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RESEARCH ARTICLE

ARCHITECTURAL ENVIRONMENT AS A FACTOR OF COMFORTABLE LIVING BY THE EXAMPLE OF ASTANA CITY

S.I. Chaly

S.Seifullin Kazakh Agro Technical Research University, 010011, Astana, Kazakhstan

Abstract. *The presented article discusses the problems of the architectural environment of residential buildings in the city of Astana. Currently, the city of Astana is being intensively built up. The construction is based on preferential mortgage lending programs that stimulate the growth of housing construction throughout the country, including in the northern cities of the country. At the same time, problems arise in optimizing the design and shaping the architectural environment, which entails difficulties in the improvement of the city. The current architectural environment of Astana is focused on serving the population primarily traveling by private vehicle. These factors lead to problems with pedestrian movement within the city. When designing the architectural environment, the climatic conditions of Northern Kazakhstan are not sufficiently considered, which leads to problems with the movement of pedestrians. The main emphasis of the organization of the architectural environment is on movement in personal vehicles. A large amount of space in adjacent spaces is allocated to parking spaces. The purpose of the work is to determine the optimal conditions for the formation of the architectural environment of residential formations, in the natural conditions of Northern Kazakhstan, to identify the relationship between climatic conditions and the formation of the architectural environment, as well as to determine the vector of development of architectural formations towards walking and a barrier-free environment. In the process of conducting the research, the following work was carried out: a retrospective analysis of the architectural environment of residential neighborhoods built in the 20th century was carried out, an analysis of the architectural environment of the adjacent spaces of residential complexes built in the 21st century in the city of Astana was carried out. Climatic conditions affecting the architectural environment of residential structures have been identified. Based on an analysis of the architectural environment of the city, recommendations were formulated for the formation of a comfortable architectural environment of residential buildings, considering the climatic conditions of Northern Kazakhstan.*

Keywords: *climatic conditions, architectural environment, factor, residential formations, landscaping, architecture, comfortable conditions.*

***Corresponding author**
Sultan Chaly, e-mail: sultan.chaly@gmail.com

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СӘУЛЕТТІК ОРТАСЫ АСТАНА ҚАЛАСЫ ҮЛГІСІНДЕ ЖАЙЛЫ ӨМІР ФАКТОРЫ РЕТІНДЕ

С.И. Чалы

Сейфуллин атындағы Қазақ агротехникалық зерттеу университеті,
Астана, 010011, Қазақстан

Аңдатпа. *Ұсынылған мақалада Астана қаласындағы тұрғын үйлердің сәулеттік ортасының проблемалары талқыланады. Қазіргі таңда Астана қаласы қарқынды түрде салынып жатыр. Құрылыс республика бойынша, оның ішінде елдің солтүстік қалаларында тұрғын үй құрылысының өсуін ынталандыратын жеңілдетілген ипотекалық несиелеу бағдарламаларына негізделген. Сонымен қатар дизайнды оңтайландыру мен сәулеттік ортаны қалыптастыруда мәселелер туындайды, бұл қаланы абаттандыруда қиындықтар туғызады. Астананың қазіргі сәулеттік ортасы негізінен жеке көлікпен жүретін халыққа қызмет көрсетуге бағытталған. Бұл факторлар қала ішінде жаяу жүргіншілер қозғалысын қиындатады. Архитектуралық ортаны жобалау кезінде Солтүстік Қазақстанның климаттық жағдайлары жеткілікті түрде ескерілмейді, бұл жаяу жүргіншілер қозғалысына байланысты мәселерге әкеледі. Архитектуралық ортаны ұйымдастырудың негізгі екпіні жеке көліктердегі қозғалысқа арналған. Іргелес кеңістіктердегі үлкен көлемді орын автотұрақтарға бөлінген. Жұмыстың мақсаты Солтүстік Қазақстанның табиғи жағдайында тұрғын үй құрылымдарының сәулеттік ортасын қалыптастырудың оңтайлы шарттарын анықтау, климаттық жағдайлар мен сәулеттік ортаның қалыптасуы арасындағы байланысты анықтау, сонымен қатар сәулет құрылымдарының серуенге және кедергісіз ортаға даму векторы. Зерттеуді жүргізу барысында келесі жұмыстар жүргізілді: 20 ғасырда салынған тұрғын үй кварталдарының сәулеттік ортасына ретроспективті талдау жасалды, 20-шы ғасырда салынған тұрғын үй кешендерінің іргелес кеңістіктерінің сәулеттік ортасына талдау жасалды. 21 ғасыр Астана қаласында жүзеге асырылды. Тұрғын үй құрылыстарының сәулеттік ортасына әсер ететін климаттық жағдайлар анықталды. Қаланың сәулеттік ортасын талдау негізінде Солтүстік Қазақстанның климаттық жағдайларын ескере отырып, тұрғын үйлердің жайлы сәулеттік ортасын қалыптастыру бойынша ұсыныстар тұжырымдалды.*

Түйін сөздер: *климаттық жағдайлар, архитектуралық орта, фактор, тұрғын формациялар, ландшафттық дизайн, сәулет, қолайлы жағдайлар.*

***Автор-корреспондент**
Султан Чалы, e-mail: sultan.chaly@gmail.com

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НАУЧНАЯ СТАТЬЯ

АРХИТЕКТУРНАЯ СРЕДА, КАК ФАКТОР КОМФОРТНОСТИ ПРОЖИВАНИЯ НА ПРИМЕРЕ ГОРОДА АСТАНЫ

С.И. Чалы

Казахский агротехнический исследовательский университет имени С.Сейфуллина, Астана, 010011, Казахстан

Аннотация. *В представленной статье рассматриваются проблемы архитектурной среды жилых образований города Астана. В настоящее время город Астана интенсивно застраивается. В основе строительства лежат льготные ипотечные программы кредитования, стимулирующие рост строительства жилья по всей стране, в том числе и в северных городах страны. При этом возникают проблемы в оптимизации проектирования и формировании архитектурной среды, что влечет за собой трудности в благоустройстве города. Нынешняя архитектурная среда г. Астана ориентирована на обслуживание населения преимущественно, передвигающемся на личном автотранспорте. Данные факторы приводят к проблемам пешеходного передвижения в черте города. При проектировании архитектурной среды климатические условия Северного Казахстана недостаточно учтены, что ведет к проблемам передвижения пешеходов. Основной упор организации архитектурный среды сделан на передвижение в личном автотранспорте. Большое количество площади в придомовых пространствах выделяется на парковочные места. Цель работы – определение оптимальных условий при формировании архитектурной среды жилых образований, в природных условиях Северного Казахстана, выявление взаимосвязи между климатическими условиями и формированием архитектурной среды, а также определение вектора развития архитектурных образований в сторону пешего передвижения и безбарьерной среды. В процессе проведения исследования была проведена следующая работа: проведен ретроспективный анализ архитектурной среды жилых микрорайонов, построенных в 20 веке, проведен анализ архитектурной среды придомовых пространств жилых комплексов, построенных в 21 веке на территории города Астана. Выявлены климатические условия, влияющие на архитектурную среду жилых образований. На основе анализа архитектурной среды города, были сформулированы рекомендации для формирования комфортной архитектурной среды жилых образований, с учетом климатических условий Северного Казахстана.*

Ключевые слова: *климатические условия, архитектурная среда, фактор, жилые образования, озеленение, архитектура, комфортные условия.*

***Автор-корреспондент**
Султан Чалы, e-mail: sultan.chaly@gmail.com

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CONFLICT OF INTEREST

The authors state that there is no conflict of interest.

АЛҒЫС / ҚАРЖЫЛАНДЫРУ КӨЗІ

Зерттеу жеке қаржыландыру көздерін пайдалана отырып жүргізілді

МҮДДЕЛЕР ҚАҚТЫҒЫСЫ

Авторлар мүдделер қақтығысы жоқ деп мәлімдейді.

БЛАГОДАРНОСТИ / ИСТОЧНИК ФИНАНСИРОВАНИЯ

Исследование проводилось с использованием частных источников финансирования.

КОНФЛИКТ ИНТЕРЕСОВ

Авторы заявляют, что конфликта интересов нет.

1 INTRODUCTION

The general plan of Astana developed and formed during the 19th-21st centuries. In the pre-revolutionary period, it was a small town built up with typical two-story houses of that time. The city developed according to the general plan and strictly with the approved project. In the Soviet period, the city had a predominantly rectangular street grid, formed during the years of economic development during the first and second Stalinist five-year plans.

The development of virgin lands led to a large-scale housing and public works construction and improvement in the city. In 1957, the «Kazgiproselstroy» Institute developed a city planning and development project with an estimated completion date of up to 1980 and a population of 160,000 people. According to the project, the residential part of the city occupied the most picturesque areas and was oriented towards the river and the park. The city planning structure was based on the desire to improve residential areas, accurately define characteristic highways, create a city center and connections between remote parts of the city.

The next impetus in the development of the city was the transfer of the capital of the Republic of Kazakhstan. The research group of the Japanese Agency for International Cooperation «JIAC» began work on the general plan of Astana in February 2000. Kisho Kurokawa headed the «JIAC» group. It was envisaged to build a new capital on the bank (right and left) of the Ishim River, flowing through the entire city. The modern direction in the development of the general plan of Astana was determined by the conclusion of the international expert commission dated September 12, 2007. The concept of development of the general plan until 2030 was determined. At the same time, urban development problems of the 21st century were solved.

At the present stage, the composition of the city is characterized by spaces of various scales with varying degrees of openness in relation to the environment, the use of contrast and nuance in the formation of architectural ensembles and the urban environment as a whole.

However, over time, the city was divided into two parts - the old part (right bank) and the new part (left bank). Currently, active construction (mainly residential areas) is carried out along the banks of the Ishim River, as well as in the right part of the city. On the right bank there is mainly micro-district development with typical houses of the Soviet period, on the left bank there are the newest residential complexes with various types of development.

Figure 1 – courtyard space in an old housing stock
(author`s material)

Micro-district development is represented by large formations – micro-districts: «Molodezhny», «Vostochny» and «Tselinny». During their construction, all the requirements of SNiPs of that time were taken into account and on the territory, there were: schools, kindergartens, consumer services centers, department stores, and clinics, equipped children's and sports grounds within walking distance. Currently, on the territory of these micro-districts, moral obsolescence of

houses is observed, while the adjacent spaces in most cases have been reconstructed. Modern small architectural forms and sports grounds have been added. However, only cosmetic repairs are carried out in residential buildings, which entails a deterioration in the standard of living of citizens living in the right-bank part of the city. At the same time, it is necessary to emphasize the lack of a barrier-free environment for movement, which affects the comfortable stay in the adjacent and street spaces of the city. **Figure 1** shows the courtyard space on the right bank of the city.

The residential development of the left bank of Astana is represented by large districts: Yesil and Nura. The development of the city consists of: block and mixed planning. In the architectural environment of the new city, many problems can be traced: the scale of city streets and sidewalks does not correspond to a comfortable living environment for a person, the largest streets of the city - Tauelsizdik Avenue and Saraishyk Street have 10 and 8 traffic lanes, which makes it difficult for pedestrians to move along these busy streets **Figure 2.**

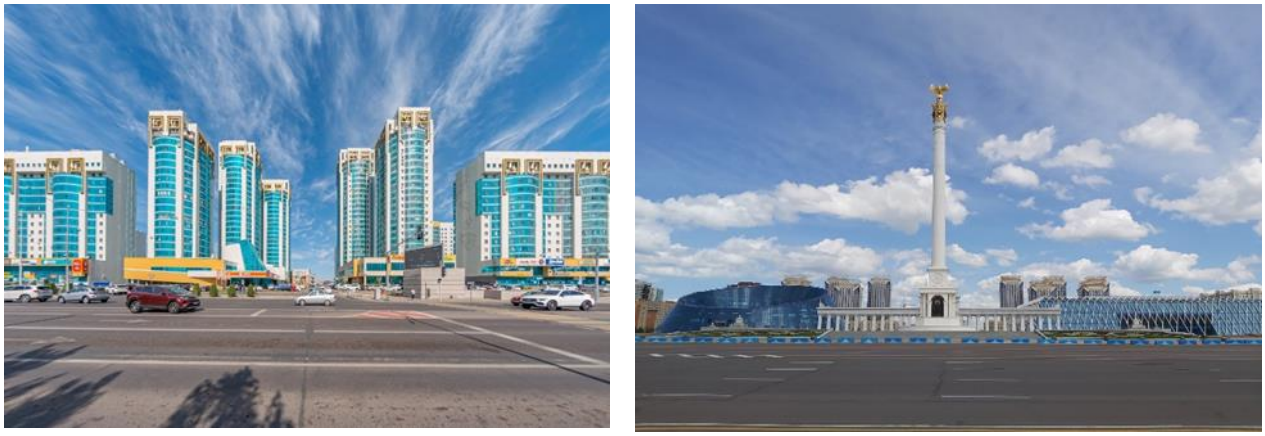

Figure 2 – Sarayshyk Street and Tauelsizdik Avenue
[author`s material]

Giant small-scale pedestrian spaces without landscaping, which has a negative effect on wind and gas-noise conditions. In rare cases, coniferous plantings are located along the perimeter of roads, which do not cope with gas and noise pollution. Sidewalks in front of busy building facades are dotted with car driveways and parking spaces, thereby interfering with comfortable pedestrian walks. The architectural environment of residential buildings on the left bank of Astana is not adapted to the climatic conditions of Northern Kazakhstan, a large emphasis is placed on the development of parking spaces and convenient driveways for cars, the pedestrian environment of the adjacent spaces is very poor and does not correspond to the parameters of the climatic conditions of the region. Environmental standards and rules are ignored by developers. **Figure 3** shows the courtyard architectural environment of a residential complex on the left bank of the city.

Instead of deciduous trees that absorb dust and noise, they plant sparse coniferous plantations that are unable to filter the air and as a result die from the gas pollution of large streets. Thus, using the example of Lake Maly Taldykol, which was filled in and drained for the construction of residential complexes, it can be noted that the pristine landscape is not used as a recreational space, but on the contrary, is destroyed for commercial gain.

In the course of the conducted research, the foreign experience of cities located in identical sharply continental climatic conditions was analyzed. For example, the cities of Canada, Finland, Sweden, the USA (Minnesota). The design of the architectural environment of cities in these regions is carried out taking into account climatic features, as well as with the support of the zero emission policy. Cities are transformed into a pedestrian-friendly environment and less tolerant of personal automobile transport. This is facilitated by the development of comfortable public transport, a barrier-free pedestrian environment, as well as the adaptation of pedestrian streets to the harsh climate.

The research problem is the lack of due attention to the organization of the architectural environment of the city and its adaptation to the climatic conditions of Northern Kazakhstan. First of all, this is a problem in the organization of the landscape and architectural appearance of the profiles of streets, courtyards and squares. Secondly, extremely high and low temperatures are not taken into account, in which it is impossible to organize free pedestrian movement during rush hours. Thirdly, the scale of squares, streets and park areas is not taken into account, a city resident gets lost in the flat

urban wastelands, which look great only from satellite maps. Also, in the architectural environment there are no elements that would shelter pedestrians from wind loads. In the organization of the landscape architectural environment - instead of using natural resources, they are partially destroyed, subsequently leading to environmental problems.

Figure 3 – improvement of the residential complex «Bagystan» on the left bank of the city. (author`s material)

An analysis of domestic and foreign experience, as well as an analysis of literary sources and field research, allowed us to formulate the leading hypothesis: comfortable living conditions for the population are achieved through the formation of an architectural environment taking into account all climatic and regional features of the area.

2 LITERATURE REVIEW

At present, a huge amount of knowledge and information in the field of designing a comfortable urban environment has been accumulated in world literature.

The theoretical aspects of the formation of the architectural environment in cold regions of the globe were revealed in the works of Alvar Aalto **(Aalto, 1978)**, who in his works describes the design of residential and public buildings in the cold regions of Finland, he also devoted many years to the adaptation of environmentally friendly materials to the harsh conditions of the northern regions. In his works, he emphasized the comfort and organization of lighting in regions where it quickly gets dark.

In the works of Jeffrey Ellis Aronin **(Aronin, 1959)** the main climatic conditions of the northern regions are considered, favorable and unfavorable conditions of the region and how they affect human life and architecture in general are described in detail. Foreign examples in construction practice are described and how the climate affects the planning of streets and cities

Christopher Alexander **(Christopher A., 1977)** succeeded in the issues of organizing topological requirements and further development of trends in the architecture of northern regions; his works developed typological templates that will help organize a comfortable architectural environment at all levels of design. The issues of adapting architecture to climatic conditions are in the first place.

Yudin A.I. **(Yudin, 2013)** in his work reveals the historical background of landscape design development, offers effective ways for urban landscape development. Tyulpin V.F. **(Tyulpin, 2011)** in his research reveals the problems of urbanization and the city's ecological system. Ways to solve environmental disasters through forecasting and the use of sustainable technologies are proposed.

On the adaptation of the architectural environment to the sharply continental climatic conditions of Northern Kazakhstan, the following works can be noted: Kornilova A.A., Mamedov S.E.O., Karabaev G.A., Khorovetskaia E.M. Shlyakhtich E.V. **(Kornilova et.al., 2023)** This article touches upon the problems of the harsh climate of Northern Kazakhstan and the adaptation of the architectural

environment through the construction of spatial structures that resist precipitation, wind loads and excessive solar radiation.

3 MATERIALS AND METHODS

In connection with the goal and hypothesis put forward, in the process of carrying out work on this topic, various research methods were used, which are based on a comprehensive and detailed examination of the problem, the study of objects and their features in a variety of relationships and relative independence.

The methodological basis is a comprehensive study of the development of the architectural and planning structure of Astana. The comprehensive study is based on principles such as socio-economic conditionality, the sequence of historical interrelationships between the various stages of development of the master plan and the architectural environment, national traditions and progressive development.

The complex nature of the research is also characterized by the phased nature of the work: collection and study of historical materials, field study (measurements, sketches, photographing, documenting), systematization and generalization of collected materials, conducting historical and theoretical analysis, the formation of theoretical positions and conclusions.

1. Field study is a method by which it is possible to study the object under study in real urban conditions without direct intervention. This method is useful because it can be used to obtain objective and undistorted data about the object of research. In a real urban environment, the field method is characterized by observation, measurement, and visual collection of information in the form of photo fixation.

2. Historical data analysis – this method is based on the study and interpretation of information from the past in order to understand and develop processes over time. This approach will help create a predictive model that can be used to analyze and predict future processes. This method also allows for a comparative analysis and assessment of the dynamics of the development of processes in the architectural environment of the city. The historical context, which was described earlier, is also important for creating a complete picture and subsequent objective assessment.

The following methods were used in the work: the system approach, the analytical method, the method of time and expert forecasting, the method of architectural design, as well as methods of economic, mathematical and abstract logical modeling.

All analytical conclusions are based on the collection of archival and historical materials, as well as on the study of existing solutions. Archival research was conducted in the museums of the Republic of Kazakhstan.

Architectural design methods were used in the formation and reconstruction of the architectural environment of residential communities in Astana, taking into account national and historical features in accordance with the wishes of the population and economic feasibility, and taking into account the results of technological scouting. Abstract-logical methods and computational-variative methods were used throughout the work.

The research methods are based on field studies of Astana city, analysis of the urban situation and individual districts of the city, micro-districts of the old city, as well as new districts of the left bank were studied. The study analyzed the adjacent spaces of new residential complexes, as well as courtyards and parking areas of the old city. More than 20 objects of residential complexes and the old housing stock of the city were photographed.

The documents and information about the general plan of Astana of the Soviet period were also analyzed, the buildings and recreational areas of the city, which were subsequently built up, were studied.

The transport situation of the city was studied in detail, and it was also analyzed: more than 5 major avenues of Astana, including Tauelsizdik Avenue and Saraishyk Street. The data of the field study were captured using photo fixation.

4 RESULTS AND DISCUSSIONS

4.1 Gardening problems.

After conducting a full-scale survey of residential formations and pedestrian street profiles, the main problems can be identified:

1. Developers are exclusively engaged in planting coniferous trees that die and do not open in urban polluted conditions; deciduous trees are planted exclusively by seedlings that are younger than 5 years old. As a result, the green spaces cannot withstand high wind loads and die without opening. **(Kikimbayev, M. 2023)**

2. The harsh climate and the lack of fertile soils affect the green spaces. Natural soils in the city area are often unsuitable for landscaping and require the import of chernozem.

3. Also, in many cases, there are no irrigation systems, such systems are provided mainly in park areas, in turn, green spaces located near roads and streets do not receive proper watering.

4. Construction in the city is in full swing and with the pace of urbanization, there is an increase in buildings, roads and parking lots, in turn, developers are not engaged in landscaping adjacent territories. The principles of formation of the architectural environment are presented in the **Figure 4**

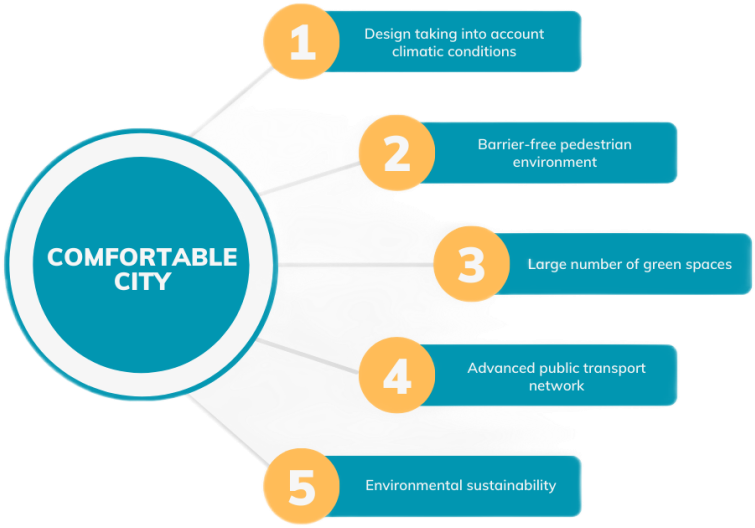

Figure 4 – The model for creating a comfortable architectural environment [author`s material]

4.2 Problems of transport accessibility and organization of pedestrian zones in the city

1. In an urban environment, there is a lack of a sufficient number of comfortable pedestrian streets with a human scale, along which it would be pleasant to move. Such large avenues as Turan, Kabanbai Batyr and Saraishyk St. have turned into huge empty spaces, which are mainly focused on personal transport. Mangilik Avenue, crossing Syganak St., is a motorway interchange that does not take into account the movement of pedestrians.

2. The climatic conditions of the northern region do not allow for full movement along the streets of the city, it is cold in Astana for 8 months of the year, and living in the city without personal vehicles becomes uncomfortable. Ice forms on the sidewalks, pedestrians are exposed to wind loads and extremely low temperatures. **(Abdrasilova G.S., Aukhadiyeva L.M.2024)**

3. The city's transport systems do not adapt to rush hours; public transport consists only of buses that run at different time intervals. During rush hours, pandemonium is created in public transport, bus line systems on the roadway are not as efficient, they are occupied by private vehicles or completely covered with snow in winter, which prevents buses from running.

4. The problems of organizing a barrier-free pedestrian environment are related to the fact that the main service points for the low-mobility population do not fully comply with the regulations, and there are many elevators and ramps in the city that are designed so that they cannot be used. **(Amirbekova A. et.al., 2023)**

For comparison with the foreign experience of organizing the architectural environment of the city, we can consider the experience of Canada and the northern cities of the USA. Montreal is home to the RESO system, which is also known as the underground city. The concept of the city is simple, in view of the harsh climatic conditions of the region, tunnels were built underground in the business center with a total length of 32 kilometers, which connect business centers, hotels, entertainment centers and metro stations. **(Ermgassen et.al., 2022)** These underpasses are well lit and the

temperature in them is much warmer than outside. Thus, the local population can move around the city center at any time of the year without going outside. **Figure 5**.

Figure 5 – Underground square in RESO. Canada, Montreal [author`s material]

5 CONCLUSIONS

In the course of the research, the main problem areas of the city in the field of organization of the architectural environment were studied. With the help of field studies, a sociological survey, and a study of modern literature in the field of organizing a comfortable architectural environment, the main research issues were identified. The ways of solving problems in the field of organization of the architectural environment of the city are proposed.

A model of a comfortable architectural environment at the level of urban space organization has been developed. Optimal conditions have been identified that contribute to improving the well-being of society. Using the developed concepts in practice will help to achieve success in organizing urban spaces in the local regional conditions of Astana city.

Based on the results of the conducted research, it was concluded that the architectural environment of Astana is not designed for the climatic conditions of a sharply continental climate. It is necessary to review the methods of designing the architectural environment and make a bias towards creating comfortable conditions for the population.

1. There is a windproof green belt within the city of Astana, an arboretum with green spaces should be created in this area, which would be used in further tree planting directly in the city. It is also necessary to organize automatic watering of green spaces in all green areas of the city. In terms of the number of green spaces, it is necessary to reach the WHO recommended mark of 50 m2 per inhabitant.

2. It is necessary to organize a sufficient number of public transport, to make public transport more comfortable and mobile. Organize proper care of warm stops and increase their number. Increase the number of public transport and its frequency during rush hours.

3. A lot of work is required in adapting the architectural environment to the harsh climatic conditions of the city. It is necessary to organize wind protection from green spaces and small architectural forms in the form of canopies that would protect from snow and wind. It is necessary to adapt foreign experience in the form of the organization of covered structures for free movement in winter conditions.

4. The central heating system can serve to create warm sidewalks that would help in the fight against ice.

5. It is necessary to introduce an assessment of the actions of developers and oblige them to work in the field of organizing a barrier-free travel environment for low-mobility citizens of the city.

As well as in the field of landscaping and organization of courtyard spaces, courtyard spaces should be adapted to the harsh climatic conditions of the city.

Continuing the study of the architectural environment of the city will help to study in great detail the synergy of a person and the surrounding space, synthesize new directions in the field of the architectural environment of residential formations in the regional conditions of Northern Kazakhstan.

In the future, the creation of a comfortable architectural environment of the city in the harsh conditions of Northern Kazakhstan should be developed with the help of modern conceptual projects that can be implemented in design and construction organizations.

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