Using a Systematic Approach in the Analysis of the Factors That Influence On a Form Formation of Buildings of Higher Educational Establishments

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Abstract. This material covers the row of basic factors that influence on architectonically-spatial solution formation of building of Higher educational establishments (hereinafter universities). For this purpose, the systematization process of factors that influence on the university architecture was conducted and presented. The conclusion of this article was the proposed concept of considering universities as a hierarchical system, elements of which act as factors of influence, which in the process of alternating influence lead to the main goal, namely the formation of a new university building.

1. Introduction
Historically folded so, that the universities were born new knowledge, formed scientific hypotheses and theories, universal outlook on life and man. A university sent his activity to the grant of universal knowledge to the young people that formed the intellectual society elite [1]. Therefore and in the modern world higher educational establishment is the inalienable constituent of society life and development. For the last halves a century, due to modernization and change of architectural approaches, universities cardinaly changed the vector of the development.

In different times an architectural form has undergone various influences from the controversial world. Historical development changed society gradually, and in turn it changed architecture too. The last century witnessed mushroom growth of technical progress and an architectural form just similarly acquired characteristic features of this time. A unique feature this time is transience. For one century architecture changed the "clothing" several times, although in past ages it would take much longer. All of it is the display of active modification of factors that mightily influence on architectural form formation [2].

2. Review of basic form formation factors
Necessary pre-condition of architectonically-spatial decisions research of university building is all-round consideration and systematization of all factors that influence on their forming. Factors show a reason, motive force of form shaping process of any building.
Systematization of factors that influence on form formation of universities building conduct by determination of all factors (general amount) and them further analysis with the aim of creation of the system. To the factors that influence on architecture of universities building should be included the following: university specialization (determines functions); number of students; urban setting; constructive scheme; the ability to adaptation in the future; natural and climatic factors; personal vision and style of the architect; social value; economic factor (allocated budget for the construction); environmental friendliness; materials for construction; level of society development; psychological perception; state ideology; architectural traditions of a country (Figure 1). Farther more detailed will consider each of them.

**Figure 1.** Factors of form formation influence on Higher educational establishments buildings

**University specialization and number of students.** It is one of major architectural factors, it determines functions and size. Architecture of university building is formed under act of many factors. But a functional factor always was priority in planning of higher schools.

University specialization (for example: technical or classic), amount of students, influences on architecture of Higher educational establishments. In the 1950-1970's small and medium universities usually built on typical projects, providing extended "linear" buildings, square in a plan volume with a courtyard, or system of contiguities to each other compact blocks. Large (on 5-10 thousand students) and the largest universities (over 10 thousand students) are built usually after individual projects, which are complex of differentiated by destination buildings (faculties, departments, laboratories, auditoriums and sports) [3].

Universities can combine in itself many functions, such as: educational, elucidative, library, sport, spectacle, exhibition, feed, medical, administrative and economic. An Educational-scientific zone is the main in a complex of Higher educational establishment. Its composition solution determines the location and functional planning of other areas.

**Urban setting.** This factor determines size of planning territory, place of location (in a center, on outskirts, outside the town) and placing in relation to a transport highway. The size of territory for building of educational corps depends on a dimension and university specialization. The territory is more effective used when mount of students is greater. So educational establishments of technical specialization with the number of 4 thousand students according to norms need an area from a calculation 6 hectare on 1000 students, and at a capacity 10 thousands and more - territory should be almost in 1.5 times less - from a calculation 4 hectare on 1000 students [1].
Co-operation is especially effectively at homogeneity of educational technologies and functions of establishments that form a complex [4]. Subdivisions of the cultural-educational (an assembly and conference halls, club apartments) and domestic settings do not depend on the university specialization, that is why it is also advisable to combine them into a single complex of buildings, and to block with the similar structures of other educational establishments, which are part of the educational association. Effective general exploitation of power-hungry and considerable after sizes educational-laboratory blocks, experimental equipment and others like that. In cooperation should be the most intensive use homogeneous zone, which allows slightly reduce the total plot size of the institution in comparison with standards [5].

Perspective direction of university buildings compression is the use of compact architectonically-plan solutions of educational corps and increase the number of building stories [6]. In foreign practice, there are many examples of multi-storey educational buildings with compact structure. In Japan, for example, successfully operating a 50-storey skyscraper, which houses three schools for 10 thousand students (Figure 2).

**Figure 2.** Gakuen Cocoon Tower, Japan [7]

Often an educational zone compact joins to a transport highway or takes place along it, which needs the sufficient isolation of educational corps from transport noise. Sometimes a speed transport highway rounds an educational complex or all small town. In practice there are cases, when a municipal highway crosses territory of educational establishment, dividing it into the separate isolated sectors. Such reception is possible, when a road creates enough autonomous zones that need independent entrances. For example, selection in the separate zone of rest territories, large sport grounds, stadiums with parking places.

**The ability to adaptation in the future.** Self-organization, system ability to adapt to the different terms of environment or queries of society. Development of technologies changes the consumer imagery about a comfort, quality and building functionality, that is why providing of maximal operating no interaction, easy dismantling, replacement and reconstruction of engineering elements of building gives an opportunity to avoid the rapid aging, loss of financial and social attractiveness, and also prevents losing relevance architectural object of his appointment. Thus, under the adapted structure is meant its ability to get new qualities for reorganization its structure or approaching the optimum. Today important possibility of change or adjustment the functional setting [8].

**Constructive scheme.** Today accenting of attention on constructive factors, in the decision of spatial structures, testifies that a construction can become a form-building component and spatially-tectonic
accent, in detection certain features and principles of educational corps forming, but not only by the means of architectural intention embodiment. Constructive factors appear in the following: on a structural chart and bearing basis; on the type of construction and in a particular form; on material and technology of structural forms erection; after lightning technology and acoustic features [9]. This list finds out the wide palette of architectonically-structural facilities that strengthen form formation action of constructive factors, as factors of spatial structure creation in construction of Higher educational establishments buildings.

**Level of society development and social value.** A peculiar criterion of spiritual culture of the people, the driving force of its economic potential is the state of education and science in society. The same happens in reverse: the mental level of society is inversely affects the development of science, technology and architecture of the country. Education, aesthetic priorities, ethical relationships, socio-cultural environment, spiritual and emotional level of creation and perception of architecture, values, needs all this has a significant impact on the vision of the world, living standards, which is reflected in the architecture [10]. The university has great public importance, so it should be presentable, as is one of the most important buildings of the city and is like a "business card" [10]. That is why the city should invest in a good spatial architecture that has more influence than just awful and cheap building, which are all around now.

**Environmental friendliness.** Now it is very relevant and popular factor as the current period is characterized as objective process of global urbanization, as a result architecture causes violation of the state balancing environment to humans and cause deepening environmental crisis. Sustainable architecture uses a conscious approach to energy conservation and compliance with environmental principles in the design of architectural environment, reconnect with nature, using renewable resources. The theme of environmental and non-interference in natural ecosystems is rapidly gaining popularity and relevance in the developed world the past 10-20 years. New trends in architecture and design - the constant movement towards greener, passing to the fore the problem of preservation of environment and safety of architectural environment for humans. Since the 70s of the 19th century thanks to the efforts of some designers and architects, these trends have begun to actively develop in a separate area of architecture - eco- architecture.

**Psychological perception.** Architecture is the method of information transfer and psychological influence. Quality of stay in an architectural environment directly depends on the factors of human perception of surrounding environment. Architecture comes forward as a transmitter of social function, and reason of its existence and key figure is a man (in this case students and teachers). It is human nature to subconsciously manage the environment, due to the instinctive desire of orientation in space. It in particular shows up in aspiring to symmetry, to evenness of elements, that it is related to the nature of binocular vision (vision with two eyes in which brain merges image into a single icon) [12]. Symmetric elements are usually perceived as single unit, and visual integrity is one of major terms of aesthetic influence of architectural form. Examining a difficult multi-disciplinary environment, a man aims to reduce in it some system, to erect the complication to more simple order. Due to this factor close located elements are appropriately perceived as single unit. It is related to other law - more simple forms are easier to understand. Muller found that maximum amount of elements that is simultaneously perceived by a man, is about seven ±1 [12]. If more elements get in eyeshot, it seems chaotic multitude.

**State ideology and economic factor.** Architecture as part of political activity (somehow, the construction associated with economic, legislative and other features of the country) is at the same time, a form of influence on public opinion. From the history of architecture you can find out that changing fashion trends, new styles, rebirth and reinvention historical heritage has always been associated with the change of political power. The ideology of the country determines the relation of the state to education. This as a result affects the amount of money that is allocated for construction, impacts on materials are used, equipment, size and complexity. Architectural creations reflect the era, so the main,
the most visible and important buildings should early from the design stage consider the ideology of the customer, not only of those who ordered and paid for design and construction, but also the government of the country in which it is embodied, its attitude of contemporaries and future generations.

Architectural traditions of a country. Today, the boundaries are blurred and in buildings built before you can watch a great stylistic differences in national terms, finishing materials and styles. On the illustrations you can see a pronounced English style law school of the University of Michigan and grandiose Gothic of Jagiellonian University (Figure 3, 4).

Figure 3. University of Michigan South Hall, Ann Arbor, Michigan, USA [13]

Figure 4. Jagiellonian University Krakow, Poland [14]
Personal vision and style of the architect. This factor lays special mark on the future of university buildings architecture. It is determined in the diversity of compositional techniques and author’s „message” he wants to address the public. Below you can watch the works illustrations of famous "penmanship" of well-known architect Frank Gehry (Figure 5).

Figure 5. MIT's Strata Center, Boston, Massachusetts, USA [15] and The Dancing House, Prague, Czech Republic [16]. Author Frank Gehry

Natural and climatic factors. Very important factor for creation of whole environment and its separate elements, in fact it one of the most important factors, that influences on protecting of man from unfavorable climatic terms. Natural factors can be defined by primary, that operate only depending on the natural and climatic terms of a specific region. They influence on a forming of man necessities, and approaches of creation an environment of human existence. Among the set of climatic factors are the following: temperature and humidity conditions; solar radiation; seismicity; geological characteristics of the soil. In the context of this kind of buildings as higher education institutions is an important natural lighting, and therefore very important insolation. Sunlight is one of the largest climatic factors affecting the architecture. In recent decades, the global architectural practice prevailing tendency to use large areas of transparent materials in the enclosure constructions that embodies the principles of the architecture of high-tech and particularly popular in the design and appearance of the audience.

3. Analysis of systematization process of main shaping factors
After analyzing all the factors it is advisable to group a hierarchical system (Figure 6). This system consists of three levels and "generalized" would look like figure 6.
Figure 6. Hierarchy of levels that influence on a higher education institutions building shape formation

This hierarchy levels influences the shaping of universities’ buildings in this case acts as a super-system. A further modification process performed by the detail of the system to model the entire process of forming institutions (public buildings). Theoretically, to systematize all factors are divided into certain levels of the hierarchy. Factors of each of the three levels are linked between by a power and influence priority (their scale on the situation). After all, at every stage of development from its beginnings forms (ideas) to implementation are some factors that affect first hand. Shown factors in Fig. 1 have different impact at each stage. That is why this differentiation of these factors was done (Table 1).

Table 1. Hierarchical distribution of the factors that influence on a university buildings shaping

| Hierarchy levels          | Factors that influence on a shaping of university buildings                                      |
|---------------------------|-------------------------------------------------------------------------------------------------|
| COUNTRY LEVEL             | state ideology; university specialization; number of students; level of society development; social value; architectural traditions of a country. |
| PARTICULAR SITUATION LEVEL| urban setting; natural and climatic factors; economic factor.                                   |
| OBJECT LEVEL              | constructive scheme; materials for construction; environmental friendliness; the ability to adaptation in the future; personal vision and style of the architect; psychological perception. |

Let’s proceed to systematize the factors of shaping by modeling university buildings form formation system.
4. Results and discussions
It remains to say that this research work has expanded our understanding of the factors affecting the formation of architecture of Universities’ buildings. As a result of detailed analysis of each factor became evident their importance and influence on the architecture of the university. This classification, which is the result of the research will more in detail analyze conditions of the university building shapes. Thanks to it we can consider the formation of the building from idea until realization. These observations will help us to draw conclusions as to confirm or deny the existence of generally accepted theory of constants (elements without which this type of building loses its value) in the architecture of the university.

![Diagram](https://via.placeholder.com/150)

**Figure 7.** Process model of shaping university buildings (public buildings)

5. Conclusions
The above factors distribution, of course, is arbitrary and theoretical. In practice, these factors often are linked so closely that it is difficult to separate from each other. It is found that all factors influencing the formation of architecture of higher education institutions should consciously combine. The result should be a complete concept of architectural and spatial organization of the university, which is based on the simultaneous consideration of these factors, all of which can be considered the main (and others - subordinate), but none of them can be removed.

Furthermore, it should be identified level of society development. Thanks to this level masters create the most advanced architecture that affect the global development architecture and is a source of new ideas. This factor is extremely important and necessary exactly to our state, where unfortunately is not enough powerful spiritual engine. That’s why the architecture of our country is only beginning to think modern categories. This suggests that improving the process of architecture shaping in modern Ukraine needs spiritual development of society, namely identity, strengthening ethical and moral relationships between architectural community, improving the socio-cultural level as architects as customers. This would be the key to achieve in the next decade in the architectural shaping such heights, which foreign fellow architects have already taken.
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