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ARCHITECTURAL CHALLENGES IN THE DESIGN OF GENERAL EDUCATION SCHOOLS: THE CASE OF THE "BINOM" SCHOOL IN ASTANA

ЖАЛПЫ БІЛІМ БЕРУ МЕКТЕПТЕРІН ЖОБАЛАУДЫҢ СӘУЛЕТТІК МӘСЕЛЕЛЕРІ: АСТАНА ҚАЛАСЫНДАҒЫ «BINOM» МЕКТЕБІНІҢ МЫСАЛЫНДА

АРХИТЕКТУРНЫЕ ВЫЗОВЫ ПРОЕКТИРОВАНИЯ ОБЩЕОБРАЗОВАТЕЛЬНЫХ ШКОЛ: КЕЙС ШКОЛЫ «BINOM» В ГОРОДЕ АСТАНА

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Keywords:
Architecture, school architecture, preliminary design, classrooms, comfortable environment. Architectural and planning solutions, secondary school, urbanization, functional zoning,

ABSTRACT
The article is devoted to the study of modern trends in the architecture of buildings for new standard secondary schools in Astana, identifying the features of the development of functional planning schemes. During the analysis, using the example of the BINOM school (Astana, A. Baitursunova St. 49A), planning solutions were identified, as well as their shortcomings that affect the degree of comfort in these structures and the quality of education that meets the requirements for conducting various forms of classes, which made it possible to consider the possibility of their adaptation and feasibility in practice. The main positive and negative characteristics were identified, which made it possible to analyze the directions of development of modern school education in Astana, which make it possible to give recommendations for updating the composition of premises and the nature of the formation of the planning structure. To systematize the problems, categories were formed: Architectural and planning safety problems, sanitary and hygienic (environmental) problems, problems of forming psychological comfort, Urban planning safety problems, Scientific and technical problems, etc. The discovered problems have a significant impact on the level of comfort and, accordingly, on quality of education provided. They are due to shortcomings in building codes and standards, which must take into account modern requirements and trends in the formation of educational institutions.

Түйінді сөздер:
Сәулет, мектеп сәулеті, алдын ала жобалау, оқу кабинеттері, жайлы орта.

ТҮЙІНДЕМЕ
Мақала функционалдық жоспарлау схемаларын әзірлеу ерекшеліктерін анықтай отырып, Астана қаласының жаңа типтік орта мектептеріне арналған ғимараттардың сәулетіндегі заманауи тенденция-

Сәулет-жоспарлау шешімдері, орта мектеп, урбанизация, функционалдық аймақтарға бөлу.

ларды зерттеуге арналған. Талдау барысында BINOM мектебінің (Астана қ., А.Байтұрсынова к-сі, 49А) мысалын пайдалана отырып, жоспарлау шешімдері, сондай-ақ осы құрылымдардағы жайлылық дәрежесіне және сабақтың әртүрлі формаларын өткізуге қойылатын талаптарға сәйкес келетін білім сапасына әсер ететін олардың кемшіліктері анықталды, бұл оларды тәжірибеде бейімдеу мүмкіндігі мен орындылығын қарастыруға мүмкіндік берді. Негізгі оң және теріс сипаттамалар анықталды, бұл Астана қаласының қазіргі заманғы мектеп білімін дамыту бағыттарын талдауға мүмкіндік берді, үй-жайлардың құрамын және жоспарлау құрылымын қалыптастыру сипатын жаңарту бойынша ұсыныстар беруге мүмкіндік береді. Мәселелерді жүйелеу үшін санаттар қалыптастырылды: Сәулет-жоспарлау қауіпсіздік мәселелері, санитарлық-гигиеналық (экологиялық) мәселелер, психологиялық жайлылықты қалыптастыру мәселелері, Қала құрылысының қауіпсіздігі мәселелері, Ғылыми-техникалық мәселелер және т.б. Табылған мәселелер жайлылық деңгейіне және сәйкесінше, ұсынылатын білім сапасына айтарлықтай әсер етеді. Олар білім беру ұйымдарын қалыптастырудағы заманауи талаптар мен тенденцияларды ескеруі тиіс құрылыс нормалары мен стандарттарындағы кемшіліктері айқындалды.

Ключевые слова:
Архитектура, архитектура школы, эскизный проект, учебные классы, комфортная среда. Архитектурно-планировочные решения, средняя школа, урбанизация, функциональное зонирование.

АННОТАЦИЯ

Статья посвящена исследованию современных тенденций в архитектуре зданий общеобразовательных школ нового типа в г. Астана, выявлению особенностей разработки функционально-планировочных схем. В ходе анализа на примере школы «БИНОМ» (г. Астана, ул. А. Байтурсунова, 49А) были выявлены планировочные решения, а также их недостатки, влияющие на степень комфортности в данных сооружениях и качество образования, соответствующее требованиям проведения различных форм занятий, что позволило рассмотреть возможность их адаптации и реализуемости на практике. Выявлены основные положительные и отрицательные характеристики, что позволило проанализировать направления развития современного школьного образования в г. Астана, позволяющие дать рекомендации по обновлению состава помещений и характера формирования планировочной структуры. Для систематизации проблем были сформированы категории: Архитектурно-планировочные проблемы безопасности, Санитарно-гигиенические (экологические) проблемы, Проблемы формирования психологического комфорта, Градостроительные проблемы безопасности, Научно-технические проблемы и др. Выявленные проблемы оказывают существенное влияние на уровень комфорта и, соответственно, на качество предоставляемого образования. Они обусловлены недостатками строительных норм и стандартов, которые должны учитывать современные требования и тенденции формирования образовательных учреждений.

INTRODUCTION

Throughout his life, a person goes through a long and thorny path, forming skills, habits and accumulating knowledge. Since ancient times, the human need for education contributed to the formation of educational institutions, but it should be noted that people received knowledge and information even before the formation of educational institutions, through individual learning. Education is crucial for human development, facilitates a healthy mindset and develops cognitive abilities (Sharma, D., 2020)

In modern society, the issue of education is becoming increasingly relevant. Education through the development of individuals also affects society as a whole and is a direct driver of its economic, social, political (and all other) growth and development (Tijanić Š, K., 2021). Secondary education is of particular importance as a compulsory and basic stage of education for all citizens. Social changes in recent years in Kazakhstan, particularly in Astana, create an urgent need for additional school education services, as evidenced by the wide range of offers from commercial organizations, such as development schools, gymnasiums, clubs and various studios, sports sections for schoolchildren, etc. The growth in the number of pedagogical methods and programs, the intensive introduction of non-traditional forms of conducting classes, the expansion of the range of developmental activities and games at school contribute to the need to conduct research to study the specific features of the formation of the structural organization of the modern architectural environment for secondary school education.

In the article: Chen, W.-T.; Liem, FN; Kao, C.-H.; Mubasher, M.; Lin, K.-H. Improving the satisfaction results of school renovation projects using fuzzy function deployment suggests designing schools using a QFD system.

QFD is a series of activities related to product development, process planning and manufacturing, focused on customer needs. QFD has been used to understand user needs, thereby reducing product requirement uncertainty among designers and engineers. The quality function is then used to translate user requirements into improved technologies (Sharma, D., 2020).

In the above article, the authors propose to use the fuzzy function deployment method in order to optimize the school design process using the QFD system, without paying special attention to the internal organization of premises and territory. It is important to note that the QFD system may be advisory in nature, and not all architects may be familiar with it in practice. In this context, this article proposes to look at specific schools and suggest improvements in accordance with local building codes and standards. This approach encourages more accurate and tailored school design to meet the needs of new educational institutions. Having considered updates to the composition of the premises and their relationship with each other and the territory of the site.

MATERIALS AND METHODS

– method of document analysis. At the initial stage of this research, literary and scientific material from design and regulatory documents was collected, then an analysis of the collected material was carried out. (“General educational organizations” BC RK 3.02-11-2011 *, preliminary design of a school at the intersection of St. A. Baitursynuly and A80 streets).

– the field survey method consisted of studying a number of new school buildings in the city of Astana.

– graphic comparison method

– method of generalizing the results. Due to the scale of this study, at the final stage, a generalization and clarification of the results obtained is carried out.

RESULTS AND DISCUSSION

The purpose of the study is to form the prerequisites for updating the composition of premises and their relationship with each other and the territory of the site, determining the updated composition of premises necessary for carrying out the modern educational process, establishing their logical functional connections between individual premises or their groups and identifying shortcomings.

School buildings and facilities constitute essential educational infrastructure and have a formative impact on the safety, development, and socialization of students (Katic, D.; Krstic, H., 2021).

The formation of the educational process is directly reflected in the architecture of educational institutions. Modern types of school education involve differentiation of approaches to teaching methods, and therefore complicate the very function of interaction between the pedagogical and methodological-psychological team and students.

In addition to contributing to accidents and physical security concerns (Liu, S.S., 2021) failure to maintain school buildings properly and effectively can also negatively impact student health and safety (Norazman, N.2019)

Despite the fact that Astana is a metropolis and the capital of the republic, the lowest number of urban schools was recorded in this city – 147 units. According to the Bureau of National Statistics, the number of students in the capital in 2022 is 212.3 thousand people, divide it by the norm 1100 students for one school and we get 193 - this is how many schools there should be in a metropolis. And we have 147 of them, it turns out that the shortage of schools in Astana is 46 units. And this is only official data.

A recent academic paper on school architecture by Prakash Neiar, Rendall Fielding, S. William Brubaker, Vark Dudek and others provides an extensive analysis of contemporary approaches to the design and construction of educational institutions. The article highlights key aspects of school architectural design, including the use of space, instructional technology and the provision of a learning environment.

It is important to note that this study, despite its significance, does not exhaust all aspects and problems in the area under consideration. Our article aims to fill some gaps and overlooked aspects in previous research, enriching the general understanding of this topic."

The authors focus on the importance of creating an environment conducive to children's learning and development. They discuss design principles that maximize the effectiveness of the learning experience, and also incorporate current trends such as the use of technology in education and addressing the needs of diverse learners.

They also consider aspects of sustainable architecture and environmental sustainability in the construction and operation of school buildings. The authors emphasize the importance of a balanced approach to architecture that takes into account the needs of students, teachers and the environment. They will also illustrate the concept of Smart Healthy Schools (SHS) and, in particular, SHSS equipped with wireless Internet of Things Sensors (IoTSHS) and display units for optimal monitoring of indoor air quality through manual ventilation and/or mechanical ventilation cycles.

Modern technologies, intellectual communication systems and new teaching methods require new forms and spaces for learning. They are also forcing architects and designers to develop unique solutions for school architecture. The visual aspect is of great importance, as architecture can be an additional tool for motivating and inspiring students. The psychological perception of children allows non-standard forms, solutions and interiors to become additional incentives for cognitive activity.

A modern school must meet the criteria of a space that will provide comfort and safety for students. The school building and the surrounding area must meet safety and sanitary requirements. It should be noted that it is the comfortable stay of students that increases the productivity of the educational process. This issue concerns not only classrooms, but also corridors, recreation areas, playgrounds, lobbies, library-coworking spaces - i.e., the comfortable, convenient formation of a system of spaces and social and functional zoning in general is considered.

BINOM school is one of the specific projects in the field of education, implemented through a public-private partnership mechanism between the innovative construction holding BI Group and the city administration of Astana.

Each BINOM school is a 5-story building, which has 127 classrooms, 9 expanded laboratories in physics, chemistry, biology, nanotechnologies and biotechnologies. There is also

a cinema hall with 100 seats, co-working areas for teachers and children, a television studio, game rooms, smart classes, a 3D printer for creative experiments, robotics classrooms, metal and wood carving workshops, Speaking Club, Tedx B, etc. Open a canteen, a medical center and a library, which contains 5,000 popular publications of Kazakh and foreign writers, leading classics of the world. In addition to desktop computers, the school also provides laptops for the learning process.

One of the advantages of schools is the possibility of inclusive education. BINOM SCHOOL has created a comfortable learning environment for children with special educational needs. Two gyms and several outdoor playgrounds will allow children to play football, volleyball, basketball and other sports; there is also a work-out area. In addition to the positive aspects, it is necessary to identify the problems. The final result of the construction project is then turned over to the user, and ends with the operation and maintenance phases (Chen, W.T., 2013).

A general overview of school building facilities included a study of the problems of forming an architectural environment for school education. As a result of studying the objects of the BINOM school, the following characteristic points and problems of forming the architecture of buildings for secondary school education were identified:

Categories were formed to systematize problems

Architectural and planning safety problems:

– doors from classrooms open into a common corridor, thus reducing its width and creating a traumatic situation;

– fire escapes are located near the outer wall and lead outside, however (four of the six ladders) lead children into a “well” that has formed in the structure of the building and has only one exit. If this tunnel is closed by a fire truck or there is a fire in it, then it will be impossible to get out; (Fig. 1).

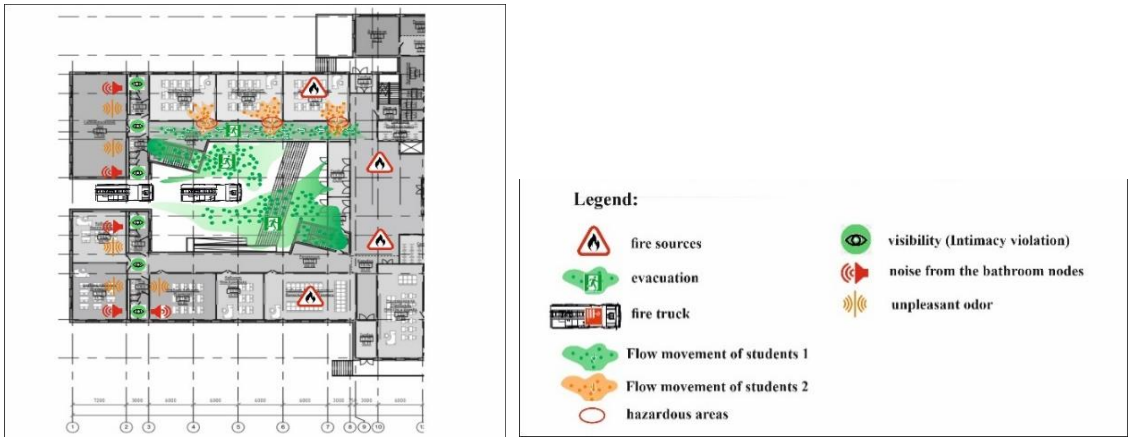

Figure 1. Fragment of the agreed preliminary design of the BINOM school (Astana, A. Baitursunova St. 49A)

Note – diagram created by the author (Ozhet, 2024)

Problems of forming psychological comfort:

– exit from the san. nodes and changing rooms are directly connected to the common corridor, which causes inconvenience when using these premises if the door opens;

– the offices have an adjacent wall with the bathroom. nodes. In this regard, the following problems may arise:

1. If sanitary facilities are poorly ventilated or have drainage problems, odors can permeate classrooms, which can be unpleasant and distracting for students and teachers.

2. Sanitary facilities can be a source of noise, especially if they have plumbing fixtures such as flush toilets or shower stalls. This can interfere with students' concentration and make class difficult.

3. Privacy Issues: If washroom walls are poorly soundproofed or have insufficient partitions, this can create privacy issues for students and school staff.

4. Hygiene: If sanitary facilities are poorly maintained and kept clean, it can lead to the spread of bacteria and infections into adjacent rooms.

5. Safety: If sanitary facilities have problems with water supply or electricity, this can create potential dangers for students and school staff.

Architectural and planning problems:

– in the gymnasiums, located according to the project on the first floors, there are no dressing areas or toilets. Nodes; The lack of changing rooms and sanitary facilities in the gym can lead to inconvenience, poor hygiene and limited training opportunities. (FIG 1);

– on the fourth floor, according to the project, there are premises (school television studio and music room, choreography studio and school film and photo laboratory) that do not have natural light; Lack of natural light can have a negative impact on the health and well-being of students. They may experience fatigue, headaches and lethargy due to lack of light. This can lead to decreased productivity and concentration during classes. It is important to gain insight into how children feel about the quality of their physical environment (Russo, A., 2023).

– also on the third and fourth floors there is a co-working area, which is a walk-through and in its structure there are entrances to other educational premises;

– scattered classrooms, physics classrooms, etc. scattered throughout the floor;

– virtual absence of recreation areas.

Sanitary and hygienic (environmental) problems:

– there are no green protective zones on the territory; Therefore, problems such as street noise insulation and an increase in thermal effect may arise. Green areas act as natural coolers, absorbing solar radiation and reducing the heat gain (Eaton D., 1998). The lack of green areas can lead to elevated temperatures on school grounds and create uncomfortable conditions for students and staff.

– natural ventilation is provided by small windows, which are not easy to access due to the height of the floor;

– the project does not fully consider the insolation of the premises; some of the classrooms face north;

– insufficient consideration of the orientation of specialized premises (chemistry, physics, computer science classrooms); it is advisable to orient these zones to the east to reduce overheating in these premises. And for better natural ventilation (Design for learning forum. 2006), they need to be designed with double orientation.

The importance of daylight and indoor air quality are now givens for increasing student achievement. Participants agreed that other environmental factors, including lighting, sound, heating, and nontoxic materials, deserve greater attention (Dudek M., 2012).

Urban planning safety issues:

– in the urban planning plan there are vertical differences (to the entrance group, to the sports zone, at the entrance to the school territory), which leads to the formation of a staircase. These architectural elements in the climatic conditions of Astana pose a danger due to the abundance of precipitation, and we should also not forget that they are used by children of different ages (FIG 2); also take away useful area of the territory

– on the site there are steep slopes of the sites, which are hazardous. As a result, the school administration puts up a “second fence” and this territory is difficult to exploit.

In general, the irrational use of school grounds, additional fences and steep slopes on the territory, can create problems with accessibility, safety and the irrational and functional purpose of the space.

Urban planning problems and inconsistency of the project:

– the preliminary design does not correspond to the actual state of the building (there is no running track, training and experimental area, parade ground, greenhouse);

– placement of the transformer substation and solid waste site at the main entrance; A solid waste site can emit unpleasant odors and attract rodents and insects. (Mamedov S., 2021) This can become a source of pollution and a threat to human health, especially if it is located close to the main entrance.

– the entrance to the building is located far from the entrance to the site;

– a small number of entrances to the territory, not full coverage of the residential area;

– storm water from the school grounds flows onto the sidewalk;

– shade canopies are not provided in open spaces; (few of them);

– incomplete coordination with the road transport network (there is a part of the road into the fence);

– not enough parking spaces;

– there are no places to load the school catering unit (the car drives along the sidewalk);

– failure to consider the main pedestrian routes on the school grounds, resulting in the appearance of makeshift paths. (Fig. 2).

School grounds can provide a wealth of interest and resources for both personal and social education. Such direct experience in observation, investigation and participation in design and development of grounds helps pupils to be informed, responsible and enterprising (BC RK 3.02-111-2012).

Figure 2. Comparative analysis of the agreed preliminary design BINOM schools (Astana st. A. Baitursunova 49A)

Note – diagram created by the author (Ozhet, 2024)

The school territory as a third teacher is a rich and diverse continuation of the educational space. Classes, events and sports competitions can be held here. In greenhouses, special gardens and vegetable gardens, plants can be grown for scientific and educational purposes. Nature inside and outside is important, since the landscaping of the school grounds has both a sanitary and educational function. (BC RK 01-03-2013).

Scientific and technical problems:

– there is no provision for an air conditioning system or fresh air supply in classrooms (except for specialized ones);

– there are no places for air conditioning.

Buildings with poor ventilation, inadequate lightning and acoustic conditions, and unfavorable heating or cooling systems have direct consequences on welfare factors and impact the larger environment.

Socio-economic problems:

– the formation of open “wells” in which large porches are located is not entirely justified socio-economically, it is difficult to remove sediment in this space, the degree of comfort of its use is low;

Common problems:

– absence (or very weak) connection of the elements of the master plan with the architectural and planning structure of the school building.

The difference between the educational environment and a typical educational institution is that in the first case, virtually every fragment of space has educational potential.

CONCLUSION

A growing body of research shows that the quality of the physical environment affects users' stress levels, physical and mental health, and self-esteem. An assessment of the attendance of school buildings shows that problems related to environmental comfort are common, indicating the need to reconsider the necessary parameters. For school architecture to embrace its important role in new educational goals, the design process must change to enable practitioners to meet current requirements within local constraints.

By recognizing and actively working to address these modern challenges in new school buildings, we can ensure that these spaces truly support high-quality education and provide students with an environment that promotes their academic growth, overall well-being, and prepares them for academic success. 21st century.

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