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Modern Directions in School Buildings Formation

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Abstract

The purpose of the article is to identify modern areas in designing the network and buildings of general secondary education institutions on the example of Ukraine. In the course of the research, the preconditions for forming the network and buildings of different school types were analyzed. In particular, the existing network, material and technical base of schools were considered, their features were revealed. Based on the study of modern socio-pedagogical and architectural and urban factors, the requirements for the architectural and planning organization of school buildings have been identified. It was established that the existing material and technical base of general secondary education institutions does not fully meet these requirements. The generalization of the theory and practice of the school buildings formation in developed countries of the West, Ukraine and the countries of the post-Soviet space allowed to identify the latest trends in the design of general secondary education institutions. The authors provided suggestions on the territorial educational districts formation as a promising direction for improving the school network. The perspective types of general secondary education institutions, which are formed on the basis of interagency integration with other objects of cultural and household services, are revealed. Methods of school buildings architectural and planning organization that meet the modern educational process requirements are developed.

Keywords: *interdepartmental integration. ,school building, school network, territorial educational district.*

1. Introduction

The strategic objectives of reforming education in Ukraine are the development of a national education system, ensuring the priority of human development. The general secondary education in the state is aimed at the comprehensive development of the individual through education, upbringing and development, based on universal values and principles. [1-3]
The main idea of reforming the educational industry is the transition from theoretical training to the formation of modern competencies that allow solving practical, individual and professional tasks. The bulk of institutions of general secondary education was built mainly in the second half of the twentieth century (Fig 1-3). Their architectural and planning organization meets the requirements to the educational environment of those times and does not fully meet modern socio-pedagogical requirements. In the context of the introduction of new approaches to education in Ukraine, there is a need to improve the principles of networking and building of educational institutions. [1-4] In today's conditions of reforming the Ukrainian state, there are significant changes in the system of cultural and domestic services of the population, the state of which is lower than the regulatory requirements. [5] This leads to an increase in the social role of schools, especially in rural areas, and creates the preconditions for the functioning of the institution of general secondary education as a public center. [6-8] Such schools play the role of a cultural and educational institution in the living environment, and their educational, sporting, general-purpose facilities can be used not only by children but also by the adult population. The network of institutions of general secondary education needs to be developed and improved, and conditions of stay of children and youth in buildings and on land sites of the establishments must be in line with modern socio-pedagogical and architectural and town-planning requirements.

2. Research methodology

During the study, the network of schools and buildings of institutions of general secondary education was systematically considered in the light of modern socio-pedagogical and architectural and construction requirements.
Methodological algorithm for scientific research consists of stages:
- analysis of socio-pedagogical prerequisites for the formation of a network of institutions of general secondary education;
- identification of modern requirements for the construction of a school network and architectural and planning organization of school buildings;
- development of scientifically grounded proposals for the improvement of the school network and the architectural and planning organization of buildings of institutions of general secondary education.

To determine the socio-pedagogical requirements for the architectural and planning organization of school buildings, modern pedagogical research, experience of innovative pedagogical activity was studied. In this case, methods of qualitative, quantitative, comparative analysis were used. The methods of structural-functional and graph-analytical modeling were used in developing proposals for promising network organization. The method of experimental design was used to formulate proposals for the organization of the network in specific urban planning conditions. The methods of statistical and factual analysis of literary sources, design documentation on the subject of research, field surveys and

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photos of available school buildings were used to determine the features of the existing school network and perspective directions for the formation of school buildings.
Problems of the formation of educational institutions in different years were devoted to the research of Kovalsky L.M., Kutsevych V.V., Stepanov V.I. Features of functional-planning decisions of school buildings are considered in works Klochko A.R., Korovin O.A., Svendsen D.L.H. and others. The problem of school buildings mismatches with new requirements and school services in general has been investigated by Prakash Neiar, Rendall Fielding, S. William Brubaker, Vark Dudek and others. In these works the search for new forms of school buildings, as well as new principles for their design and location in the structure of settlements.

3. Socio-pedagogical preconditions and conceptual foundations of the school buildings formation

The humanization and democratization of society, the dynamism inherent in modern civilization, the rapid change in technology and technology around the world requires the creation of conditions in which the people of Ukraine have acquired education that fully meets the requirements of the present. [4] The formation of institutions of general secondary education in varying degrees is influenced by socio-economic, pedagogical, urban, architectural and constructive factors. [8]
The initial conditions for the functioning of the education system in Ukraine are legally established provisions on the integrity and continuity of the education system; compulsory full secondary education; the unity of education, education and development; the availability of every citizen of all forms and types of educational services provided by the state. Educational levels are defined by the Law of Ukraine "On Education" - elementary education, basic secondary education, specialized secondary education, which are acquired in institutions of general secondary education of I, II, III degrees. These institutions may function separately or be structural units of one legal entity (educational institution).
In accordance with the state strategy of reforming the educational field of the country in the formation of institutions of general secondary education, it is necessary to provide:
- accessibility of education for all children and young people of the region regardless of place of residence;
- possibility to choose institutions of general secondary education;
- improving the quality of educational services, the efficiency of the educational process;
- variability of educational services taking into account individual inquiries;
- diversification of the forms of organization of the educational process;
- creating conditions for the development of the abilities of each child, as well as for the education of children with special needs;
- compliance with the requirements of economic expediency and efficiency of educational institutions in the region;
- rational concentration and effective use of material, financial, human resources. [1-4]

A characteristic trend for Ukraine is a steady increase in the share of urban population. This creates some problems in urban construction, especially in providing residential areas with educational institutions. Market economic conditions, the transfer of land to long-term leases radically changed the urban development situation in the country. In most cities there are no vacant plots of sufficient space for the construction of schools, which requires new approaches to the architectural and planning organization of the school building. [9]
Accessibility and quality of education for rural residents remains the main problem in rural areas of Ukraine. The features of the functioning of schools in rural areas of Ukraine are due to their low filling capacity. The establishments of general secondary education of low filling are distinguished by the higher cost of education, the lack of a sufficient number of qualified teachers, the methodological isolation of teachers, the impossibility of choosing by a student of an individual educational trajectory, the inadequate socialization of students. [8]



Fig. 1: Existing school buildings in Ukraine.

In accordance with modern pedagogical requirements, the purpose of education is determined by the main social task - education of a harmonious creative personality. In accordance with this goal, forms and methods of training are being built up; the share of project, team, and group activity in the pedagogical process grows. In order to achieve this goal, an updating and space-subject environment, means of training are needed. [4] Planning and design of the educational space are aimed at developing the child and motivating her to study.

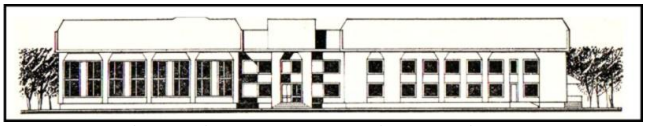


Fig.2: The facade of a school building of the 80s of the XX century.

The existing school buildings were formed from buildings built on typical projects mainly in the second half of the twentieth century (Fig 1-3). The development of architectural and planning organization of school buildings is constantly in the direction of increasing the composition and areas of school premises. [10,11] As a result, there is a functional aging of school buildings, which is due to insufficient number of necessary premises of sufficient space. Such phenomena create requirements for the educational process, which are systematically updated. This leads to the re-equipment of classes for training facilities of another purpose, reducing the number of student cities. The consequence of this is the deterioration of functional-planning and operational qualities of school buildings. In addition, the physical deterioration of these buildings is much slower than the moral. Such a contradiction between the satisfactory physical condition of the building and the very unsatisfactory planning requires finding new principles for their organization aimed at increasing their effectiveness.
The planning structure of existing school buildings is traditional and consists of separate cells (classes, offices, laboratories) that have a constant size, shape, grouping, the transformation of which is impossible. [11] These premises are usually specialized. Students have their training in classes; they rest in recreations, and have classes on a particular subject in offices and laboratories. This leads to the ineffective use of the school building. The solution to this problem will be facilitated by conducting training sessions not only in the training rooms, but also in other premises, in particular, general schools.



Fig.3: Existing school building in Ukraine.

The disadvantages of existing school buildings also include:
- complex form of buildings, which affects the increase of the surface of external walls, leads to additional costs and reduces their energy efficiency;
- complication of the shape of the building leads to a violation of the visual and spatial orientation of the child in the interior, creates inconvenience in the use of vertical horizontal communications;
- absence of natural light in the assembly hall and the presence of stationary seats, which limits the possibility of using it as a training room (Fig. 1-4). [12]



Fig. 4: The project of a secondary school for 500 people in Baturyn, Chernihiv region. General view. Architects G. D. Bilyavskaya, P. V. Velichko, and others. 2012.

The issue of organizing the architectural environment for inclusive education in institutions of general secondary education deserves particular attention. According to democratic and humanistic world standards, humanity is now transforming into a new ideological paradigm - "a united society," which includes the desire to deinstitutionalize and socially integrate people with peculiarities of psychophysical development. A new cultural and educational norm is formed, it is new to people physically and intellectually disadvantaged.
By ratifying the main international legal instruments (UN Declarations "On human rights", "On the Rights of Persons with Disabilities", UN Conventions "On the Rights of Persons with Disabilities", "On the Rights of the Child"), Ukraine has committed itself to respecting universal human rights, in particular as regards obtaining quality education for children with special educational needs, including children with disorders of psychophysical development. The Law of Ukraine "On Education" stipulates that state authorities and local self-government bodies shall create conditions for the provision of the rights and opportunities of persons with special educational needs in order to receive their education, taking into account their individual needs, capabilities, abilities and interests. The buildings, constructions and premises of educational institutions must meet the requirements of accessibility. To do this, the appropriate conditions must be created by providing a reasonable fit and a versatile design. [13]
One of the key issues in the organization of inclusive education in the schools that are operating and projected was the provision of an architectural barrier-free environment of these institutions [1-4]. In order to educate children with special educational needs (children with physical and mental disabilities, including children with disabilities) in institutions of general secondary education conditions are created to ensure unimpeded access to buildings, premises, elements of land plots of such institutions for children with deficiencies of locomotor system, in particular those who move in wheelchairs, and children with hearing and vision impairments. [13]
Analysis of existing school buildings and experience of their operation, project proposals, socio - pedagogical preconditions for their design allowed to determine the perspective tasks of their designing on several criteria:
- development of new city-based approaches to the formation of a network of institutions of general secondary education;
- development of measures to increase the efficiency of the operation of the building by increasing the load on the premises, their multifunctional use;
- provision of the organization of inclusive education;
- formation of internal space of buildings with inclusion in the educational process of rooms of the general school unit;
- search for new approaches to the design of the building, aimed at improving its aesthetic, operational qualities, microclimate of the building;
- search of methods of architectural and planning organization of a school building, aimed at preventing its moral aging.

4. Proposals for the formation of buildings for institutions of general secondary education.

Creating a high-quality network of educational facilities and ensuring accessibility to schools at the place of residence of children is one of the most pressing current problems. An analysis of the theory and practice of forming a school network, modern pedagogical studies confirm that the creation of full-fledged material and technical base of schools near the students' homes is impossible. This is justified by the lack of necessary financial and human resources, and in cities - the lack of residential areas, especially in historical buildings, free areas for the construction of new school buildings. [9]
According to the current research in the field of the formation of educational systems, pedagogical technologies, foreign experience for improving the school network, it is promising to apply measures based on the cooperation of resources within the group of schools. The idea of co-operation of resources is relevant in the current conditions of the crisis situation in the social sphere, the limited financial, personnel and material resources that are available in the education system. Measures based on the principle of co-operation of resources include the integration of educational institutions with cultural and educational institutions, health care institutions through the development of relations between them, the formation of a unified management infrastructure, the distribution of material and technical resources, human resources, information and methodological support. [8]
An effective way to implement the principle of resource cooperation is to create educational districts. The formation of territorial educational districts is aimed at solving the problem of the effectiveness of educational services, through the consolidation of resources within a group of schools. The educational district is considered as a form of interaction between educational institutions, which is carried out through the purposeful and organized involvement of educational resources of institutions of different levels of education, forms of ownership, subordination. [10]

Educational districts consist of reference and magnetic secondary schools. Educational establishments with developed educational material and teaching-methodical base, convenient location and equipped with qualified pedagogical personnel are defined as supporting ones. When determining the reference establishments, it is also necessary to take into account the prospects of socio-economic development of the territory, demographic trends and other local conditions.

Support schools serve as centres of methodological work, provide advisory and methodological assistance to teachers, conduct optional classes, special courses, training sessions that correspond to their specialization, provide magnetic schools with methodological and educational literature. Such schools have an expanded educational and material base, may have a boarding school with appropriate facilities for short-term or long-term residence of students. Magnetic schools carry out their activities on the basis of cooperation with supporting ones. Thus, in accordance with the new provisions and modern educational requirements, in the conditions of the formation of territorial educational districts, the educational process is ensured not only within the framework of a specific institution of general secondary education, but also on the basis of other types of educational institutions that interact with each other. [8]

An effective measure for increasing the efficiency of the school network is the use of multifunctional types of school buildings, which are formed on the basis of inter-departmental integration of the institution of general secondary education and other institutions of cultural and household services (Fig. 5). The effectiveness of such measures is confirmed by domestic and foreign experience of multifunctional rural public buildings. The establishments with which the integration of educational institutions is possible should meet the requirements of social and pedagogical expediency, compatibility of functional processes, the presence of identical premises and conditions for the creation of universal spaces, the unity of the three - dimensional planning structure and constructive systems, the possibility of combining flat structures.

Taking into account the preconditions for the integration of the institutions of cultural and household services, the following main typological groups of multifunctional school buildings are used to form the school network:

- socio-cultural centre (a magnetic or basic institution of general secondary education, a preschool institution, a leisure facility, institutions of extracurricular and primary vocational education);
- cultural and educational centre, (a magnetic institution of general secondary education, a leisure facility, a library, a museum);
- educational complex (magnetic institution of general secondary education, institutions of preschool and institutions of extracurricular education);
- educational and sports complex (foundation of general secondary education, institutions of extracurricular and primary vocational education, physical culture and health institution). [10]

Application of multifunctional types of school buildings, expansion of the composition and areas of club and sports facilities of a school building creates preconditions for functioning of the institution of general secondary education as a cultural and educational institution, promotes growth of its social role in the living environment and allows it to be used not only by children but also by the adult population. [6]

The generalization of the practice of designing and building schools in the developed countries of the West allowed to identify positive directions for the formation of buildings of institutions of general secondary education, aimed at improving the efficiency of their operation:

- the integration of educational facilities of one functional purpose into one module. For example, the art module forms a room for spectators, halls of music classes, school theater premises; the module of applied technologies (offices of different directions of creative activity, including fine arts, modeling, design, etc.); natural science module (cabinets of physics, chemistry, biology, laboratories, experimental platforms); sports module (several sports halls, including a room for team games, a gym, a fitness room, lockers, showers, coaches); administrative module; library module (media center); dining room module (often blocked with atrium modules or dining room dining); module of technical premises;
- wide application of the upper and second light for additional illumination of the educational premises;
- allocation in a three-dimensional planning decision of the building of the school of the main communicative spaces for the convenience of orientation (corridors, recreation, galleries, mezzanines), which unite all functional modules with the space of the atrium;
- use of forums both in the interior space of buildings and on external platforms;
- high coefficient of efficiency of using the area of the building due to flexible planning and multifunctional use of premises; (the ratio of the area of educational and auxiliary zones is 70% - 30%) (Fig. 6,7). [12]



Fig. 5: Multifunctional community school in Achtmaal, The Netherlands. General view, plans, interior of the public place. Atelierpro, 2015. *Photo© Atelierpro*



Fig. 6: Elementary school in Thiantai, China. General view, courtyard. LYCS Architecture, 2014. *Photo © Yu Xu, Shengliang Su*

Flexible planning will allow the adaptation of school buildings to changing requirements and conditions, by minimizing the amount of construction and installation work, time and money. This contributes to the improvement of their operational qualities and the efficiency of investments. [11,14]

The use of flexible planning techniques will create a building that will have adaptive properties. These techniques include:

- versatility (multifunctionality) of premises and space of a building;
- transformation of the premises and the possibility of internal redevelopment;
- perspective development of the building. [14]

The composition of school premises can be reduced by universal and multifunctional use. Educational premises of the universal standard is one of the means of extending the functional longevity of the building, as it allows to redistribute the appointment of premises due to their re-equipment when changing age streams, the direction of labor training, the nomenclature of circles, and so on. In this case, the premises are preserved for a long time - the school year and longer. On the other hand, universalization involves the use of the same specialized premises for the organization of training in various forms (individual, group, frontal classes, etc.) and for various types of activities. The layout of the learning process changes during the lesson, which is associated with a change in equipment arrangement, which should be easy and mobile. [11]

Flexibility of educational facilities, recreation and versatile facilities is ensured by:

- on the basis of a large subject area, the possibility of differentiation of space through the transformation of premises (large, medium, small premises for various forms of occupation and number of students);
- possibilities to provide zoning of the primary cell (class, cabinet, etc.) for multipurpose use with transforming equipment and furniture;
- intensification of the operation of premises through their universal (multifunctional) use;
- provision of short communication links between the training areas, inside the training section, within the training area;
- complex engineering of the building based on the wide use of transformed partitions, screens, mobile equipment and furniture; progressive microclimate systems, natural, combined and artificial lighting (upper sources of lighting) and other technical means; effective acoustic and soundproof materials, etc.

Transformation of the premises carries a functional load like a universalization. Possibility to combine two or more study rooms with each other within the classes or study sections allows providing such functional and planning conditions, which will easily pass the necessary educational process. Ensuring the possibility of transformation of study facilities through the design of sliding partitions is most effective from existing methods of transformation in schools. In addition, the use of modern materials and structures allows carrying out this process quickly, efficiently and without violation of the necessary sanitary and hygienic requirements and other requirements for these premises. With this solution, it is possible to combine several rooms in one for the purpose of conducting lessons in the format of the game, lectures, workshops, seminars, etc. with the participation of one or more teachers and tutors, with the possibility of easy transition to the standard premises of the main configuration and filling. [14]





Fig. 7: DH Triangle School in Donong-dong, Korea. General view, interior. NAMELESS Architecture, 2015. *Photo© Sun Namgoong*

In buildings of new types, the entire useful area is considered as a continuous extension of interconnected premises with a maximum reduction in the area of communications. This is provided by the design of non-transit zones, which are used as multifunctional space: an area of individual classes and lectures, a recreation area, expositions, etc. At the same time, a significant economic effect of reducing the area that is not used is achieved. In this case, the necessary psychological effect is provided, in which there is prac-

tically no sense of homogeneity and attachment of the student to the classroom, with the possibility of solitude in the process of preparing for classes or rest (Fig. 8).



Fig. 8: Novopechersk school in Kiev. Interior of recreation. Architects Bogdanov AI, Dobrovolskaya O. O. and others, 2014.

An important area of improvement of architectural and planning decisions of institutions of general secondary education is to provide a safe and friendly environment for a school building (Fig. 9). The sense of alienation, lack of interest in school is one of the reasons for the students' asocial behavior. To solve the problems of school safety in a comprehensive way, it is necessary to minimize the impact of physical and psychological threats. The causes of these dangerous phenomena are overcrowding of schools, lack of space, lack of storage places, intersecting streams, sharp corners, slippery floors, poorly secured equipment, drafts, deafening corners, blind zones, unsightly and non-modern look of school interiors, inadequate equipment quality and finishing materials of premises.



Fig. 9: Mesterfjellet School in Larvik, Norway. Interior of the public space. CEBRA Architecture. 2014. *Photo © CEBRA Architecture*

At the stage of designing new schools and the reconstruction of existing ones it is necessary to plan a safe space that is freely inspected, to avoid congestion and collisions of diverse flows of students.

Stairs are one of the most traumatic places in the school, they cause hazards associated with narrow marches, open spans, slippery stairs, lack of railings, poor lighting, uncontrolled crowds, collision of streams, and more (Fig. 10). The lobby is an important communication space in which students interact throughout the day. In foreign schools, the lobby is usually one intact with the entrance group. In the domestic schools, constructed on typical projects, the lobby is most often built as a separate space. Provision must be made for zoning of the lobby and thought-out tools for separating the flow of students. Different means are used for zoning and separation of flows students, among them are color and light markers, floor marking, ceilings and walls, benches and upholstered furniture, clothes cabinets, and more.

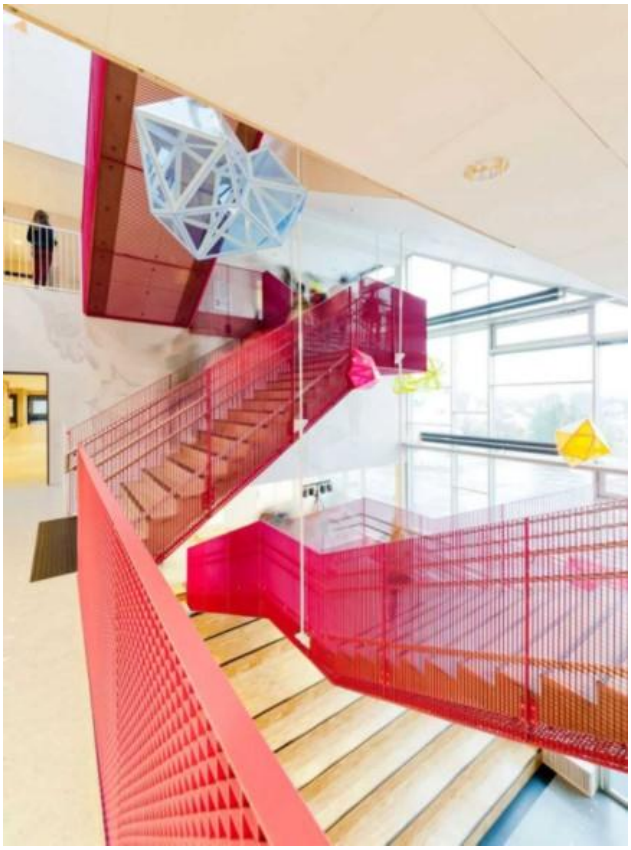


Fig. 10: Mesterfjellet School in Larvik, Norway. A fragment of stairs in the interior. CEBRA Architecture. 2014. *Photo © CEBRA Architecture*

In order to create an attractive environment for a school building, it is recommended to use color, modern decorative materials and comfortable furniture, to create spaces that are comparable to the child. [15]

The introduction of inclusive education, the ability to use the building for people with disabilities determines its architectural accessibility. The availability of the building involves the implementation of special measures to adapt to the needs of disabled persons entering the group (approaches, porch, vestibule). In the school building, all rooms intended for use by visitors should be accessible to people with disabilities and designed in accordance with the principles of universal design. The peculiarities of physical and mental disadvantages of children, the absence or partial violation of certain sensory sensations are caused by the introduction of various landmarks and aids (visual, tactile, gelfotechnical) into the environment, providing sufficient safety and speed of movement. [13]

3. Conclusions

As a result of the research, it was established that the architectural and planning organization of existing buildings of institutions of general secondary education does not fully correspond to modern

socio-pedagogical, architectural and urban conditions. To improve and design new school buildings, it is necessary to determine the current trends and methods of forming institutions of general secondary education.

In the course of the study, it was found that in the current conditions of limited material and technical, personnel and territorial resources it is expedient to form a network of institutions of general secondary education as a holistic hierarchical structure based on territorial educational districts. Structural elements of these formations are base schools that have a developed material and technical base and act as resource centers for magnetic schools. The use of multifunctional types of school buildings (socio-cultural, cultural and educational centers, educational, educational - sports, educational and residential complexes), especially in rural areas, will contribute to the availability of quality education and the effectiveness of the school network.

It is recommended to use compact volumetric planning schemes and flexible planning techniques (transformation, multifunctional use of premises, availability of reserve areas) to ensure the architectural and planning organization compliance with modern socio-pedagogical requirements, increase the efficiency of operational qualities, and prevent the moral aging of school buildings.

For the comfortable organization of inclusive education, it is necessary to provide measures for the availability of a school building for the small-scale people of different categories and to implement its planning on the basis of the principles of universal design.

When designing institutions of general secondary education, special attention should be paid to creating a safe child-friendly environment. This involves the formation of well-controlled transparent spaces of the school building, the organization of student flows, the design of safe stairs, the constant lighting of all premises, the active use of color, modern materials and equipment.

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