population.

Seven conclusions are formulated in the third section.

CONCLUSION

In the XXI century, in the conditions of increasing anthropogenic impact on natural ecosystems, the theme of architecture adaptability to existing and newly emerging challenges acquires special significance. Modern architectural trends are aimed at the formation of a sustainable world, where artificial objects should be adapted to real conditions, being durable, environmentally sound, structurally safe and functionally flexible.

Kazakhstan scientists conduct research aimed at finding solutions that meet both global and local challenges, paying special attention to the adaptability of the architectural environment.

As a result of the conducted scientific research on the topic «*Formation of adaptability of architecture in regional conditions*» to achieve the goal of the thesis, a number of new provisions were substantiated and the set tasks were solved:

1. The concept of «adaptation» as a process of adjusting to changes caused by natural, climatic and anthropogenic factors is substantiated and formulated in relation to architecture. This process results in «adaptability», considered as the most important category necessary to ensure sustainable development of architecture.

2. Based on the study of adaptive architecture traditions in historical retrospect, a clear relationship between the evolution of civilizations and the increasing anthropogenic impact on architectural forms and solutions has been revealed. With the increasing influence of anthropogenic factors, architectural approaches changed qualitatively, which indicates a direct correlation between the development of civilization and architectural adaptations to new conditions (schemes «*Influence of natural-climatic and anthropogenic factors on architecture in different epochs of civilization development*», «*Traditions of architecture adaptability to natural-climatic factors*»);

3. The constructive-technical, functional-planning and artistic-figurative aspects of adaptive qualities of architecture are studied in the scheme «*Compositional expressiveness of constructive solutions*» four groups of types of compositional forms are defined: dynamic structures, horizontal towers, vertical towers, spatial structures.

4. Based on the analysis of modern technologies, it is shown how buildings can adapt to external conditions and interact with the environment through kinetic elements, climate control systems and energy-saving solutions (schemes «*Technological evolution in architecture of the XIX-XXI centuries*», «*Tectonics in modern architectural solutions*»);

5. As a result of a comparative analysis of existing international practice, a line of buildings corresponding to the Sustainable Development Goals has been identified, including nine types, and their main characteristics have been identified: energy-efficient buildings with minimal energy consumption, passive, bioclimatic, intelligent, «healthy», environmentally neutral, «green», circular and functionally flexible buildings (schemes «*The structure of the formation of sustainable building types*», «*The main characteristics of sustainable buildings in modern practice*»).

6. It has been revealed that the adaptation of existing buildings through their repurposing and modernization is a strategic solution to ensure sustainability in conditions of an oversaturation of the anthropogenic mass of material structures on a global scale (scheme of «*Adaptation of existing buildings to a new function*»).

7. Based on the analysis of «pandemic» architecture as an example of emergency adaptation to global challenges, adaptive solutions have been identified: modular assembly of structures; repurposing of existing buildings; heterotopic concept; vertical organization. The study of post-disaster architecture has shown the need for further development of adaptive strategies to ensure safety in the face of disasters, both natural and man-made, including in Kazakhstan (scheme «*Adaptive solutions for post-disaster architecture*»).

8. The dissertation identifies and reveals the features of the main types of adaptations in architecture: functional and planning (depending on the goals - for heritage preservation, for repurposing - expansion, reconstruction, major repairs, restoration); structural and technical (major repairs, reinforcement of structures, the use of innovative structural elements, new energy-efficient building materials, ensuring resistance to sudden temperature changes, seismic loads); artistic and figurative (historical allusions, local interpretations, a new reading of the meanings of identity, digital morphology of forms based on Artificial Intelligence algorithms), which is reflected in the schemes «*Types of functional and planning adaptation*», «*Types of constructive and technical adaptation*», «*Types of artistic and figurative adaptation*».

9. Based on the study of constructive and technical, functional-planning and artistic-figurative aspects of the adaptive qualities of architecture in Kazakhstan from the middle of the XX century to the present, regional factors of the formation of adaptive architecture have been identified (schemes «*Regional factors of the formation of regional architecture*», «*The influence of modern factors on the adaptability of architecture*», «*Redevelopment of buildings of educational institutions*», «*Reconstruction of buildings of educational institutions*», «*Peculiarities of architecture adaptation in the conditions of Kazakhstan in the Soviet period*», «*Adaptability in modern architecture of Kazakhstan*», «*Artistic and figurative adaptability of architecture in Kazakhstan*»).

10. It has been revealed that the adaptation of existing buildings is a strategic decision to ensure sustainability in conditions of oversaturation of the physical mass of material structures. For the first time, the latest information on methods of ensuring the adaptability of structures in modern architecture of Kazakhstan has been introduced into scientific circulation based on the analysis of exclusive data obtained from leading experts in the architectural and construction field. Examples of adaptation include projects such as the Talan Towers terrace in Astana, the Prometheus School and the NGS school in Almaty, the experience of 3D construction, as well as the transformation of industrial facilities, public structures (schemes «*Features of adaptation of architecture in Kazakhstan*», «*Adaptability in projects of new and reconstructed buildings and structures in Kazakhstan*»).

11. Based on the research and analysis of the current state of the problem of adaptability of structures in Kazakhstan, the paper defines the principles of ensuring

adaptability of architecture in modern conditions of Kazakhstan for the purpose of sustainable development, according to which the process of mutual integration of architecture and the needs of the population takes place (schemes «*The process of formation of adaptability of architecture*», «*Principles of ensuring adaptability of architecture in modern conditions of Kazakhstan*»):

- the principle of flexible functional organization of planning solutions;
- the principle of introducing relevant constructive solutions in accordance with technological innovations, taking into account natural and anthropogenic risks (seismics, pandemics, etc.);
- the principle of synchronizing the identity of the artistic image in architecture with the cultural and historical needs of the population;
- the principle of climatic adaptability of objects and architectural and spatial environment to the conditions of the region;
- the principle of public participation in the formation of the material and spatial environment;
- the principle of digitalization of the architectural and construction industry through the introduction of digital technologies in design, construction, and facility management (including TIMSO).

The scientific novelty of the dissertation research lies in the study of new aspects of the adaptation of architecture to modern conditions in the context of sustainability - functional, constructive, technical, artistic and figurative. Exclusive information on the methods of ensuring the adaptability of structures in modern architecture of Kazakhstan has been introduced into scientific circulation.

The conclusions and proposals of the dissertation can be used both in scientific (integrated into the curricula of bachelor's, master's, doctoral studies in Architecture, included in scientific research, in the content of textbooks, monographs) and for practical purposes (in design practice in the development of structural, technical and functional planning solutions for buildings and structures aimed at adaptive use; in projects of reconstruction, rehabilitation, re-profiling of functional purpose, strengthening of regional identity, etc.).

The materials of the dissertation confirm the hypothesis put forward in the work that adaptability is an integral property of architecture, in connection with which the study and identification of patterns, the development of a theoretical basis for adapting architecture to modern conditions in the context of globalization contribute to the sustainable functioning of material and spatial structures and objects in the process of forming the living environment.

Thus, it can be stated that as a result of the conducted research, the set scientific goal was achieved - the adaptive capabilities of modern architecture in the climatic, socio-economic, cultural and historical conditions of various regions (including Kazakhstan) were determined in the context of global aspirations for sustainable development in the XXI century. 12. The dissertation developed a resulting scheme demonstrating the relationship between traditional and innovative methods of adapting architecture at different stages of human development, which shows promising directions for the development of adaptability of architecture: in the XXI century, in the context of greening thinking, design solutions focus on the

symbiosis of technologies and traditions for the rapid construction of adaptive buildings in various climatic conditions, as well as in situations of natural disasters (the scheme «*Architecture in the process of human evolution*»).

The following publications pertain to the dissertation research topic:

1. Onichshenko Y., Abdrasilova G. Innovative engineering solutions in modern architecture of Kazakhstan: adaptation to seismic and climatic risks. Civil engineering and architecture. 2024. 12(5), 3391 – 3401. DOI: 10.13189/cea.2024.120519

2. Danibekova E. T., Onichshenko Y.V., Abuova D., Balmanova T., Kanafina A. Preservation of architectural heritage through conscious tourism. Materials of the XX International Scientific and Practical Conference named after V. Tatlin on February 15, 2024 Penza: August 2024, 63-66

3. Abdrasilova G., Onichshenko Y. Environmental friendliness of architecture as the conceptual basis of Norman Foster's projects. XIX International Scientific and Technical Conference «Materials and energy-saving technologies in structures with optimized energy potential». Poland, Czestochowa 13. 07. 2024. Issue 13, 61-70, 2024

Tuyakaeva A.K., Danibekova E.T., Abdrasilova G.S., Onichshenko Y.V. Regional identity in the architecture of residential buildings in the 1930s-1990s of the city of Karaganda. Bulletin of KAZGASA. 2023. №4 (90). 64-75. <https://doi.org/10.51488/1680-080X/2023.4-05>

5. Onichshenko Y.V., Abdrasilova G.S. Architecture of Japan: interpretation of traditions in modern conditions. Bulletin of KAZGASA. 2023. 2(88). 75-85 <https://doi.org/10.51488/1680-080X/2023.2-10>

6. Onichshenko Y.V., Abdrasilova G.S. Adaptive technologies in the architecture of international airports of the XXI century. Bulletin of KAZGAS. 2022. 4(86). 56-66. <https://doi.org/10.51488/1680-080X/2022.4-06>

7. Abdrasilova G.S., Onichshenko Y.V., Generalova E.M. Mutual integration of architecture and engineering as a reaction to climatic and anthropogenic conditions. Bulletin of KAZGASA. 2023. 1(87). 99-112 <https://doi.org/10.51488/1680-080X/2023.1-106>

8. Abdrasilova G.S. Onichshenko Y.V. Adaptability of architecture in Toy Ito projects as a reaction to the variability of the world. Collection of articles of the 79th All-Russian

9. Abdrasilova G.S. Onichshenko Y.V. Adaptation of architecture to the conditions of energy-efficient concepts (using the example of the Commerzbank building in Frankfurt am Main). Materials of the international scientific and practical conference «Architecture and Urban Planning of Tajikistan yesterday, today and tomorrow». Tajik Technical University named after academician M.S. Osimi. 2022. Part two. Dushanbe. 240-243

10. Abdrasilova G.S. Onichshenko Y.V. Adaptability of architecture: transformation of constructive solutions in conditions of natural risks. Collection of articles of the III International Scientific and Practical Conference modern problems of design. Baku, 2021, 352-366

11. Abdrasilova G.S. Onichshenko Y.V. Architectural monuments: symbiosis of tectonics and form. Proceedings of the XVII International Scientific and Practical Conference named after V. Tatlin on February 16-17, 2021, Penza, pp. 241-245

The structure and scope of the work. The dissertation work consists of one volume. The total volume of the dissertation is 188 pages, of which the main text is 152 pages (introduction, three sections, conclusion, list of sources used - 329 titles), appendices - 36 pages (31 author's graphoanalytic schemes, 2 acts of implementation, 1 copyright certificate)