Development of eco-architecture in Kazakhstan is gaining ground

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ABSTRACT: People are a part of nature. Therefore, in creating a comfortable and surrounding space, balance and harmony with nature must be maintained. Eco-architecture is directed toward the organisation of social processes in the urban environment, so as to improve the environment; to a dialogue with nature and with the local cultural and historical heritage. Eco-architecture requires as much application as possible of renewables and, at a minimum, the adoption of traditional energy resources. Architectural projects in which there is use of natural solar and wind energy are becoming ever more popular. Eco-architecture is an indicator not only of the spiritual, but also the economic condition of society. It develops together with the economy. A shortage of traditional power sources requires the development of new tendencies in modern architecture. This means the use of alternative power sources, economic heat-insulating materials, and new lighting systems. In this article, the authors examine the green building trend gaining ground in Kazakhstan.

INTRODUCTION

The development of ecological architecture in Kazakhstan is especially needed now, because of the sharp deterioration in the state of the natural environment, against the backdrop of the processes of urbanisation and the technological revolution. The study of trends in the development of eco-architecture and sustainable urban development in other countries, where this is developing intensively, is of great interest to Kazakhstan architects. For a rapidly developing country such as Kazakhstan, it is important to study foreign experience in the field of ecology and green building in order to avoid mistakes and to have experience in solving them.

Environmental architecture facilities should be built in the Republic of Kazakhstan to address the needs of population growth in the cities, urbanisation and intensive construction, and to improve the quality and manufacturability of construction industries. Of course, regional features play an important role here. Consequently, what is being developed and applied in Western countries is not always applicable to construction in Kazakhstan. Having studied and analysed the regional peculiarities of the formation of eco-architecture in Kazakhstan, it is possible to develop the eco-architecture that is the most suitable for the country. It is also important to study ways for the possible application in the area, of ecological developments in architecture and construction.

VALUE OF SUSTAINABLE ARCHITECTURE

Violation and inappropriate human influence on nature is a relatively new phenomenon associated with two main factors: first, population growth and second, human dominance over nature. Since the beginning of the industrial revolution and the excessive exploitation of natural resources, balance with nature has been lost, and natural resources have been depleted. This has led to some disparity between man and nature. Therefore, it is necessary to take steps to improve the environment as a part of national security. There is a need to respect the environment, the study of ecology, the climate, and so on. Thus, sustainable design is not a formal style based on transient conditions and emotions, but rather consists of deep notions about the interaction between man, nature and architecture.

There are still some misunderstandings about the concept of *green* or *sustainable architecture*. Thus, architects and designers should inform themselves in this regard to help them with architectural subsystems and to understand their real impact. There are many systems and technologies for the implementation of *green architecture*, but they are not sufficient for architecture that meets the latest requirements. It is important to respect the environment, nature and knowledge about the environment, as well as about the relevant conditions. Thus, green design is not a formal style and is not inspired by transient conditions. Nevertheless, it has many deep concepts that reflect the interaction between man, nature and architecture. In essence, a person must change their way of life to avoid excessive use of energy and the

pollution of air and water. Altogether, this means the use of sustainable architecture. If this issue is not addressed, the next generation will experience the consequences of a lack of natural resources, air pollution and global warming [1].

INFLUENCE OF *ASTANA EXPO 2017* ON THE DEVELOPMENT OF ECO-ARCHITECTURE

More than 20 years ago, Kazakhstan gained its independence after the collapse of the Soviet Union and took its first steps into unknown territory as a new, independent state. Kazakhstan is a new country with a rich heritage of vast landscapes in the main steppes, with lots of resources such as oil, gas and minerals. Kazakhstan is becoming more and more identified as a country with sustainable development and with a leading role in international nuclear non-proliferation movements. It abandoned the world's fourth largest nuclear arsenal in the years following independence. In 2017, an international exhibition, *Astana Expo 2017*, was held in the country. There are aims to use environmentally friendly resources; there are vast oil and gas reserves, as well as other resources; and the aim is to build modern cities with unique architecture that competes on the world stage.

Astana Expo 2017 is one of the key national projects in Kazakhstan. This large-scale project has stimulated the positive growth of green architecture in the country. Astana Expo 2017 was held over three months, the participating countries numbered about 100 and, as expected, about 5 million visitors attended. Thanks to this, the exhibition was the largest international event of its kind in Central Asia. The exhibition coincided with the celebration of the 20th anniversary of Astana as the capital of the country, and marked the emergence of an independent Kazakhstan and the region as an energy and communication hub of Europe, Asia and the Middle East.

Such large-scale projects provide great opportunities for integrating the green concept with the growth of the country. The specialised exhibition in Astana was where projects were presented in the field of green development, as well as renewable and sustainable energy sources. Each element of design in the exhibition was to encourage and support the idea of clean energy, which involved exhibition and cultural pavilions, residential buildings, retail space, educational and civic facilities, as well as parks and parking [2].

The leaders of Kazakhstan saw in the exhibition hopes for the energy of the future being long-term sustainable. It helps to stimulate an international discussion on sustainable development with clean energy. Astana functions as a magnet for attracting significant investments to create exposition facilities and an expanded infrastructure for the city. These projects create new jobs, stimulate tourism, and also mobilise the economic and social resources of Kazakhstan.

Locations created for the exposition served as a fruitful long-term investment, positioning Kazakhstan and its capital as a centre of attraction for future major international projects and information presentations. In the future the projected buildings will operate as power plants generating energy from solar panels and wind turbines, which will entail the integration of Kazakhstan's green architecture into the innovative international environment of green construction. The modern projects aim at using renewable energy sources as the main source for infrastructure and the daily operation of buildings.

At the very centre of the exhibition, the sphere-shaped pavilion became a real symbol of the concept of *Energy of the Future*. Its innovative structure and surface reduce heat loss and solar radiation, while at the same time saving the energy of the building through integrated sustainable systems, such as photocells. Each building of the specialised exhibition was designed to reduce energy consumption and increase the amount of clean energy that can be generated.

In addition to the excellent energy efficiency of individual buildings, the architects ensured that all development would be linked together by incorporating a smart grid, a smartly recycled water mesh, an integrated waste management system and an off-season underground thermal energy storage facility. After the exhibition, the place was transformed into operational modern facilities, such as offices and research parks for international companies and entrepreneurs.

An exhibition at this level makes it possible to present the best world energy-saving technologies, as well as new developments in the use of existing alternative energy sources, such as solar, wind, sea, oceanic and thermal energy. The initiative allowed the raising of the image of Kazakhstan, according to the international community, to lead the country to a new level of development. It was a grandiose, ambitious, national project. The development of alternative energy, despite the availability of rich natural resources, is included in the priorities of the state. Kazakhstan has a very large potential for renewable wind and solar energy. In the near future, alternative energy could become an environmentally friendly source of profit for the country [3].

The future not only concerns technologies in the field of alternative energy; it also concerns the creative ideas of the younger generation. However, the lack of evidence of *green* progress in the country may indicate that the environmental concept or environmental values have not yet been at the forefront of the construction industry's agenda. Confident steps of the government, private companies and professional bodies are crucial to promote the environmental concepts and ensuring *more environmentally friendly* changes in the industry. The quest for *green* construction is relatively new in Kazakhstan, but holding the international exhibition under the theme, *Energy of the Future*, brought the environmental concept of sustainable development of this to the forefront of the agenda on a par with other developing countries.

ECOLOGICAL FACTORS THAT INFLUENCE THE DEVELOPMENT OF GREEN ARCHITECTURE

Green construction is still at an early stage in Kazakhstan. The factors promoting the introduction of this into new construction projects are known, but the conclusions drawn on the basis of research indicate that any actions to promote the concept of *green building* in Kazakhstan have not yet had a significant impact on the environmental sector.

Thanks to the use of environmental studies and urban planning principles, as well as the rich traditions of local architecture, some steps can be taken to improve the eco-architecture and protect the environment through three strategic principles:

1. Reconstruction and regeneration of existing buildings in the central and old neighborhoods, especially the buildings of the past century.

2. Improvement and modification of existing buildings and structures and their adaptation to the principles of *green architecture*.

3. Applying the opportunities for regeneration of new micro districts and development that promote the best design standards through the principles of ecological and green architecture.

The attention of urban design in Kazakhstan to the sustainable development mode should be aimed at preserving both natural and built-up areas. There is a need to develop already built-up areas in the most efficient way, making them more attractive for life and work. In sustainable urban design, priority should be given to the adaptation and reuse of existing buildings, infrastructure and roads, as well as the reuse of recycled building materials and components. Sustainable development leaves an imprint on the conservation of natural resources, as well as the protection of wildlife and habitats.

Sustainable development also implies a high degree of independence at all levels of the city structure. Part of this self-sufficiency lies in the production of food and waste processing. It may be reasonable to conceptualise the urban structure as an integral part of the bioregion and the countryside and, at the same time, as an integral part of the urban structure, in which case the countryside, with its opportunities for food and production, will develop and contribute to the development of the city. It is generally accepted that global warming is occurring and that the protective ozone layer is in danger.

Most of the air pollution, partly associated with global warming, is caused by the burning of fossil fuels when creating energy to support urban life. Nevertheless, this is by no means the only ecological danger that is directly related to the consequences of urbanisation on the planet. Other hazards include: pollution of water resources; reloading of environmental effluents, such as at large river mouths; acid rain and urban air pollution. Most of the pollution causing environmental damage can be attributed directly to the construction process. For example, 50 percent of the world's fossil fuel consumption is directly related to the maintenance and use of buildings.

In addition, energy is employed for the manufacture of building materials, their transportation to the site and their erection in the structure of the building. The maintenance and use of buildings alone result in the production of 50 percent of the world's production of carbon dioxide, which is about a quarter of greenhouse gases. Designers and residents of buildings can significantly reduce the amount of pollutants entering the environment by the careful selection of environmentally friendly materials, the use of an ecological design approach and reasonable care for the use of the building.

INFLUENCE OF REGIONAL TRADITIONS ON THE CREATION OF ECO-ARCHITECTURE

It is not hard to find ideas of ecological architecture since they are all quite widely developed in forgotten local traditions. Good urban planning, that is, the organisation of public space, is not necessarily connected with the great works of architecture, but often with a pleasant arrangement of houses that is not too powerful, as well as with the structures in which commercial, educational and other institutions are located that support the work of the city. Traditions of folk architecture have many lessons for those who are looking for sustainable design solutions.

Five principles of eco-architecture [4]:

Principle 1: There are many examples of energy conservation and environmental protection. The first principle, extracted from the study of past practice, is the priority given to the preservation and reuse of buildings, infrastructure and materials.

Principle 2: The second principle is the use of local regional building materials for the construction of buildings. Wherever possible, it is preferable to use materials that require low cost for non-renewable energy in the manufacture, transportation to the site and in the construction process itself. Preference should be given to those materials obtained from sources that do not pollute the environment. These building materials,

which are labour-intensive rather than energy-intensive in their extraction, transportation and installation, are more environmentally friendly in terms of resource allocation, and are more acceptable for eco-architecture purposes, i.e. there is a need to avoid materials that damage the environment.

Principle 3: The third principle is to mitigate the consequences of any environmental damage. All new buildings damage the environment, no matter how carefully they are designed. Therefore, new developments should be designed with tree planting schemes in order to compensate for some of the pollution effects caused by construction.

Principle 4: The fourth principle is to link development with local climatic conditions. In the climatic conditions of Kazakhstan, there are both cold and hot climates. It is important to isolate buildings to the highest standards. To reduce the thickness of the outer wall, orient the window openings of the building to the sun; organise the interior of the building, so that the groups of warehouses and similar premises are facing north. To organise for winter, design east and west façade winter gardens and solar lawns or solar catchments. Buildings located on the slope of a hill can be located partially underground with a roof covered with earth and vegetation. The building can unobtrusively fit into the landscape, making extensive use of the insulating properties of the land itself. There are a growing number of projects of this type that are of particular interest for sustainable development.

Principle 5: The fifth principle is to design buildings to provide flexibility, so that a combination of rooms located under one roof can be adapted for various purposes throughout the life of the building [4].

PROSPECTS FOR THE DEVELOPMENT OF ECO-ARCHITECTURE

At present, the protection of the ecological environment and the promotion of green construction are widely recognised and widely promoted. *Eco-architecture* as a concept increasingly is being introduced into urban planning and design in Kazakhstan. The idea of sustainable development, based on an ecological concept, is also becoming more and more recognised. With urban construction and development, it is necessary to also change the traditional way of building design. The concept of ecological, green building and environmental construction of the city is a new development trend to make the city more accessible, full of energy and vitality.

The usual ecological concept of architectural design refers to the harmonious status of the urban ecological environment, the harmonious coexistence of humans and nature with participation and interdependence. There is the organic whole of the urban environment in the concept of an ecological system of design in modern cities. Ecological culture grows from the concept of an ecological city that reflects the ecological culture of the city and the green design of the building, as well as being a symbiosis with the natural environment with mutual integration and sharing.

The green building should promote the development of the urban ecological system with a solid circular angle as a starting point, reducing the consumption of resources and energy, as well as preventing and reducing waste and harmful substances, as well as pollution of the urban environment. There should also be sustainable development of the city. The *green building* design is a kind of life essence of artistic action, not only satisfying the aesthetic needs of urban residents; it also influences public culture. When strengthened, the green building and the urban environment create a sense of order and rhythm, awakening in the lives of people the beauty or the ideal of life, the beauty of feelings and longing. The measure of the building - the main criterion of green construction - is the degree of environmental protection of the environment, regardless of maximising the use of environmental resources. Based on this, the idea is to follow the objective law of nature, to live in harmony. Such a building can have mass, while meeting construction time requirements.

Green building construction projects, whether design, construction or use should follow the principle of economy, with the focus on price, efficiency and quality; at the same time attention should be paid to economic benefits, and reasonable cost control. The quality of construction can bring a good living experience to households; a more humane design contributes to the physical and mental health of the inhabitants. When developing the best new investments in energy, the aim should be to reduce air pollution, to create *green* construction, improve the quality of life and produce a healthy environment. Green building, as a new type of building, is one where the design has to be constantly adapted to social changes, so the trend of social development is highly important. The design should be assessed by its appearance and performance. As the upgrade progresses, designers must continue to improve the aesthetics with independent innovation to bring new energy to the green building.

At present, the development of green construction in Kazakhstan is at the level whereby broad knowledge is held by those in narrow circles; people know what a green building is, the advantages and general concepts. With increasing consumption of resources and energy, green energy conservation measures are mandatory. Green construction is an inevitable trend in the development of the construction industry in the country. Designers take the *scientific view of development* as a guide, adhering to a people-oriented strategy, an ecological concept of sustainable development and actively supporting the ecological balance. By focusing on the design of energy conservation and environmental protection, in addition to establishing quality of life and working conditions for people, the development of green building can be promoted effectively.

INTRODUCING ENERGY-EFFICIENT DESIGN TO THE EDUCATIONAL PROCESS

To achieve progress in strengthening sustainable development in architectural education, it is necessary to take the following steps:

1. Sustainability should be fully integrated into the curriculum for architecture in all architectural schools, urgently. This should be included in the contents of compulsory subjects through specialised courses in environmental science. The timeframe should be established for the mandatory inclusion of courses on sustainable development in all departments of architecture, using experimental courses.

2. In the shortest possible time, several leading urban development departments should experimentally include some of the recommended rating systems for green architecture and sustainable design. They must choose software for energy assessment, as well as software for energy modelling and implement tools in sustainable building design. Students should be subjected to real experiments appropriate for their level. Experimental courses should be properly financed. The results should be widely disseminated. In each department, two or three lecturers should be specially trained to conduct experimental courses.

3. Town planners should ensure compliance with established norms within the framework of departmental accreditation procedures. The *issue* of training instructors should not be underestimated. That is, regular seminars and workshops should be organised to familiarise the lecturers with the concept of sustainability, since even among teachers, there is a general lack of understanding.

4. It would be most useful if stakeholders in the educational system disseminate results and shared experiences (successes and failures) with the public through public seminars, publications in popular newspapers and television and radio programmes.

Promoting sustainable architecture, as recommended in this document, can be highly useful for students, practising architects and society as a whole.

IMPROVING ECO-ARCHITECTURE IN KAZAKHSTAN

The concept of the *green building* is a new approach that combines an extensive set of methods and technologies to save water, energy and material resources in the construction and maintenance of buildings and can reduce the negative impact of buildings on the environment and human health, as well as on operational costs. Green buildings are not only a contribution to sustainable construction and the environment, but they are also a benefit to builders and owners. Lower development costs, lower operating costs, increased comfort, higher indoor environmental quality, and increased durability and lower maintenance costs are all indictative of a typical green building. In the case of Kazakhstan, an effective transition to green buildings requires appropriate management [5].

It would require policy co-ordination at national, regional and municipal levels. There is a need for co-ordination both vertically between different levels of government, and horizontally within the municipal government. A synthesis is required between the various departments of the municipal corporation, to co-ordinate the work to implement green Kazakhstan from the perspective of green buildings.

Architecture and design play a highly important role in making a building green. Along with adequate sunlight, the minimisation of energy consumption, proper ventilation and much more play an important role. Innovations in buildings and energy technologies should be well-integrated into the system, so that they represent a whole package that is not easy to miss or ignore. A proper architecture design should be issued for construction. Significant management is required, to recognise the flaws in the project layout submitted for clean-up, and to help the existing plan to better adhere to the green agenda.

The concept outlined above is accompanied by a number of myths that must be abolished. One such misconception is that a green building is more expensive and, therefore, is not a viable option. This is not the case; experience has shown that the cost is viable and, even though it is slightly higher than the normal cost of construction, this is recouped within in the first three to four years of being occupied.

To construct green buildings, specialised skilled workers are needed, while the current workforce employed in the sector largely is uneducated and unskilled. Thus, large educational institutions and universities should start to hold training seminars that will help to create the necessary skills among the existing and future workforce. The government itself must first take the initiative and turn the green building concept into an enterprise with minimal profits. There are several small initiatives that have been taken by the government in this direction.

The task is to make *green building* the main practice. A favourable government structure at the local level will be the key to adequate implementation and enforcement of policies and codes. The government should reduce the taxation of necessary materials and help subsidise the *green* materials needed for green buildings, and also provide carbon credits to builders along with tax breaks and fines, so they can encourage and motivate builders to take seriously the development of green housing.

CONCLUSIONS

Ecological problems are harmful products of human activity in a biophysical environment. The human race should slow down the destruction of ecological habitats of weaker species simply from *egotistic* desires. The affirmation should be that humans want to lead a sustainable way of life; whereas their actions prove the opposite. They took the free things available in nature, such as food, water, air, light, minerals as a matter of course and used them to the verge of their disappearance. Major environmental problems may include climate change, environmental pollution, environmental degradation and depletion of resources. Environmental authorities advocate the protection of natural resources that are endangered species and the protection of any ecologically valuable natural area.

Sustainability is the key to preventing or reducing the impact of environmental problems. At the present time, there is clear scientific evidence that humanity is living unsustainably and that an unprecedented collective effort is required to return humankind to using natural resources within sustainable limits. For people to live sustainably, the Earth's resources must be used at a speed with which they are replenished.

Sustainability is related to the economy through the social and environmental consequences of economic activity. The main focus is on the overall capacity (stability) of planet Earth regarding sustainability of economic sectors, ecosystems, countries, municipalities, neighbourhoods, homesteads, individual lives, individual goods and services, occupations, lifestyles and behaviour. This can entail the complete range of biological and human activities or any part of it.

Globally, and in the broadest sense, sustainable environmental management is linked to oceans, freshwater systems, land and the atmosphere. But in accordance with the principle of sustainability, it can be applied equally to any ecosystem, from the rainforest to the home garden. In Central Asia, the green revolution is quietly gaining momentum. Kazakhstan leads a number of nationwide initiatives to integrate into the country environmentally friendly industries. The construction industry plays an important role in achieving Kazakhstan's green ambitions. National enterprises invest in the design of the green residential quarter, with office premises in Astana. All designed buildings of the complex are equipped with systems to reduce energy and water consumption.

As stated, the trend of green construction gradually is gaining momentum. *Mega SilkWay* shopping centre opened its doors in 2017, in Astana. The international company, Renaissance Construction, is behind this project. Covering 15 hectares of a total area of 140,000 square metres, the shopping centre is the first of its kind in Kazakhstan and was built with environmentally friendly materials and green technologies. The Kazakhstan government plans to provide all the buildings under construction with environmentally friendly technologies and materials. Foreign companies will have a number of opportunities in Kazakhstan. Namely, in the supply of sustainable sources of building materials and the knowledge necessary to create a truly green construction industry.

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