REFURBISHMENT OF A HISTORICAL BUILDING – DESIGN ISSUES

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Summary

Over a 10-year modernization of the main building of Gdansk University of Technology is coming to the end. The ever increasing number of students requires not only the development of the campus with new facility buildings, also the existing buildings are subject to adaptation and modernization. In addition to high-impact solutions, as restoring the former glory of the building (reconstruction of the clock tower), or introducing a new quality (glazing of both internal courtyards), one of the objectives was to adapt the vast attics to studios and work-shops. Connected to the reconstruction of damaged or neglected infrastructure, especially ventilation and heating system, the task becomes a complex engineering and organizational challenge. In case of a historical building, entered in the register of monuments, in constant use, the difficulty of carrying out such a task is significantly increased. Respecting complex spatial relationships, the introduction of the contemporary architectural means into the historic building requires custom design solutions.

The method adopted to solve design problems rely on restoring the original technical solutions, based on an analysis of constructional elements of the original structure. The main building was raised in an innovative way – the eclectic, referring to the Dutch neo-renaissance façade hid at that time innovative, modular system of steel frame construction, double-floor installation spaces and more. Changing user requirements and degradation of some elements have not allowed completing their restoration and use; however, the original design idea has been retained and developed, providing both users comfort and safety of the structure.

Keywords: historic building refurbishment and modernization, technical equipment of historical building

1 Framework

The article provides a brief overview of design solutions, both architectural as well as installations, in order to restore full capacity of an object with a complex functional program, located in the historical tissue. Presented solutions are part of the technical modernization plan for the main building of the Gdansk University of Technology.

In almost continuous way, excluding the years of World War II and the period of post-war reconstruction, the building performs the same function for over 100 years. The boundary conditions defining the framework for this activity are the only change. These conditions may vary due to many reasons: growing number of students and staff, adjusting the functioning of the university (increasing the number of training courses, new teaching methods, increasing role of the laboratory exercises etc.) and, finally, improving utility requirements (improving comfort, facilitating access for the disabled, updating technical equipment and technology). From this point of view, there are several problems relying on building infrastructure issues: access to separate functional areas, heating, ventilation and fire-safety. Additionally, a significant increase in the number of users has been generating "social" needs serving the academic community – yet virtually non-existent (or existent in rudimentary form) in the main building. So, the technical refurbishment has become a contribution to the functional revitalization. Scheduling of investments has enforced a pattern and sequence of activities: high priority to technical solutions and then, on technical basis, the further architectural concepts are implemented. The path is constantly revised, as there are changes in deciding factors – for example adjustments of refurbishment strategies or financial capacities. Thus adopted the path of realization allows for the implementation of the necessary technical solutions and mechanisms that form the basis for subsequent utility transformations.

2 Background

At the original edifice of the Königliche Technische Hochschule zu Danzig (1902) attics played a subordinate, secondary role. Despite the large area of even greater volume, their role was only a purely utilitarian protection from the weather, closing volume of the building or an element of natural ventilation and laboratory fume channels.

Over time, as the number of students of the Gdansk University of Technology has been growing, there was more and more interest to consider the possibility of their use. Finally, the conversion of attics has been prepared with all the necessary elements of inner infrastructure. One of the biggest challenge was to adjust the fire protection requirements and to provide adequate user's comfort, which resulted in the introduction of a completely new element to the building – mechanical ventilation system.

3 Research methods

In short, one could say that the adopted method reflects what in other fields of technology is known as "reverse engineering". A detailed inventory of the building, with particular emphasis on attics, allowed the "discovery" of many long-forgotten spatial, technical and constructional relationships.

Diagnosis of mentioned above defects in the functioning of buildings, supported by analysis of the original layout plan, design and installation, helped to prepare a general repair plan. Despite the relatively scarce resources that could be initially allocated for the implementation of the most urgent tasks, it was decided that the project would take into account the complementary solutions, mutually reinforcing, scheduled for possible independent implementation stages. Each of the stages would be a functionally, technically and organizationally closed part of the target solution. Thus approved method of execution assumed a hierarchy of tasks – priority was given to these stages, the implementation of which depended more during further ones. For each task, the original action was to adopt appropriate infrastructure solutions, strictly related to the building as a whole; only on this basis any architectural solutions could be built. Assumptions for refurbishment and technical modernization of the building fully complied with the current financial and organizational capabilities, allowing for the partial realization of the necessary technical elements. Due to the historic nature of the building there were imposed certain restrictions and requirements for technical and architectural solutions – preservation of the form and detail. There was also a need to find and "discover" the construction module of the building, to fit future systems in the existing one. Although the building was built in a historic style, it was erected with relatively new, almost industrial methods.

From an architect's point of view it was possible to achieve the design goal by styling the appropriate elements of infrastructure – air in- and outlets taking a historic form or using restored clock tower as an element of the ventilation system. These were the outer elements; the inner shafts had to be set through several floors of the historic tissue of the building, with massive brick walls. These considerations led to a decision, what kind of distribution system would fit the best in such building. It was decided it would be a dispersed or distributed ventilation and installation system, based on zoning built with existing fire-wall divisions. Finding appropriate ways to accomplish the task was a clue to a successful design solution.

As already mentioned, a necessary condition for the task was to divide it into several stages. Each step was a part of the functionally closed system and spatial solutions had to take account of subsequent stages. Combined with spatial, functional and installation system of the building into a single coherent system was the advantage of the proposed solution, ensuring continuity of operation of the facility. Staging was associated with increased costs. Firstly, it required a long-term strategy of modernization; secondly it meant additional expenses for the implementation of elements required for the next steps.

The paper is to prove, taking architecture and ventilation system as examples, that it is possible to interlace these issues into a single project, that aesthetics and utility is closely associated with the intention purely technical. Now, considering several elements, we will trace how these assumptions worked in practice.

The first works on the adaptation of the main building's attics began in the late 1990s. This then unused space occupied an area of over 2200 m2, so it was a quite attractive reserve for the University needs. The plan was to allocate new classrooms and workshops at the attics and the task was associated primarily with the construction of an efficient system for communication and evacuation, along with the installation of fire safety systems and installation of a mechanical ventilation system, what turned out to be the biggest problem.

Characteristics of the attics and the historic nature of the building excluded an easy installation of technical equipment just as free-standing elements, mounted on the walls or on the roof. The layout and extent of the building was also an obstacle – sloping roofs and their construction was an invincible barrier for horizontal network of the installation. Therefore designers concluded that the most optimal solution would be to build a distributed system, with separate air in- and outtakes, built in a form of historic chimneys.

During the initial research works, thanks to intensive inventory measurements (the original plans and other drawings had been lost, we have got simplified functional diagrams only) certain spatial relationships had been "discovered". Evaluation of the building structure had a huge impact on the project scope and sequence of implementation. For example, the wooden construction of attics was strictly connected and built on the basis of steel, two-storey frames. The module determined by these frames helped to restore the initial layout of rooms which led to the adoption and implementation of the design assumptions consistent with the spirit of the original design.

The assumptions included, among others: the division of the building into parts or blocks (closed with solid fire walls), restoring circumferential inner communication (on each floor, if possible), basing solutions on the construction module and existing installation ducts and shafts. On the other hand, it turned out that some of these technical means had been either impossible to reconstruct or utilize (due to damage and years of neglect), or they totally had not met the parameters of the current needs and technical capabilities (duct size, operating mode).

Recognition of these elements led to the conclusion that modernization of attics alone would be a temporary action, blocking the possibility of subsequent transformations and repairs for the entire building. So, it became obvious that refurbishment of the whole building would be the only proper solution.

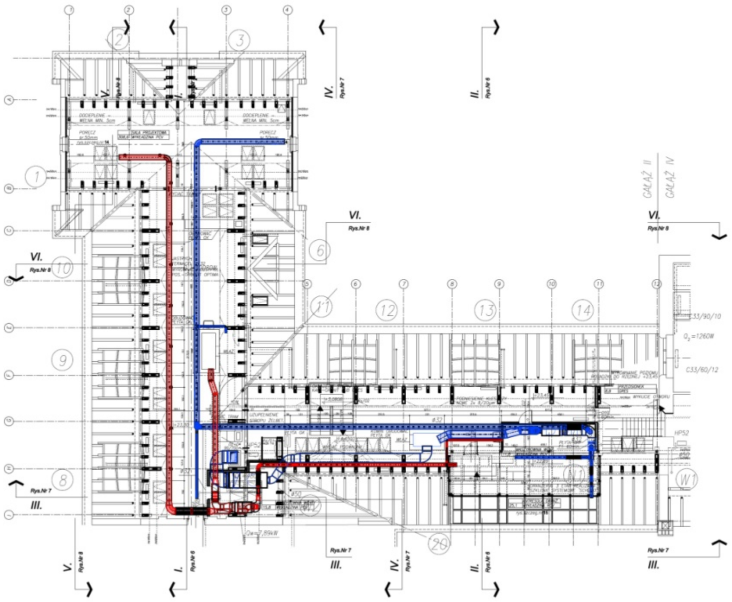

Fig. 1 *Installation layout for the attics, HVAC system on an architectural plan*

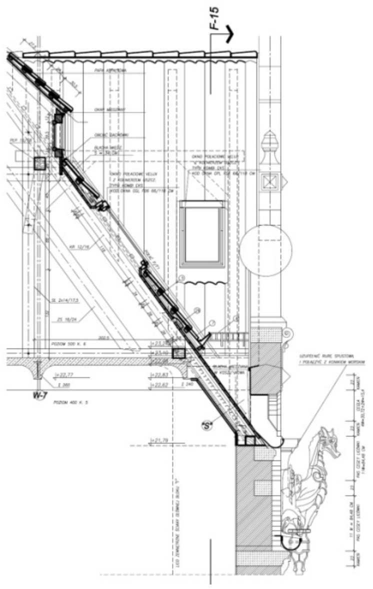

Fig. 2 *Section through the sloping roof, with masonry and coppering renovation details*

Fig. 3 *Attics, with HVAC system shown*

Fig. 4 *Art studio at the attics*

Fig. 5 *Panoramic view of the southern courtyard, still without a glazing*

4 Objectives

From a technical point of view adopted design method is relatively simple: to determine the space for technical equipment, to find the ducts for the installation and to fit the solutions in an attractive architectural packaging. It gets a more complex task when we consider a historical building, with its limitations – alterations and reconstructions from the past, with an out-dated original installation system, requirements for heritage conservation.

There is a difference between designing a system from a scratch for a new building and the introduction of the system into the existing structure of the historic building. Technical tool for this purpose is to identify the building's structure and elements, to prepare a detailed inventory (in the case of the University building there were hundreds, if not thousands, of auxiliary drawings) and to develop a long-term strategy for the implementation of the proposed technical solutions. It is certain, too, that a satisfactory result can be achieved only through the cooperation of specialists in many fields.

5 Conclusions

Thank you very much for making your efforts to compile this paper. We do believe the CESB13 conference will be a fruitful event for all authors as well as visitors.

We are looking forward hosting you in Prague!

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