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THE INFLUENCE OF NATURAL AND CLIMATIC CONDITIONS ON THE FORMATION OF EDUCATIONAL INSTITUTIONS ON THE EXAMPLE OF TECHNICAL SCHOOLS

Yuldasheva M. K.
Associate Professor
Tel: +998902708318
Rakhmatova D. D.
1st year Master's degree, 70730101-Architecture of Buildings and Structures
Tel: +998904533323

Annotation. The article discusses the influence of natural and climatic conditions on the architectural formation of educational institutions, in particular technical schools. The theoretical foundations of climate-adaptive architecture are revealed, the features of the design of educational buildings in the dry-hot climate of Uzbekistan are analyzed, and foreign experience in creating energy-efficient educational institutions is considered. Attention is paid to the orientation of buildings, the use of traditional architectural techniques, energy-efficient materials and technologies. It is emphasized that taking into account climatic factors is a prerequisite for creating a comfortable educational environment, reducing operating costs and increasing the resilience of architecture to modern conditions.

Keywords: technical school, educational institution, climate, architecture, planning solution, energy efficiency, dry-hot climate, educational environment, architecture.

Annotatsiya. Maqolada tabiiy-iqlim sharoitlarining ta'lim muassasalari, xususan, texnik maktablarning me'moriy shakllanishiga ta'siri muhokama qilinadi. Iqlimga moslashuvchan arxitekturaning nazariy asoslari ochib berildi, O'zbekistonning quruq-issiq iqlim sharoitida o'quv binolarini loyihalash xususiyatlari tahlil qilindi, energiya tejaydigan ta'lim muassasalarini yaratish bo'yicha xorijiy tajribalar ko'rib chiqildi. Binolarning yo'nalishi, an'anaviy arxitektura texnikasi, energiya tejaydigan materiallar va texnologiyalardan foydalanishga e'tibor qaratiladi. Ta'kidlanishicha, iqlim omillarini hisobga olish qulay ta'lim muhitini yaratish, operatsion xarajatlarni kamaytirish va arxitekturaning zamonaviy sharoitlarga chidamliligini oshirish uchun zarur shartdir.

Kalit so'zlar: texnik maktab, ta'lim muassasasi, iqlim, arxitektura, rejalashtirish yechimi, energiya samaradorligi, quruq-issiq iqlim, ta'lim muhiti, arxitektura.

Introduction

Architectural design of educational institutions cannot be considered outside the context of natural and climatic conditions. Climate has a direct impact on the formation of space-planning solutions, the choice of building materials, the

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orientation of buildings, and the organization of engineering systems. This is especially evident in vocational educational institutions, such as technical schools, where it is necessary to provide favorable conditions for the educational process, considering the high density and long stay of students [1].

Modern trends in architecture are associated with the transition to sustainable development, the introduction of "green" technologies and the reduction of energy consumption. This makes the topic of the influence of climate on the architecture of educational institutions especially relevant for technical schools. In the context of global climate change in Uzbekistan, rising air temperatures and rising energy consumption, the task of adapting architecture to natural conditions is becoming one of the priority problems. [2]

For the Republic of Uzbekistan and, in particular, the city of Samarkand, the issue of taking into account natural and climatic factors in the design of educational buildings is of strategic importance. There are sharp temperature changes, high solar radiation, a significant number of hot days a year and a fairly cold winter. In such conditions, design without taking into account climatic factors leads to overheating of premises in summer and excessive heating costs in winter.

The purpose of this article is to identify the features of the influence of natural and climatic factors on the formation of architectural and planning solutions for technical schools, as well as to analyze foreign experience that can be adapted to the conditions of Central Asia.

Theoretical Foundations of the Influence of Climate on the Architecture of Educational Institutions

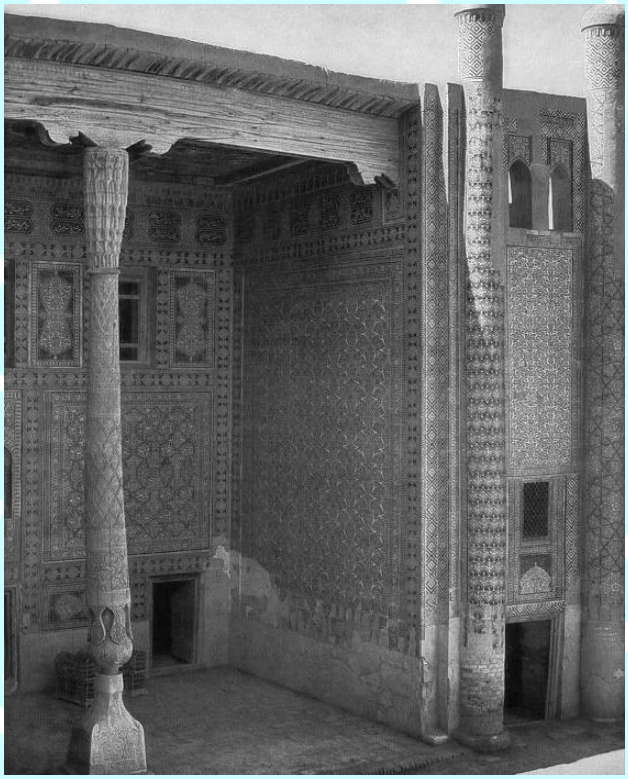
Natural and climatic conditions are a complex of factors: air temperature, humidity level, solar radiation, wind rose, precipitation and seasonal changes. These elements form the requirements for the organization of the learning space and the structural solutions of buildings [3].

Architectural science has developed a number of principles of climate-adaptive design:

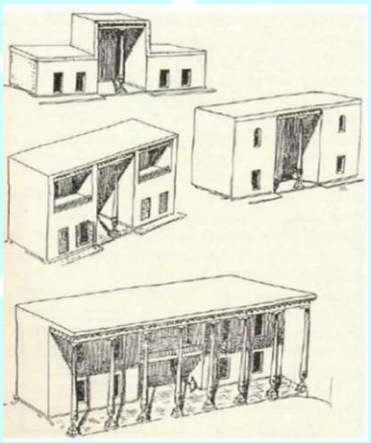
1. **rational orientation of buildings** to minimize overheating or overcooling of premises;
2. **regulation of natural lighting** due to the correct location of window openings and the use of sun protection structures;
3. **providing natural ventilation** to reduce the load on mechanical cooling systems;
4. **use of local building materials** with optimal thermal insulation characteristics;
5. **Integration of green technologies** such as vertical gardening, green roofs, rainwater harvesting systems.

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The historical experience of Uzbekistan demonstrates that traditional architecture has always taken into account climatic conditions. The mass use of aivans (canopies that protect from the sun), courtyards that created the microclimate of the building, massive walls made of pakhsa and adobe bricks made it possible to regulate the microclimate without the use of technical means [4]. These solutions today can be considered as the prototype of modern sustainable architecture.







Khiva. Tash-khauli. Palace of Allah Kuli Khan. Residential building in Khiva. Techniques spatial composition.

Modern research shows that competent consideration of climatic factors can reduce the energy consumption of buildings by 30–40% [5]. For educational institutions, this is especially important, since reducing operating costs frees up funds for the educational process, and favorable indoor conditions contribute to the health of students and teachers.

Natural and climatic features of the region (on the example of Samarkand)

The city of Samarkand is located in the zone of sharply continental climate, characterized by the following parameters:

1. hot and dry summers with temperatures up to +40...+42 °C.
2. cold winters with temperatures down to -10 °C and below.
3. high solar radiation, on average more than 280 sunny days a year.
4. low humidity in the summer months.
5. sharp temperature changes between day and night.

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These climatic features directly affect the architecture of educational institutions. Buildings without sun protection are exposed to overheating, which leads to a deterioration in the well-being of students and an increase in electricity consumption for air conditioning. On the other hand, in winter, with insufficient thermal insulation, there is significant fuel consumption for heating [5].

In comparison, in temperate European countries, the focus is on heat conservation, whereas in Samarkand, the primary concern is to protect against overheating. At the same time, the combination of hot summers and cold winters makes the design task more difficult than in regions with mild climates.

Thus, the design of technical schools in Samarkand requires an integrated approach: from the orientation of buildings to the selection of building materials and the integration of engineering systems that can adapt to seasonal changes.

Architectural and planning solutions of technical schools considering the climate

Vocational education institutions have a complex functional structure, including classrooms, laboratories, workshops, administrative premises and recreation areas. In the conditions of a sharply continental climate, the following design solutions become key:

1. **Orientation of buildings and premises.** It is advisable to place classrooms on east and north facades to minimize overheating. Laboratories and workshops that require more natural light can be oriented to the south but should have sun protection systems [2].

2. **Formation of courtyard spaces.** Courtyards create a favorable microclimate, provide ventilation and natural shading. In the conditions of Samarkand, such spaces can be used as recreational areas for students.

3. **Sun protection.** The use of canopies, canopies, horizontal and vertical blinds, screens made of local materials allow you to reduce the penetration of solar radiation and create a comfortable light regime.

4. **Energy-efficient materials.** Modern insulation, low-emission double-glazed windows, translucent structures with controlled sunlight transmission provide a balance between illumination and heat conservation [6].

5. **Green technologies.** The use of green roofs, vertical gardening, the use of solar panels and rainwater harvesting systems not only improves the environmental performance of buildings but also contributes to the education of environmental culture among students.

6. **Engineering solutions.** It is important to design ventilation systems with the possibility of natural air exchange, as well as to use modern microclimate control systems ("smart buildings").

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Thus, the architectural and planning solutions of technical schools in Samarkand should be based on a combination of traditional techniques that have been tested for centuries and modern technologies.

Foreign experience and adaptation opportunities

The world practice of designing educational institutions in a hot climate shows a variety of approaches:

•**India.** In the architecture of schools and colleges, natural ventilation systems and sunscreens are widely used. Many buildings are designed with open galleries and shade canopies, which significantly reduces the temperature inside the premises [7].

•**UAE.** "Smart facades" are used here, which automatically regulate the level of illumination and heat gains. Photovoltaic panels and energy recovery systems are actively used in educational buildings [6].





Dynamic, kinetic shell made of more than 1000 moving elements, controlled by a computer system.

•**Turkey.** A number of university campuses have implemented projects with double façade shells, creating buffer zones between the outdoor climate and the indoor environment.





MKM Attila Ilhan Salonu Cultural Center, Istanbul. Double-skin facade, consisting of two layers of glass separated by an air gap

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Europe. In temperate countries, attention is paid to the design of buildings with "zero energy consumption". Such schools and colleges use renewable energy sources and are as isolated as possible from climate influences.

For Uzbekistan and Central Asia, adaptation of these solutions is possible, considering local traditions and resources. For example, the use of solar panels can be combined with traditional yard shading systems. In addition, the use of green technologies has not only a practical, but also an educational function: students master the culture of environmentally sustainable behavior.





Trilliant Business Park, Tashkent Office buildings in IT Park, Tashkent
Green projects in Uzbekistan

Conclusion

Natural and climatic conditions have a direct impact on the architectural formation of educational institutions, and specifically technical schools, in the conditions of a sharply continental and dry-hot climate of Uzbekistan, considering such factors as solar radiation, high temperatures in summer and cold winters, becomes a necessity for the architectural design of comfortable and energy-efficient buildings of technical schools.

Modern architectural solutions that combine traditional experience and innovative technologies make it possible to create educational institutions that meet the requirements of sustainable development of the city of Samarkand. The adaptation of foreign practices in the conditions of Uzbekistan opens up new prospects for the design of educational institutions that will be functional, economical and environmentally friendly at the same time.

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