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Formation of initial data for functional models of university campus dormitories

The role of dormitories in modern university campuses is constantly increasing. The requirements for them are expanding and becoming more complex not only as a living environment but also as a functional environment. In this regard, the problem of assessing the quality of the functional structure of dormitories is no less relevant in comparison with other university campuses. Modern student dormitories in the structure of university campuses cease to perform exclusively the function of accommodation and become part of the educational, research and social ecosystem. However, the evaluation of their design solutions is still carried out mainly at the stage of formed spatial planning solutions and is based on technical and economic indicators and regulatory verification. In this article, the authors continue to consider the functional approach to the formation and evaluation of university campuses, in particular dormitories, as their mandatory elements. Within the framework of the functional approach, dormitory buildings are considered as systems of functional modules (living cell, kitchen, public spaces, floor, etc.) having calculable parameters and criteria. As a tool for identifying lists of such parameters and their values, the use of a qualimetric methodology based on user satisfaction criteria in the range from 0 to 100 is proposed. The proposed approach makes it possible to evaluate the functional models being developed at the pre-design stage and form spatial planning solutions based on an integral satisfaction indicator, and not just regulatory compliance. The methodology can be integrated into digital information models of dormitory buildings and used in the development of campus programmes and strategies for the development of university infrastructure.

Keywords: functional model, qualimetric analysis, university dormitories, campuses, material and spatial environment, satisfaction level

INTRODUCTION

University campuses, which are being created and developing in the face of modern challenges, are increasingly coming to the need to combine several leading functions in a single space. University dormitories are no exception here. First of all, they become an extension of the educational environment. When it comes to dormitories for graduate students, doctoral students and teachers, it is often also a continuation of the environment of scientific activity. The number of students and teachers involved in startups and technology entrepreneurship projects is growing. And some of the work from them is also transferred to the walls of dormitories.

All universities strive to be a platform for the student, scientific and cultural community. They cultivate the desire for sports and creativity. And for several years they want to be not only a cozy and safe, but also a functional home for several thousand people, most of whom are undergoing personality development during this period. To do this, campus dormitories, among others, must have an extremely well-developed and balanced functional model that allows them to link diverse and diverse functional processes in one material and spatial environment (hereinafter referred to as MSE) and ensure their further development. The existing fund of student dormitories in Russia is represented quite widely and in various ways, however, even newly opened dormitories are often designed according to the model of the last century, which is characterized by a low level of individualization, low functionality of residential cells, lack of common spaces for communication and project areas, etc. It should also be noted that both the spaces and the technical capabilities of

existing dormitories often do not provide sufficient opportunities for working with electronic resources, working in a digital environment, teamwork, viewing educational content and online communication. Dormitories for students and workers are often built according to the same standard designs, and do not take into account the specifics of modern scientific and educational work. All of the factors above negatively affect campus infrastructure satisfaction in general and reduce student engagement in education and science. The lowest indicators of Russian universities are safety, pollution levels and the desire to study in the city [1].

As part of the research on student campuses, significant unproductive time spent by university residents on transitions related to the remote location of various groups of rooms and disadvantages of zoning, low functionality and poor adaptability of most spaces have been identified. We must not forget that the regulatory and legal context of the creation of campuses is still represented by a number of contradictions. The contradiction between the current regulatory requirements and the innovative nature of the settlement¹. The contradiction between technical requirements and modern technological achievements, which were supposed to be implemented, etc. It is obvious that it is functional modeling and subsequent consideration of the characteristics of functional processes in dormitories that will further form a modern approach to their creation and

¹ City University or Country Campus: Prospects, Limitations, and Consequences for Russian Universities Using the Example of St. Petersburg State University. URL: <https://www.pltf.ru/issledovaniya/gorodskoj-universitet-ili-zagorodnyj-kampus-perspektivy-ogranicheniya-i-posledstviya-dlya-rossijskih-universitetov-na-primere-sankt-peterburgskogo-gosudarstvennogo-universiteta> (rus.).

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- development through a proper approach to their design, construction and operation [2].

THE FUNCTIONAL MODEL OF THE DORMITORY

Today, the dormitories of major foreign and Russian universities, such as FEFU, KGEU, MIT, Tietgen Dormitory and others, are characterized by a variety of public spaces in the infrastructure of dormitory buildings, as well as an active social life. As part of their development and modernization, they strive to provide for the effectiveness and variability of the placement of functional zones of periodic and episodic implementation, taking into account their specifics, and to organize an integrated spatial organization of the territory in a special way.

But fundamentally, the functional composition of any dormitory consists of four interrelated types of spaces (Fig. 1). All four types of spaces are present in every dormitory, regardless of size, only their composition and area change. The presence, parameters and interaction of these spaces ensures the full functioning of the dormitory [3].

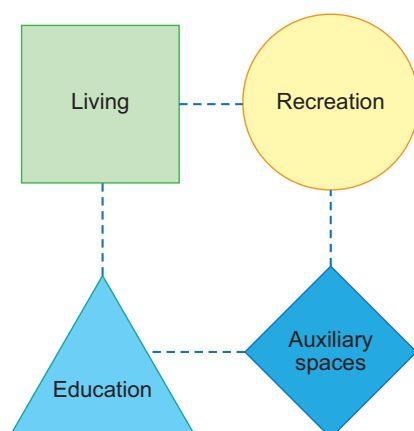


Fig. 1. The dormitory functional composition

Accommodation is the basic function of the dormitory. These are spaces that provide a comfortable sleep and lifestyle for students, graduate students, teachers, and staff living on campus. Their components are: household maintenance, storage, hygiene, cooking, nutrition, interactions, household activities, etc. Education is a space where students carry out independent learning tasks, project and team activities, participation in start-ups and scientific research, individual and collective work with multimedia, computing and other equipment. Leisure is a space that provides an opportunity for active and passive recreation, sports, as well as friendly communication. The leisure function can be implemented both at the level of a residential cell and in the public spaces of a dormitory. Administrative and service spaces are areas closed to public access and are necessary for: dormitory management, cleaning, security, inventory storage, and technical operation. The first three groups, as implementing basic functions, can be classified according to the degree of individualization into the following functional zones:

1. Residential blocks: characterized by the permanent residence of a specific group of students, combine the functional areas necessary for living, welfare and education.
2. Residential floors: combine several residential blocks with public spaces (depending on the spatial layout of the building).

They can combine common areas for household maintenance, leisure and education, accessible to all residents of the floor, as well as rooms for the management and operation of the dormitory.

3. Common areas of the dormitory, accessible to all residents (usually the ground floors). The service areas of everyday life, storage, leisure activities, self-training, and dormitory management are combined.

Combinations and parameters of functional areas should correspond to the category of residents. In order to increase satisfaction with dormitory spaces, it is advisable to take into account the variability of residents' requests and ensure versatility when forming a functional model of the campus and in the subsequent design of dormitory spaces. For example, for bachelors, it is recommended to combine living rooms into blocks with a common kitchen and dining area, a social area or a living room [4]. And it is advisable to place a coworking space on each residential floor or even in a block if the block unites more than 3 residential cells. A higher level of individualization is recommended for undergraduates and postgraduates, when a kitchen-niche and an independent communication area are provided in a residential cell. In all cases, it can be considered effective to place different types of categories of students on the same floor to create conditions for the transfer of experience and the formation of inter-faculty startups and joint projects of students and graduate students [5].

It follows from the above that the formation of an effective functional model of a dormitory is influenced by the category of residents, the sets of zones and spaces, the level of technological equipment, the parameters of engineering and low-current systems. Of course, we must not forget about the parameters of the microclimate (natural lighting, humidity conditions, air exchange, acoustics, sound insulation) and the level of decoration. But in this approach, the functional model has an "as is" format and is based on architectural, construction and engineering solutions. The correct format of the model is the "as it should be" format, reflecting the condition, capabilities and effectiveness of dormitories in the future. And if such a "correct format" for the university's research and educational environment is best represented by its management and leading staff, then for dormitories, such a format is better represented by its users. Architectural, construction, engineering, engineering, technological and other requirements for subsequent design solutions should be focused on their functional tasks. With their help, the conditions for ensuring the parameters of the material and spatial environment of the campus are determined [6].

THE METHODOLOGY OF QUALIMETRIC ASSESSMENT

To solve a number of tasks related to the search and systematization of criteria and their combinations that have the greatest impact on user satisfaction in university dormitories, the authors applied qualimetric analysis. It is a method of quantifying the quality of objects and processes based on a system of criteria (properties) and their weight significance. It allows you to express quality as an integral quantity (index), taking into account both quantitative and qualitative parameters [7]. In this article, the authors have displayed the methodology and results of applying qualimetric analysis to assess the satisfaction of the student dormitory environment. This allows us to take into account such criteria that establish a link with satisfaction as: subjective perception of privacy; level of social comfort; convenience of logistics; quality of recreational spaces; balance of individual and public areas. The necessary and reasonable parameters of a dormitory can be formed as part of the preparation of its functional model and the campus model. And the architect will

begin the process of functional zoning and preparation of spatial planning solutions with clear tasks, and maybe even checklists, in which the university, as a functional customer, will characterize the environment he needs. But today, to evaluate the design solutions of buildings, first of all, technical and economic indicators are used, which help to draw a conclusion about the rational use of the volumes and areas of the future facility. However, in this format, as research shows², future users of the building — students, teachers — cannot evaluate the quality indicators of the MSE, such as the presence of certain zones, ease of navigation, and the relative location of spaces. Some of these indicators can be described quantitatively, but for most criteria a categorical assessment is applicable (for example, “yes/no”). According to the Standard of innovative educational environment (campuses): “The level of satisfaction with the quality of services provided by dormitories is at least 75 % of user satisfaction”³. The criteria for evaluating the IPU at the design decision stage, including compactness, functionality, ergonomics, and safety, can be expressed through satisfaction with the design solution on a scale from 1 to 100 points.

Accordingly, the task of the assessment will be to select the optimal functional model and design solution based on the satisfaction assessment.

This complex indicator depends on a number of properties that need to be determined. Each property has its own weighting coefficients, which are used to determine the relative values of properties. Their sum gives an overall assessment of the integral indicator

² University Campuses and the City: Cooperation for Competitiveness. Center for Strategic Research. URL: <https://www.csr.ru/ru/research/universitetskie-kampusy-i-gorod-koooperatsiya-radi-konkurentosposobnosti> (rus.).

³ Standard of innovative educational environment (campuses). URL: <https://прокампус.пф/documents/download?id=43> (rus.).

of satisfaction with the housing and communal services of dormitories.

The numerical value of the weighting coefficient can be obtained by two methods: analytical and expert. Despite the fact that according to the rule of qualimetry, it is necessary to give preference to the analytical method [8], in the absence of statistical data, the expert method of weight assessment was chosen in the work.

The expert assessment is based on the analysis of data on student satisfaction with the university infrastructure: these are research data, student reviews in open sources (on the Internet).

In the proposed approach: the dormitory is represented as a set of functional modules; each module is described by a system of parameters; for each parameter, regulatory requirements are fixed according to Russian normative documentation⁴.

Next, a list of properties that affect satisfaction is formed, which are classified into the following property groups:

- area and interconnection of functional modules;
- functional zoning and spatial structure;
- accessibility and privacy, comfort;
- equipment and flexibility of use.

The weighting coefficient G , is determined by the expert method for each group of properties. Within the framework of this study, the specific area of functional zones, in terms of one student, has the greatest weight (45 %). Since it is precisely the lack of space that often leads to a low assessment of student satisfaction with MSE. The next most important group of properties (40 %) is the qualitative zoning of the dormitory, which determines the presence, number

⁴ SR 118.13330.2022. Public Buildings and Structures. SNiP 31-06–2009. URL: <https://www.minstroyrf.gov.ru/docs/223331>; SR 379.1325800.2020. Buildings of dormitories. Rules of design Rules. URL: <https://docs.cntd.ru/document/603252625> (rus.).

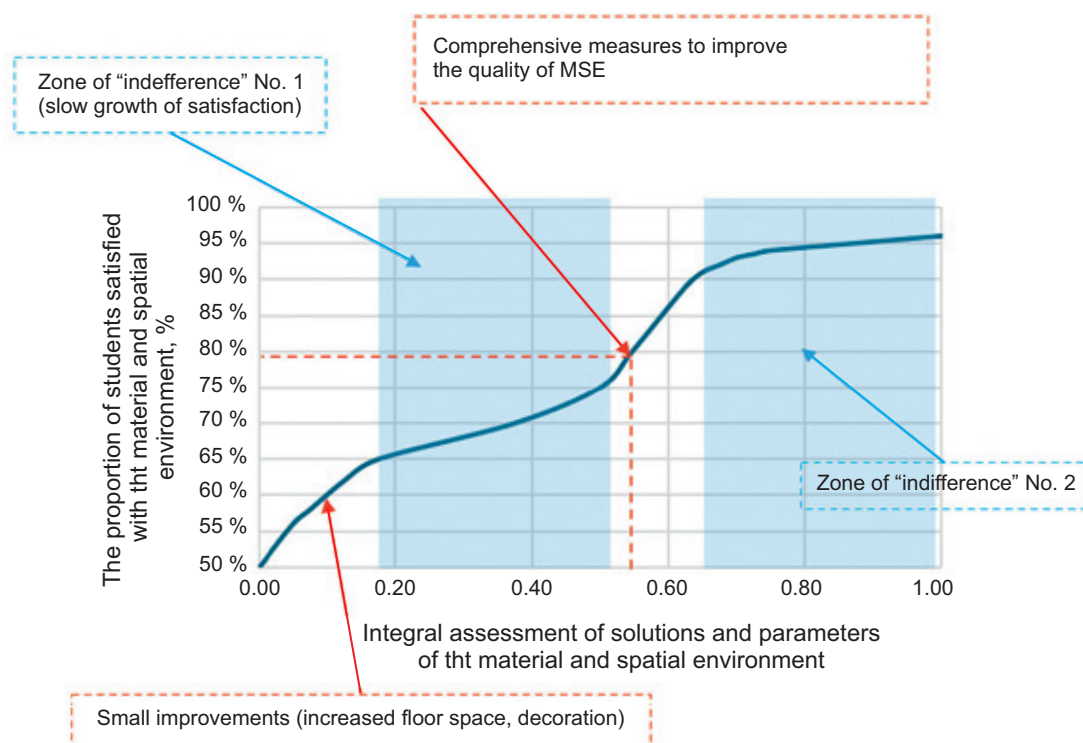


Fig. 2. The dependence of the growth of student satisfaction with the material and spatial environment of the campus on the integral assessment of satisfaction by qualimetric calculation

► and proportion of various zones in the functional model of the dormitory. It is proposed to focus the remaining 15 % of the weight on accessibility of the environment for people with disabilities, as well as taking into account the needs of various groups of residents (junior/senior students, graduate students, teachers, couples with children, international students) [9], as well as on the quality of equipment (furniture, equipment, sockets, Internet, etc.) MSE.

The next step to evaluate the objects of qualimetric analysis according to the proposed quality assessment methodology is to determine the minimum allowable or "defective" values. For properties q , these indicators are denoted by q_{def} . There are two methods for determining these values: documentary and expert. The first one is based on the indicators of existing regulatory documents. The expert method is used when it is inappropriate or impossible to use the documentary method [8]. Based on open data on student satisfaction with modern student dormitories in Russia and abroad, the authors have derived the recommended values of the MSE parameters, which correspond to a high satisfaction value. Based on these data, a functional dormitory model with optimal values of q_{i1} properties was formed. For each property, the relative property index K_{i1} was determined using the formula 1:

$$K_i = \frac{q_i - q_{def}}{q_i} \quad (1)$$

The values were compared with the relative property index K_{i2} , corresponding to the second functional model (functional model No. 2) of the dormitory, formed according to the relevant regulatory and technical requirements and recommendations.

Then, for each property, the satisfaction value was determined using the formula 2:

$$U_i = K_i \cdot G_i \quad (2)$$

The integral satisfaction index of the student dormitory for each functional model was determined by the formula 3:

$$U = \sum U_i = \sum K_i \cdot G_i \quad (3)$$

Within the framework of the conducted research, the factors and conditions determining the dependence of the growth of student satisfaction with the material and spatial environment of the campus on the integral assessment of satisfaction (Fig. 2) have been established. It was also found that the assessment of the satisfaction of MSE with properties corresponding to the high assessment of students exceeded the value obtained for functional model 2 by 53 %.

A preliminary analysis of the dependence obtained makes it possible to make an assumption that increasing the satisfaction of dormitory users by improving the parameters of the housing and communal services on an ongoing basis is ineffective, since, for example, there are some "zones of indifference" when improving properties does not bring a significant increase in satisfaction. Thus, a slight improvement in the relatively minimal possible conditions is significant, further improvement is accompanied by a slow increase in satisfaction, and when certain high-quality indicators of MSE are achieved, satisfaction practically ceases to grow. This observation needs further research, as it allows us to identify the optimal values of the MSE parameters.

CONCLUSIONS

The traditional assessment of dormitories is based on: availability of space, optimal capacity, level of sanitary conditions, and other values. As such studies and student surveys show, compliance with regulatory requirements does not always ensure high satisfaction with the environment. Against this background, the qualimetric analysis made it possible to take into account the spatial structure of dormitories, the interrelation of functional modules, accessibility, comfort, socialization opportunities, flexibility of use, and psychological perception of the environment. The satisfaction indicator can and should be determined at the stage of functional modeling, when comparing alternative models to select the optimal MSE for the future dormitory. Then, this will make it possible to form spatial planning solutions based on an assessment of the quality of the functional structure, and not just regulatory requirements.

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Формирование исходных данных для функциональных моделей общежитий университетских кампусов

Роль общежитий в современных университетских кампусах постоянно возрастает. Дополняются и усложняются требования к ним уже не как к среде проживания, а как к среде функционирования. В связи с этим проблема оценки качества функциональной структуры общежитий не менее актуальна в сравнении с другими объектами университетских кампусов. Современные студенческие общежития в структуре университетских кампусов перестают выполнять исключительно функцию проживания и становятся частью образовательной, научно-исследовательской и социальной экосистемы. Однако оценка их проектных решений по-прежнему осуществляется преимущественно на стадии сформированных объемно-планировочных решений и основывается на технико-экономических показателях и нормативной проверке. В настоящей статье авторами продолжено рассмотрение функционального подхода к формированию и оценке объектов университетских кампусов, в частности общежитий, как их обязательных элементов. В рамках функционального подхода здания общежитий рассматриваются как системы функциональных модулей (жилая ячейка, кухня, общественные пространства, этаж и др.), имеющих исчисляемые параметры и критерии. Как инструмент выявления перечней таких параметров и их величин предлагается применение квалиметрической методики, основанной на критериях удовлетворенности пользователей в диапазоне от 0 до 100. Предложенный подход позволяет оценивать разрабатываемые функциональные модели на предпроектной стадии и формировать объемно-планировочные решения на основе интегрального показателя удовлетворенности, а не только нормативного соответствия. Методика может быть интегрирована в цифровые информационные модели зданий общежитий и использоваться при разработке кампусных программ и стратегий развития университетской инфраструктуры.

Ключевые слова: функциональная модель, квалиметрический анализ, университетские общежития, кампусы, материально-пространственная среда, уровень удовлетворенности

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