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1.5 Formation of the modern educational environment of the technical university during the development of the reconstruction project

Reconstruction of university buildings — is always more than a simple renovation of outdated premises. It involves a holistic review of how the educational space works, what functions it should perform today and what requirements it should meet in the future. In the case of campuses that combine classrooms, laboratories, science centers, libraries, museums and residential units, the modernization process turns into a complex task that requires coordination of safety, technology and cultural endurance.

One of the key challenges is the balance between current standards and the preservation of the architectural identity of buildings. Today's educational spaces must be inclusive, flexible, energy efficient and geared to digital technologies. However, the intervention should not cancel out the historical or symbolic value of the object, which today is increasingly becoming a separate component of the architectural concept.

Because of the scale and diversity of structures, university renovations typically combine point reinforcement of structures, renewal of utility networks, modernization of interior spaces, and partial volume replacement. An approach oriented towards adaptive reuse is increasingly predominant in international practice. Research shows that renovating existing buildings is often a more efficient and environmentally safer alternative to complete dismantling: it reduces CO_2 emissions, reduces life-cycle costs, and allows for faster campus reopening.

Successfully implemented projects create not just renovated premises, but a new architectural ecosystem. The campus receives a modern infrastructure that improves the quality of teaching and research, promotes interdisciplinary interaction and forms a comfortable environment for students, teachers and scientists. Reconstruction in this sense becomes an investment in the future of the university —, its competitiveness, stability and ability to adapt to global challenges.

University buildings today are considered not so much as separate objects of architecture, but as parts of a complex educational infrastructure that must function in the conditions of constant technological and social changes. Therefore, the reconstruction of large — buildings such as the №7 of one of the educational institutions — building turns into a review of their role in shaping the modern building environment. If in the study [48] attention was paid to the smaller-scale building №11, where the main issue was the restoration of a compact historical volume, then in the case of the building №7, the problem is expanding: it is no longer about local intervention, but about the complete modernization of a complex construction and technical system.

Large educational buildings combine different types of premises — from classroom areas to laboratory modules, server, library blocks and workshops. Therefore, each solution not only concerns a specific design or engineering network, but also the interaction between all functional elements. In such buildings, any updates inevitably affect the thermal regime, ventilation schemes, evacuation routes, static operation of ceilings and opportunities for adapting space in the future.

That is why the reconstruction of the №7 building does not involve the division of works into separate categories, but the integration of various technical approaches into a single modernization model. The issue of preserving authentic fragments is combined with the need to implement new engineering solutions that ensure energy efficiency and stability of operation in conditions of high load. Renewal of ventilation and heating systems, implementation of reasonable microclimate control, modernization of power supply for equipment that requires continuous operation, and optimization of internal communication routes are becoming critical for such buildings.

Large university buildings, unlike compact ones, often show accumulated structural problems that cannot be solved by point interventions alone. This may apply to weakened areas of the frame, loss of bearing capacity of old materials or non-compliance with modern safety standards. In such cases, the reconstruction involves

the creation of a new internal support system adapted to modern loads, or a partial redesign of the spatial structure of the building.

To accurately determine the required volume of interventions, a wide range of diagnostic methods — are used, from scanning with infrared cameras to testing individual fragments of masonry and analyzing the behavior of structures under load. The results of these studies form the technical basis for making project decisions and make it possible to predict the operation of the building after reconstruction.

As a result, the reconstruction of the building №7 becomes not only a process of restoration or repair, but a complex transformation that covers structural stability, engineering efficiency, energy optimization and preservation of architectural identity. Unlike the building №11 described in source [48], this facility operates as a large-scale infrastructure platform, and that is why it requires a different level of design: not local, but systemic, capable of transforming an existing building into an adaptive and modern part of the university environment.

The reconstruction of large university buildings today is not based on a set of separate technical solutions, but on a rethinking of the model of the educational space itself. Large buildings, like the №7 building, were created in the logic of the last century, when the educational process was rigidly structured, and the functions of the — premises were static. Modern campuses work differently: they form an environment that must respond to constant changes in the organization of education, the expansion of research programs and the growing role of teamwork. That is why renovation projects do not start with technical parameters, but with an analysis of how people, information, light and sound circulate in the building.

The most difficult aspect of updating large buildings is the flexibility of space. The building must withstand rapid changes in work scenarios: today — lecture, tomorrow — workshop, the day after tomorrow — experimental session. This requires a new approach to the structure of premises: walls should not dictate function, and engineering systems — limit the use of space. Modern classrooms and laboratory areas are designed so that they can be transformed without complex construction and

installation interventions — using mobile stations, quick-assembly partitions, replaceable furniture schemes and digital work modules.

Particular attention is paid to the acoustic environment, which is often a weak point in large buildings. The building №7 has a spacious central part and numerous corridors, which significantly increases the noise load. Solving this issue today is not limited to installing sound-absorbing materials; it covers the formation of a clear «acoustic topography», where each space has its own acoustic profile depending on how students and teachers use it. Thus, acoustics ceases to be a decorative detail and passes into the category of strategic characteristics of the building.

In old educational buildings, the question of accessibility is becoming more and more acute. Historical planning rarely took into account the needs of different groups of users, so inclusion in reconstruction projects becomes not only a technical, but also a spatial problem. It is not about adding ramps or technical platforms, but about forming a route that allows a person with any physical characteristics to use the building as naturally as everyone else. It depends on the geometry of the entrances, the width of the corridors, the logic of vertical movement and intuitive navigation. In the building №7, such questions become key due to its significant size and complex internal structure.

Modern universities are also increasingly relying on dynamic lighting, which determines the nature of space no less than planning. In large-area buildings, where natural light penetrates unevenly, it is important to create light scenarios that not only enhance architectural expressiveness, but also adapt to the type of activity. Classes, teamwork, experiment, presentation — each format requires a different level of brightness and temperature of light. In reconstructions, this becomes not an aesthetic option, but part of a pedagogical strategy.

The problem of reconstruction of large university buildings (such as the Building №7) requires not just engineering intervention, but a deep architectural and pedagogical synthesis. The old buildings were designed according to a pedagogical model, where learning was mainly frontal (teacher – audience) and disciplinedly isolated. Modern education requires interdisciplinary interaction, teamwork and

flexible, project-oriented learning. Architecture should become a tool for the realization of this new educational philosophy.

The transition from «Audience» to «Knowledge Lab must be made. The traditional relationship between lecture halls occupying a large volume and small offices should be revised. Reconstruction should maximise the scope for active learning and experimental activities.

Modular Learning Spaces are integrated areas that combine classroom, workshop and collaborative work areas. They must be equipped with mobile furniture that is easy to move and accessible network connection and power points. This organization of space destroys the rigid boundaries between theory and practice.

Cooperation studios are specially designed rooms that facilitate group work, equipped with interactive whiteboards, technologies for video conferences and acoustic solutions that ensure comfortable communication even in a large group.

The redevelopment should transform corridors, halls and disused corners into informal learning and recreation areas. These places, located between home and study, stimulate chance encounters, the exchange of ideas and social integration, which is critical for shaping an innovative environment.

The implementation of architectural and engineering solutions aimed at energy saving is the central axis of reconstruction. Building Envelope: The greatest impact is the insulation of external walls and roofs, as well as the complete replacement of old windows with high-quality energy-saving double-glazed windows. This minimizes heat loss and reduces the necessary load on heating and air conditioning systems.

The reconstruction of large roofs opens up opportunities for the installation of photovoltaic panels to partially meet the building's electricity needs. While this may be difficult from an engineering perspective, such a move increases the university's energy independence and underscores its commitment to sustainability principles.

Reconstruction — is not only about designs and engineering; it is about the quality of life of users. Architectural solutions directly affect the level of stress, productivity and creativity of students and teachers.

The visitor must understand the logic of the building without having to constantly refer to the maps. The renovation should create unique architectural elements or public spaces (atriums, galleries, terraces) that will become symbols of the campus, meeting places and emotional connection with the university. It enhances the sense of community and belonging.

The reconstruction of the №7 building is seen as an element of the wider university system, and the renewal takes place in stages and without interruptions in studies. This approach allows modern solutions to be implemented gradually, preserving the functionality of the building and creating the basis for further transformation of the entire campus.

Concept

The combination of metal planes and transparent elements that form the modern material language of the building plays a key role in the facade solution. The main volume is lined with vertical steel panels with a stable protective coating, which set a strict rhythm of the facade and ensure the durability of the structure.

A significant part of the plane is occupied by panoramic glass inserts made of energy-efficient double-glazed windows. They enhance natural light and create a visual connection between the interior and the space of the campus.

The main accent of the facade is a block lined with natural copper. Due to its physical properties, copper creates a deep multi-tone texture that changes under the influence of light and time. This material gives the building warmth, character and exquisite expressiveness, and also emphasizes its material quality and durability. The contrast between cold steel and living copper volume enhances the plasticity of the composition and makes the facade recognizable in the campus structure. (Figure 1)

Figure 1. Exterior view of the academic buildings [made by the authors]

The master plan

The master plan demonstrates the integral spatial organization of the territory, formed in accordance with the functional requirements of the educational complex and the principles of modern improvement. The main volume of the academic building is located in the central part of the site and is oriented parallel to the internal transport highway, which ensures ease of access and optimal interaction with the existing infrastructure of the campus. Adjacent to the main building is a laboratory block, which has a separate access area and a self-contained pedestrian approach, allowing the flow of visitors and students to be demarcated.

A system of walking routes is organized around the buildings, which provide barrier-free access to all entrances and form a consistent transition between the interior and exterior spaces. Next to the main facade, there is an access road with the possibility of a short-term traffic stop, and nearby there is a parking area with designated places for groups with reduced mobility. This organization of transport infrastructure allows for safe movement and separation of transit and local traffic flows.

The southern part of the territory is designed as a public space with a predominance of landscape improvement. The landscaping system is based on a

combination of decorative trees and group plantings of bushes, which form a comfortable environment for stay and short-term rest. Smooth curvilinear landscaping lines create a soft geometry for the space, enhancing its pedestrian character and contributing to the visual relief of the building.

The northern part of the territory retains a mostly natural character and acts as a green buffer between the university buildings. In this area there is a memorial or exhibition element that serves as a local compositional accent and diversifies the spatial structure of the master plan. (Figure 2)

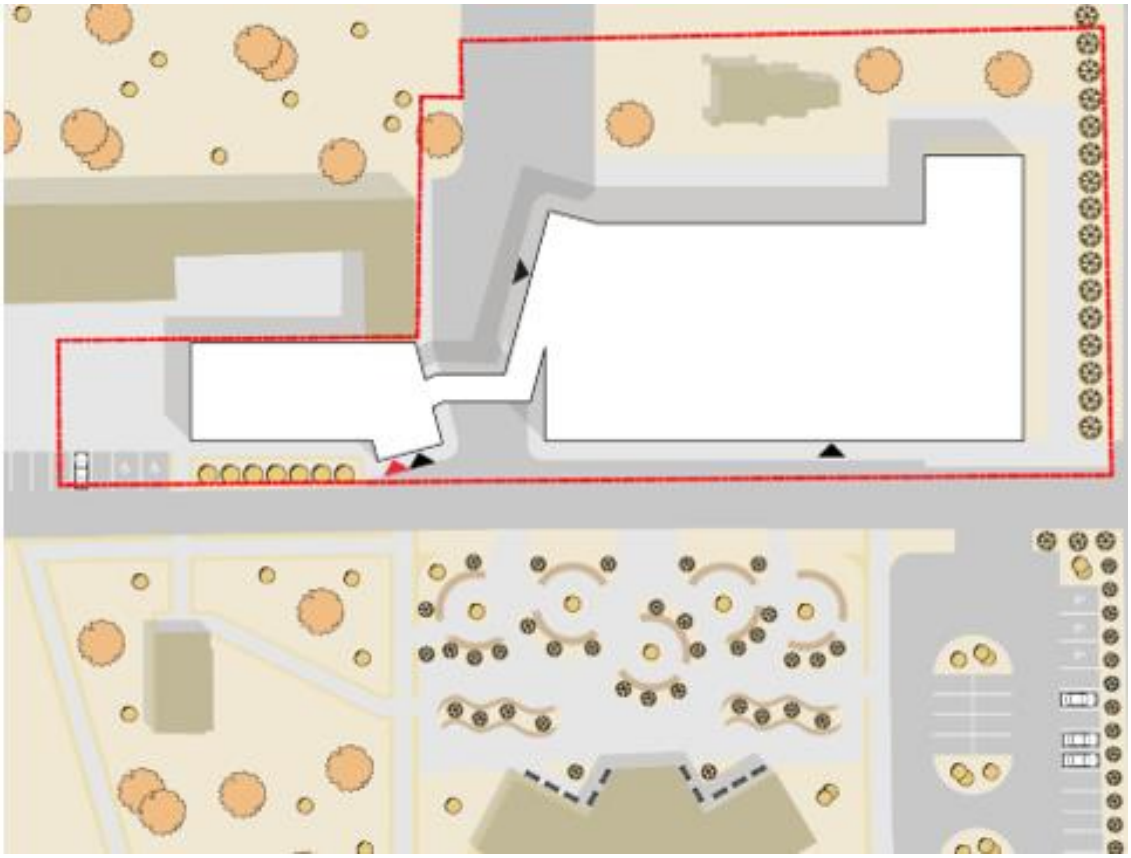

Figure 2. Project master plan [made by the authors]

Planning decisions of the project

The №7 building is formed as a complex of educational spaces that combine large workshops, lecture halls and areas for collective work of students. The two main workshop halls — are designed for practical classes, laboratory demonstrations and

project work. Their large open areas make it possible to place specialized training stands, assemblies, layouts and modules for technical experiments.

The halls are equipped to ensure the free transformation of space: mobile work surfaces, the possibility of zoning and conducting several types of classes at the same time. Due to the considerable height of the premises and the open layout, the workshops are suitable for both team classes and individual work of students. (Figure 3)

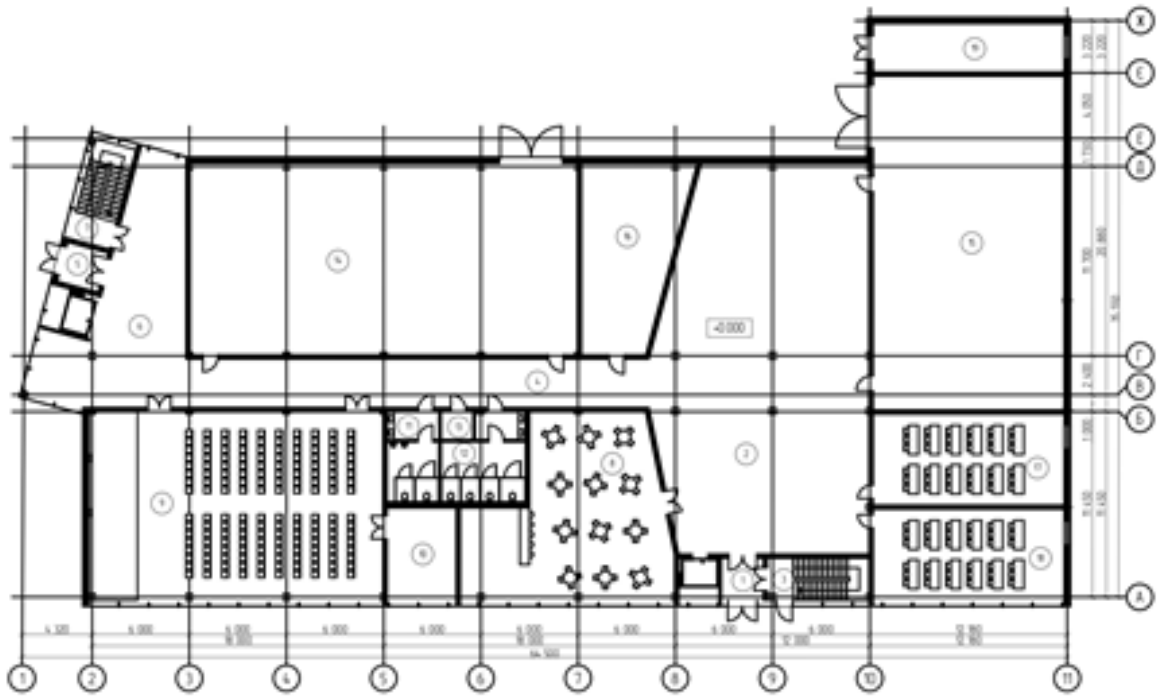

Figure 3. Plan of the ground floor [made by the authors]

The hall at the entrance to the building №7 (Figure 4) forms an atmosphere of openness and comfort from the first seconds of being in the building.

The central accent of the space is a green island composition with living plants, which creates a feeling of naturalness and serves as a place of rest and informal interaction. Surrounding it are padded ottomans and seats supporting the idea of a flexible and user-friendly space.

Wooden wall panels and warm light form a cozy atmosphere, while contrasting red columns add expressiveness and emphasize the architectural character of the interior.

With a combination of natural light, neutral materials and landscaping, the hall works as a modern public space where students can meet, wait for classes or simply relax between couples.

The hall also plays an important role in navigation inside the building, as the open two-level space visually combines the first and second floors, providing intuitive orientation and enhancing the feeling of spatial integrity. Glass fences and perforated ceiling panels contribute to maintaining the lightness of the interior and optimal light distribution.

The placement of vegetation in the central part of the hall not only improves the microclimate, but also acts as a natural «anchor, around which internal communications are organized. This approach corresponds to modern principles of biophilic design aimed at increasing the psychological comfort and productivity of users.

In general, the hall of the building №7 forms a multifunctional space that combines aesthetics, functionality and technology, demonstrating the holistic concept of building reconstruction as an open, flexible and needs-oriented environment for students and teachers.

Figure 4. Interior view of the academic buildings [made by the authors]

On the second and third (Figures 5, 6) floors of the building, there is space for review participation in the educational processes of the — anthrisol, which allows teachers or student groups to observe the work in the halls without interfering with the educational process. Such an organization meets modern requirements for openness and supervision in technical education.

The functional structure of the building is complemented by lecture halls, offices, technical premises and student space, which forms an environment for informal learning and teamwork. This makes building №7 not only a place for classes, but also a communication center for students.

The structural solution of the building uses steel beams and monolithic ceilings, which allows the formation of large columnless spans —, these are the structures that ensure the openness of the workshops and their ability to adapt to different types of educational activities. Facade systems of vertical metal panels and panoramic glazing provide natural lighting in the workshop premises, creating comfortable working conditions and emphasizing the innovative function of the building in the campus structure.

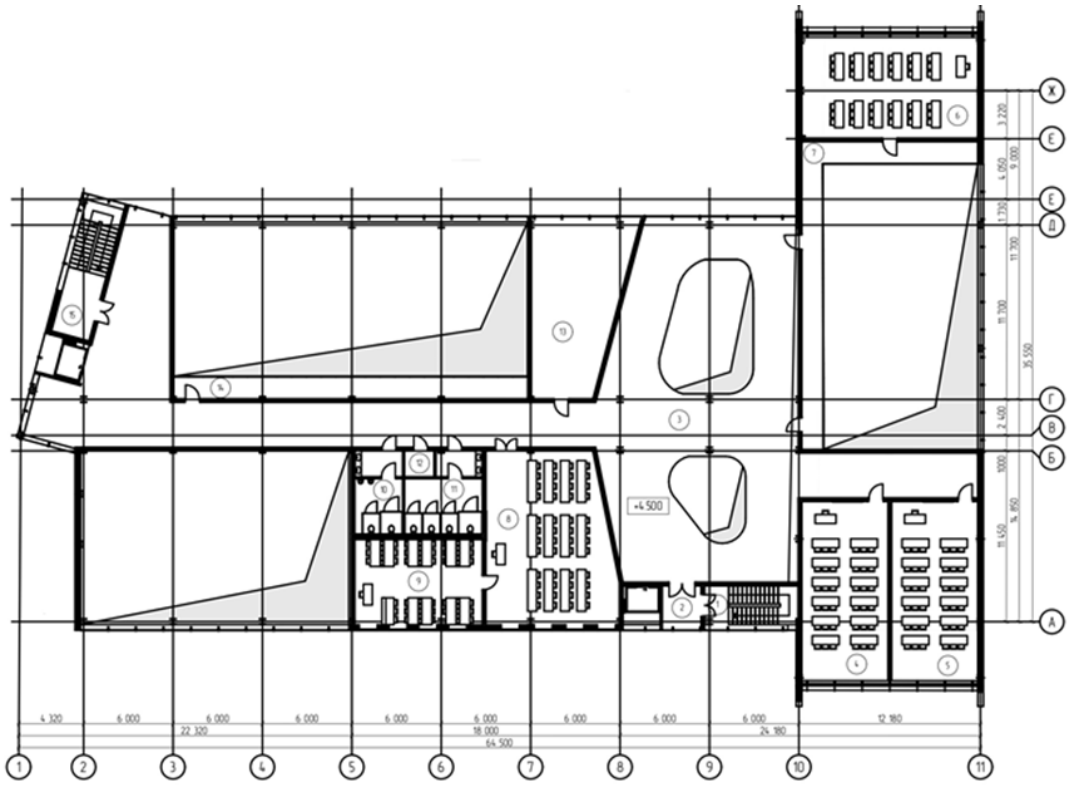

Figure 5. Plan of the second floor [made by the authors]

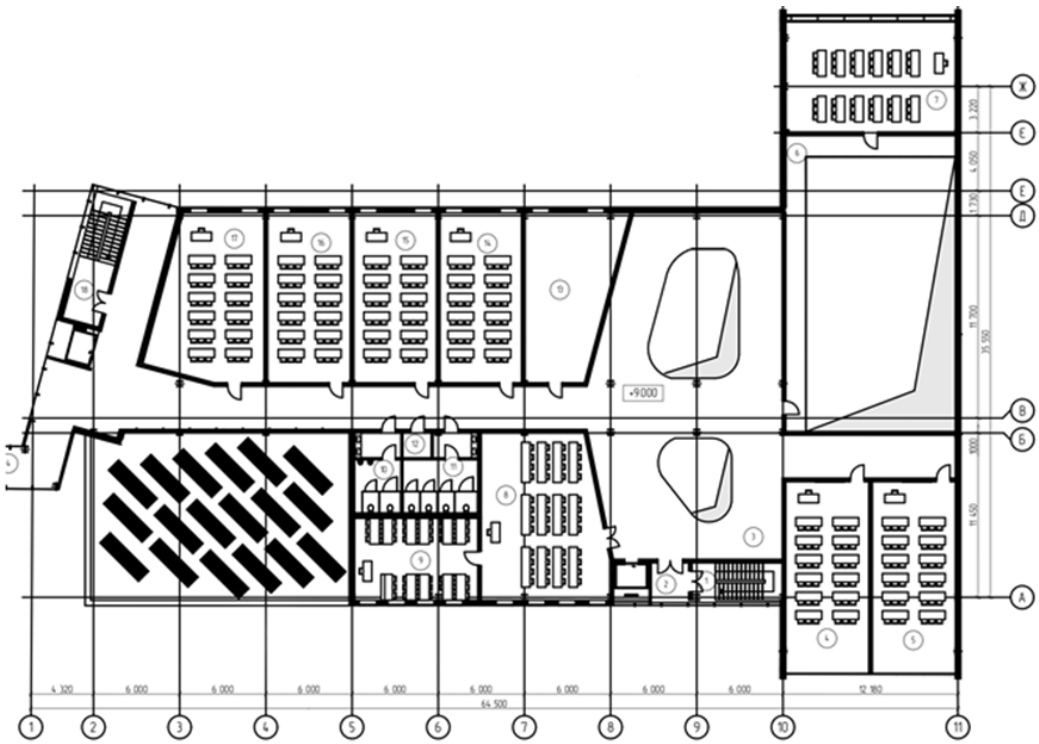

Figure 6. Plan of the third floor [made by the authors]

Cafe

In the structure of the first floor of the building, the №7 cafe (Picture 7) plays the role of an important social space that combines an educational environment with a comfortable recreation area. It is located next to the main hall, thanks to which the cafe becomes a natural crossing point of student flows and a convenient area for short breaks between classes.

The space is organized as an open and bright area with panoramic glazing that provides sufficient natural light and visual contact with the external environment of the campus. Mobile furniture allows you to easily adapt the space to different scenarios: from a quick snack to informal teamwork or meetings.

Functional zoning involves a separate part for cooking and dispensing dishes, logically separated from the seating area. This ensures ease of movement and comfort for visitors. The atmosphere of the cafe supports the general architectural language of the building — restrained materials, clean lines and light modern surfaces create a feeling of organization and technology.

Due to its location and openness, the cafe becomes not only a service element of the building, but also a place of interaction where students can work, communicate and relax, forming a living and flexible environment of the №7 building.

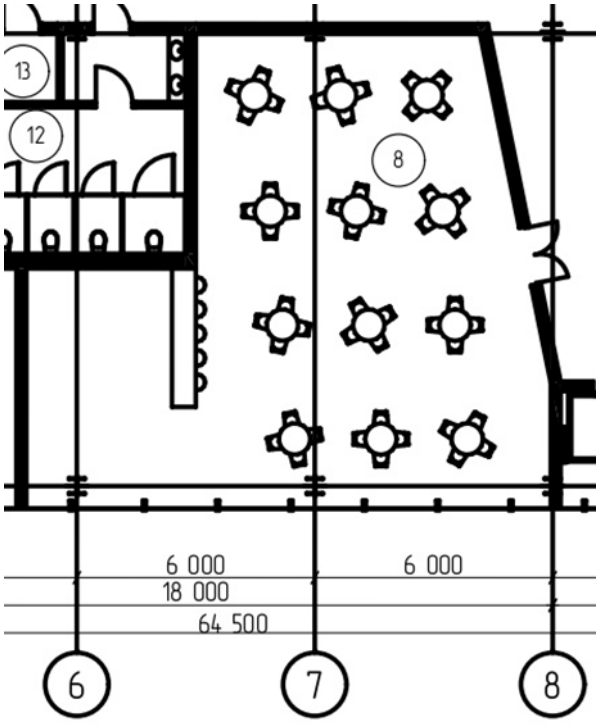

Figure 7. Cafe [made by the authors]

Conclusion

The reconstruction of the №7 enclosure demonstrates the effectiveness of a comprehensive approach to the renovation of educational buildings, when spatial, structural and engineering solutions are formed as an interconnected system. Established workshops, open study areas, a renovated hall and integrated seating areas ensure flexibility in the use of space and meet modern technical education requirements.

The proposed architectural and planning solutions contribute to improving the conditions of the educational process, optimizing the movement of users, increasing the comfort of interiors and integrating the building into the general structure of the campus. Renewal of facades, use of modern materials and strengthening of natural lighting form a complete image of the case, which reflects its new functional model.

Thus, the modernization of the №7 building not only ensures compliance with regulatory, operational and educational requirements, but also creates prerequisites for the further development of the university's infrastructure, increasing the quality of the educational environment and the competitiveness of the institution.