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SCAFFOLDINGS USED DURING THE RENOVATION OF THE METROPOLITAN CATHEDRAL OF ST. JOHN THE BAPTIST AND ST. JOHN THE EVANGELIST IN LUBLIN

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Abstract

This article describes three cases of scaffolding use as a structure for carrying out a renovation work at the Cathedral in Lublin. In order to achieve optimum access to the object, one used modular scaffolding. This type of scaffold is able to expand in any direction. In addition to the typical use, the scaffold was used as temporary roofing which allowed conducting the work during the winter. Monuments require a detailed approach to the problem of scaffolding. Despite the short period of use we should pay particular attention to the possibility of anchoring scaffoldings. Performing static calculation allows minimizing the number of anchors and used elements.

Keywords: modular scaffoldings, work at height, static scheme

1. INTRODUCTION

Scaffolding as a construction enabling carrying out renovation or assembly works is most often associated with the construction set directly at elevation of an object. However, this is not the rule. In the case of historic buildings very often we have to deal with the need to gain access to places located at considerable heights. Furthermore, anchoring the scaffold structure is a problematic matter. Historic buildings are characterized by irregular shapes and

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very often there is no detailed documentation. These types of objects in their history could repeatedly undergo reconstructions and around an object may have formed other structures that prevent carrying out renovation work. Due to these problems scaffolding structures used for the renovation of historical buildings take on complex shapes and large sizes. Please note that scaffolding structures, which differ in their shape and foundation from the solutions proposed by manufacturers, require the preparation of the technical design of scaffolding structure [5]. Improper assembling of the scaffolding may lead to its collapse, at the same time causing significant damage to historic buildings whose restoration is practically impossible or very expensive. In order to achieve optimum access to the facility, there is used modular scaffolding, enabling scaffold to extend in any direction.

2. ARCHICATHEDRAL

An example of the monument, which required the use of unusual scaffolding construction, was Archicathedral of St. John the Baptist and St. John the Evangelist in Lublin. During its history, object has undergone many changes. The Cathedral was built between 1586-1625 and served as the church of the Jesuits. The project of the church was drawn up by one of the Jesuits Jan Maria Bernardoni. It was one of the first early baroque churches carried out in Poland. In 1752 fire seriously damaged the temple which was rebuilt and expanded by the treasury and acoustic sacristy. In the years 1799-1804 in an abandoned temple the Russians organized a military warehouse. Church religious functions were restored in 1805 and it was made a cathedral. It was destroyed during military operations in September 1939 and it was rebuilt again in the years 1946-1951. In February of 1967, one made the entry into the monuments registration. In 1998 one made extensive renovation works, during which foundations of the temple were reinforced, the floor was replaced ,the crypt was rebuilt, presbytery was adapted to the needs of the liturgy and side altars were renewed. In 2009 began renovations of the facade. Because of the complex shape as well as the existing infrastructure around the facility it was necessary to prepare the technical design of scaffolding, allowing carrying out renovation work. Along with the progress of work, scaffolding elements were rearranged and adapted to the different elevations. Moreover, in the case of the terrace, scaffolding was used as a design under the tarpaulin acting as temporary shelters.

3. SCAFFOLDING AS SHELTER

In addition to the above described problems associated with the geometry of historic buildings, in the case of the Archicathedral in Lublin it was necessary to perform roofing on the terrace (Fig.1). Because of the schedule, it was necessary to perform finishing works of stone cladding on the terrace above the main entrance (portico) to the Archicathedral during the winter. The technological process prevents sticking sidings in temperatures below 5 °C, so it was necessary to tight roofing work area and the use of heaters in order to raise the temperature.

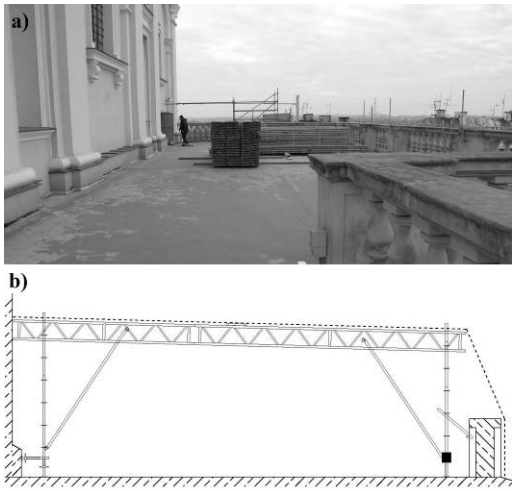

Fig. 1. Terrace above the portico a) the area in need of roof covering b) solution in the form of scaffolding

Standard setting of the scaffolding would greatly reduce the work front. Due to the unusual form of scaffolding and heavy snowfall it was necessary to prepare the technical design of the scaffold structure. As a result of calculations, taking into account the loading using wind, one obtained tensile forces in the stands to windward side, and therefore it was necessary to ballast scaffolding structure within the racks. An additional difficulty was the prohibition to anchor the structure above the level of the plinth. It resulted from the completion of renovation works within the façade. Also within the balusters there was no possibility of anchoring; hence clamps in the form of pipes were used, ensuring slide lock of the scaffold in the horizontal direction. Directly on the scaffolding structure a tarpaulin was placed, with removing lingering snow. Due to the high inside temperature and used a decrease cover, snow removal ran smoothly and there were no significant hurdles. The construction, which would not require

snow removal, would be much higher and consequentially much more expensive.

4. SCAFFOLDING AT THE ELEVATION

In the case of facade, scaffolding is associated with the structure in the form of frames arranged in the immediate vicinity of the building walls. Such solutions are well known and described in detail in catalogues of individual scaffolding producers. The situation is complicated in the case of irregularly shaped elevation. Scaffolding for this type of objects requires individual solutions in the form of extensions and hangings [4].

4.1. The facade from the courtyard side

In the case of elevation from the courtyard, problems with scaffolding solutions provided the shape of elevation itself (Fig. 2). Due to the existence of the buttresses along the entire length of the facade, they had to bypass them through extensions. Another impediment was significant inserting the upper part of the façade inside the building.

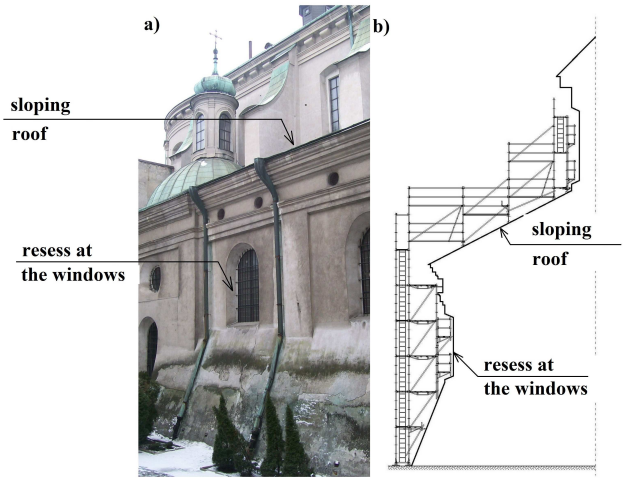

Fig. 2. The facade from the courtyard side a) view of the facade b) the model of scaffolding

It was necessary to place the scaffold using the wooden sleepers on a sloping roof. This solution delivers the problems in the proper adoption of the static scheme [1]. The support in the form of hinged bases locks the slide in a normal direction to the plane of the roof, but these are able to be moved in a parallel direction. Such a supporting scheme causes bending stands, therefore, one must

be aware of the additional reinforcement in the form of tubes screwed directly to connectors, which each tilt stand is equipped with. In addition, within elevation, there are significant window dips, to which access was ensured by means of consoles. The proposed solution required the use of anchoring within the buttresses and directly above the roof. The number of anchorages was minimized by carrying out static calculations.

4.2. The east elevation

It was also found problematic to set the scaffold at the east elevation. There is the apse, within this elevation, which had to be surrounded by the scaffolding. As in the case of elevation from the courtyard, it was necessary to set the scaffold directly on a sloping roof (Fig. 3). The shape of the apse meant that every other field was done in accordance with the rules of installing typical scaffolding, while the connection between the modules was obtained by the use of shiftings of bridges and fixing the railing by means of connectors.

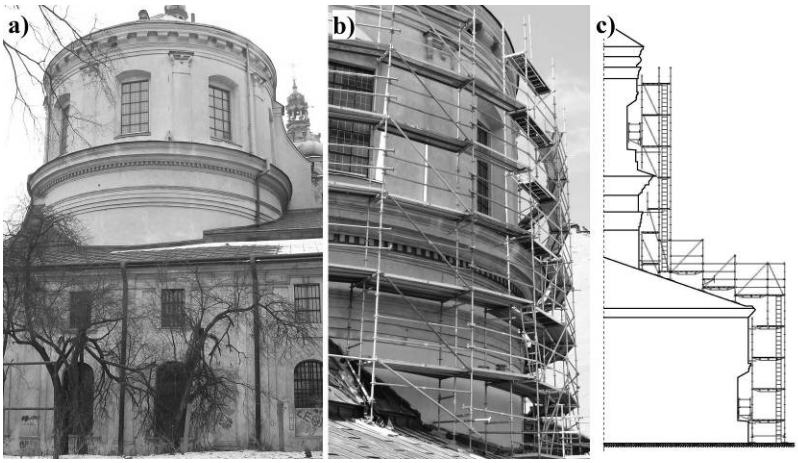

Fig. 3. The apse a) the view b) a completed scaffold c) The communication scheme

Due to such structure formation, the roof inclination and increased, relative to the flat facades, the wind action, one might expect large forces pulling out the anchors. This was confirmed by the result of conducting static calculations. In order to ensure the safe use of design, one applied an increased number of anchors, i. e. at the base of the scaffold and on almost all drillings supporting platforms if that anchor did not reach the window. Ledges prevented the scaffold to be set directly on the facade. It was necessary to apply extensions, which greatly increased the level of effort of the scaffold elements. Fig. 3c) shows a schematic scaffold, constituting communication vertical, enabling movement of workers as well as transport of materials. A common mistake is to

expand the communication vertical section in the lower part of the building and then to draw near to the proper elevation. This exposes the scaffolding to wind load in a direction parallel to the facade. Scaffolding should be expanded directly at the object, and if this is not possible it is necessary to apply stay ropes, to prevent declension of the communication vertical. This situation occurred in the case of the renovation of the Świętogórska Basilica in Gostyn in 2010. As a result wind actions there was a significant deflection of the communication vertical. Platforms located within the vertical fell on historic roof made of ceramic tiles, causing considerable damages. Fortunately, the accident occurred at night and nobody was hurt in the incident. The reason for failure was the lack of stay ropes with a significant development of corner vertical exposed to the effects of the wind.

4.3. Other encountered difficulties

Project execution of the scaffolding in the case of historic buildings often requires the designer to participate directly during the scaffold assembly.

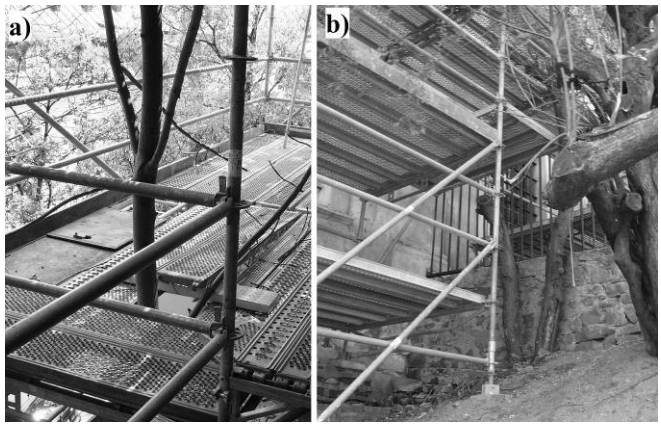

Fig. 4. The east elevation a) tree in the immediate vicinity of the facade b) the fence perpendicular from the facade

Apart from the problems associated with the dimensions and shape of the object, there are often conflicts of scaffold structure with the surrounding infrastructure around the object. This was also true in the case of the Archicathedral. From the eastern area, directly on the facade, has a significant slope, which enforced the use of tiltable stands. In addition, there is no direct access to the facade. It was necessary to make, with existing street, an additional vertical providing transportation of materials. The rather unusual situation may include the situation shown in Fig. 4a). Directly within the outline of the scaffold was a tree. Field spacing was chosen so that the tree was in the

middle of the field and it was possible to bypass this tree. Apart from tree other obstacle to "bypass" was the fencing which was also in the immediate vicinity of the elevation (Fig. 4 b). With this type of obstacles, one does not have to deal in case of new objects around which, only after completion of work on the facade, one carries out works connected with the surroundings.

5. CONCLUSIONS

Historic buildings, subjected to renovation, require a detailed approach to the problem of making scaffoldings. Despite the short period of their use one should be particularly attentive to the possibility of anchoring the scaffolding, as well as its foundation. Minor changes to the static schema, resulting from the need to adapt the scaffolding to irregular shapes of the object, can significantly reduce the load capacity of the scaffold structure. Any changes should be consulted with the scaffolds designer, since they can lead to construction failure. The aim of the scaffolding is to ensure the safety of its users [2, 3]. Setting scaffolding without drawing up documentation or making changes inconsistent with the project can lead to life threatening as well as expose to the substantial losses caused by the failure of the scaffolding. Many times, direct cooperation is necessary between fitters and designers during the assembly stage. In the case of historic buildings, an indispensable element is viewing the scene, which provides the most reliable information on the current state of the building, both-the object and the associated buildings.

ADDITIONAL INFORMATION

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RUSZTOWANIA WYKORZYSTYWANE PODCZAS RENOWACJI ARCHIKATEDRY ŚW. JANA CHRZCICIELA I ŚW. JANA EWANGELISTY W LUBLINIE

S t r e s z c z e n i e

W artykule zostały opisane trzy przypadki wykorzystania rusztowania jako konstrukcji umożliwiającej przeprowadzenie prac renowacyjnych. Obiektem, który wymagał zastosowania tego typu konstrukcji była Archikatedra Św. Jana Chrzciciela i Św. Jana Ewangelisty w Lublinie. W trakcie realizacji napotkano na szereg problemów związanych geometrią obiektu. W celu uzyskania optymalnego dostępu do obiektu zastosowano rusztowania modułowe umożliwiające rozbudowę rusztowania w dowolnym kierunku. Oprócz typowego wykorzystania rusztowania do prac w obrębie elewacji, rusztowanie zostało wykorzystane jako tymczasowe zadaszenie tarasu. Tego typu wykorzystanie rusztowania umożliwiło przeprowadzenie prac wykończeniowych okładzin tarasu w czasie zimy. Obiekty zabytkowe podlegające renowacji wymagają szczegółowego podejścia do problemu wykonania rusztowania. Pomimo krótkiego okresu użytkowania należy szczególnie zwracać uwagę na możliwości kotwienia rusztowania jak również jego posadowienia. Przeprowadzenie obliczeń statycznych umożliwia zminimalizowanie liczby kotwień oraz użytych elementów.

Słowa kluczowe: rusztowanie modułowe, prace na wysokości, schemat statyczny

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