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ADAPTATION OF THE SOUTH-WEST WING OF COLLEGIUM CHEMICUM OF ADAM MICKIEWICZ UNIVERSITY IN POZNAŃ FOR STORAGE FACILITIES

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Abstract

The article refers to the problems of adaptation of Collegium Chemicum facilities belonging to Adam Mickiewicz Uniwersity in Poznań to its storage needs. The subject building is situated in Grunwaldzka Street in Poznań. In the introduction part, the building and its structural solutions are described. The results of the materials research and the measurements of the used reinforcement have been presented. The structure diagnostic analyses were performed basing on measurements and research. The analysis allowed the determination of the limit loads. The results of the performed analysis of the current state turned out to be unsatisfactory, not only in terms of the planned storage load but also in terms of the current load state, as was shown by the construction analysis.

Keywords: adaptation, reinforced concrete structures diagnostics, strengthen

1. INTRODUCTION

Over the last twenty years Adam Mickiewicz University in Poznań realized numerous new investments, often with the support of EU funds. Due to the realization of the investment, a lot of offices of university departments, which were previously located in the city centre, have been transferred to a new campus in Morasko. As the result, the University faced a problem of numerous empty but attractively located facilities, many of which were significantly

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depreciated, and which were intended for adaptation. The paper describes adaptation of the south-west wing of the Collegium Chemicum building, situated in Poznań, in Grunwaldzka Street. It focuses on the problems with the structure of the adapted building. To adapt the intended building for the storage purposes for the University Main Library, it was necessary to examine the building in order to identify its structural constraints and to determine the permissible loads for ceilings.

2. DESCRIPTION OF THE FACILITY

The monumental building of the Collegium Chemicum in Poznań (Fig. 1) is located along Grunwaldzka Street, between Śniadeckich Street and Święcickiego Street (Fig. 2).

Fig. 1. The *Collegium Chemicum* today (on the left) and at the beginning of the 1930s (on the right)

The footage of the building, including the four inner courtyards, exceeds 10,000m^2. This is a multi-span building consisting of two longitudinal closing aisles which are connected to five transverse spans with two additional wings along the outer aisles. The whole facility comprises three and four-storey buildings, including partly utilized basements and attics. The useful floor area of the property, including communication paths, exceeds considerably 20,000 m^2.

Fig. 2. Location of the building of the Collegium Chemicum in Poznań (google maps)

2.1. Historical background

The building was completed in the neo-Renaissance style in the first half of the twentieth century. The building was designed by Edward Madurowicz and Roger Sławski. The construction started in 1920. Initially, the building was intended to house the Poznań University of Technology. However, upon the opposition by the ministry, the works were stopped. The construction of the facility was completed in 1929 as the Government Palace, one of the exhibition halls of the PeWuKa, the General National Exhibition. After the exhibition, the building was taken over by the University of Poznań, now Adam Mickiewicz University. As a result of war devastation, and especially of the fire in February 1945, the building was severely damaged. Despite the difficulties, the university teaching classes started yet in October 1945. In 2012, the Department of Chemistry was moved to a new building in campus in Morasko.

2.2. Description of the structure of the south-west wing of the facility

The south-west wing of the facility constitutes its independent part both structurally and functionally. The building has a beam-column structure, with longitudinal external walls and masonry gable walls. A floor plan of the ground floor, with marked basic dimensions on it, is shown in Fig. 3. The basic building dimensions: width -14.12 m, length - 31.61 m, overall height - 22.5 m. The clear heights of individual storeys are as follows: 2.22; 4.80; 4.98 and 4.60 m.

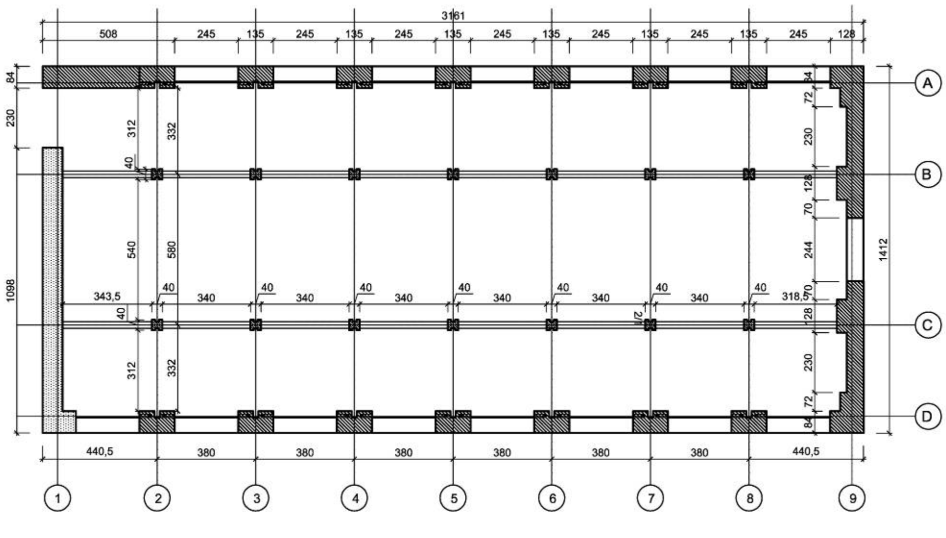

Fig. 3. Projection of the ground floor

The structure of the first three floors, (basement including) consists of two eight-span, reinforced concrete frames of a longitudinal shape (Fig. 4). Monolithic ceiling beams are based on internal, reinforced concrete columns and external masonry gable walls. Monolithic, ribbed floor slabs are made of structural clay tiles. The structural thickness of floor slabs are: 0,21 m over the ground floor and 0,18 m over the basement and over the first floor. Precast concrete slabs of the basement and the ground floor are constructed as continuous, three-span slabs. The supports are provided by internal longitudinal main beams connected monolithically to the floor slab, as well as by external longitudinal masonry walls. Precast concrete slabs of the first floor rest on longitudinal beams and on internal steel beams between reinforced concrete beams.

Fig. 4. The floor slab structures: over the ground floor (left) and over the 1st floor (right)

The last, fourth floor, i.e. attic, is covered in a transverse direction with a light steel truss (Fig. 5). Steel roof girders function as roof skylights, which provide light to the attic. A glass suspended ceiling was fastened to the bottom chords of the roof trusses. A gable, steel, roof trusses are based loosely on masonry pillars between windows in the longitudinal exterior walls.

Fig. 5. The steel structure of the flat roof: the glass suspended ceiling (left)
and truss girders in the transverse layout (right)

3. BUILDING EXAMINATION

In the absence of both the archival design documentation and the as-built documentation, for the full recognition of the structure, the structure inventory was performed as well as the measurements of the reinforcement [1]. In addition, test openings were performed to examine the reinforcement in the following structural bearing elements (Fig. 6): floor slabs, main beams and columns to the extent necessary for the verification of non-destructive inspection performed with the use of an electromagnetic locator for reinforcement detection HILTI - PS200 FERROSCAN. The performed test openings enabled the determination of the used types of breezeblocks and reinforcing steel.

Fig. 6. Test openings in the ceiling above the basement: the floor slab (left) and the main beam (right)

In order to determine the current parameters of the concrete strength, the material was examined with a non-destructive sclerometrer using the N-type Schmidt hammer. The results of the study of the compressive strength of concrete for randomly selected structural elements are given in Table 1.

Table 1. Results of non-destructive testing of compressive strength of concrete

Examined structural element	Guaranteed strength	Concrete uniformity	Class of concrete
	[MPa]	[-]	[MPa]
The ceiling over basement	12,93	satisfactory	B 12,5
The basement ceiling, main beam	13,86	satisfactory	B 12,5
The basement column	14,19	medium	B 12,5
The ceiling over the ground floor	12,87	medium	B 12,5
The ground floor, main beam	13,75	satisfactory	B 12,5
The ground floor column	15,16	good	B 15

The ceiling over the 1st floor	11,96	medium	B 12,5
The main beam over the 1st floor	14,65	satisfactory	B 12,5
The 1st floor column	15,33	good	B 15

The values presented in Table 1 imply that, both strength and uniformity of concrete do not meet today's quality requirements for reinforced concrete structural elements [2]. The class of concrete occurring currently in the majority of structural elements may be counted to, at the most, concrete class B12,5. It can be supposed that 28-day concrete compressive strength did not exceed class B10. This is the minimum class of concrete for reinforced concrete structures reinforced with steel A-0 and AI according to [3]. It should be noted that, due to the low concrete class, the reinforcement test openings proceeded with uncommon ease.

The inventory of the location of the applied reinforcement in main beams and columns confirmed that smooth steel was used for all reinforcement components. The inspection of the location of reinforcement showed its significant diversity, and in the case of ceilings and main beams – even considerable randomness of the applied reinforcement both as to its quantity and the used rod diameters. The consequence of this discovery was significant extension of the research, in relation to the principles typically used in the engineering practice, which involved random controls of the number and the diameter of the used reinforcing bars.

4. STATIC-STRENGTH CALCULATIONS

On the basis of the inventory measurements, the material tests and the inspection of reinforcement location, a comprehensive diagnostic analysis of the whole structure of the wing of the facility was performed. The location of the upper reinforcement of the structure, determined in the inspection, allowed the conclusion that the floor slabs may be regarded as multi-span continuous panels (Fig. 7 and 8).

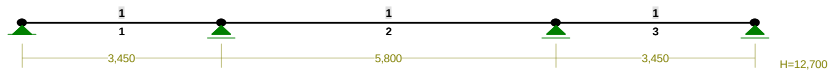

Fig. 7. Computational diagram for floor slabs over the basement and the ground floor

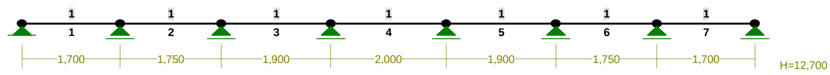

Fig. 8. Computational diagram for floor slabs over the the 1st floor

The computational model of the longitudinal, internal, load-bearing, reinforced concrete frame was adopted as a three-storey, eight-span, unmovable system (Fig. 9). Such an assumption is due to the structure of the ribbed, reinforced concrete slab, monolithically connected to the main beams. Horizontal loads are transferred onto the gable walls and the longitudinal external walls by rigid floor slabs.

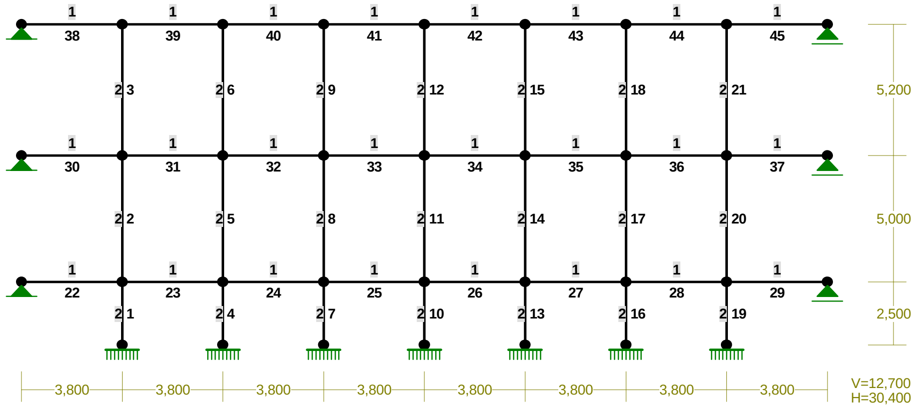

Fig. 9. Computational diagram of the main structural system

The carried out computational analysis resulted in the determination of the limit values of characteristic surface loads of floor slabs. The obtained values are listed in Table 2.

Table 2. List of allowable load values of floors in kN / m2

Floor	Structural element		Load limit	
			Of the element	Of the floor
1	PL1	Floor slab	1,50	1,50
	P1	Reinforced concrete main beam	2,85 / 1,30 *)	
	S1	Column	7,50 (2.50)**)	
	F1	Masonry pillar	10,0	
2	PL2	Floor slab	1,50	1,50
	P2	Reinforced concrete ribbed main beam	5,00 / 2,00 *)	
	S2	Column	7,50 (2,50)**)	
	F2	Masonry pillar	10,0	
3	PL3	Floor slab	7,50	1,00
	Z3	Steel rib	1,00	
	P3.1	Reinforced concrete main beam	10,0 / 10,0 *)	

	P3.2	Steel main beam (z)	2,50	
	P3.2	Steelmain beam (w)	2,00	
	S3	Column	2,50 (7,50)***)	
	F3	Masonry pillar	10,0	

5. SUMMARY AND CONCLUSIONS

Civil engineers frequently share a common opinion, that buildings erected in the interwar period were properly designed and constructed.
The example, presented in the paper, of a facility completely contradicts this prevailing opinion. This applies to both the project itself and the quality of the used materials .
Conclusions resulting from the presented example are as follows:

- in the absence of archival documentation, full diagnosis of the structure, regardless of its type and duration of its construction, should be performed,
- all types of structure components should be examined,
- structural solutions of elements of the same type should be monitored
- recognition of the structure should be performed in all authoritative cross-sections of the selected element,
- the principle of limited trust should be applied as to the repeatability of the applied solutions in structural elements of the same type.

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ADAPTACJA POŁUDNIOWO-ZACHODNIEGO SKRZYDŁA BUDYNKU COLLEGIUM CHEMICUM UAM W POZNANIU NA CELE MAGAZYNOWE

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

W pracy przedstawiono problemy związane z adaptacją budynku dydaktycznego Collegium Chemicum przy ul. Grunwaldzkiej w Poznaniu na cele magazynowe Biblioteki Głównej UAM. Na wstępie opisano badany budynek oraz scharakteryzowano zastosowane w nim rozwiązania konstrukcyjne. Przedstawiono wyniki wykonanych badań materiałowych oraz pomiarów inwentaryzacyjnych zastosowanego zbrojenia. Na podstawie wykonanych pomiarów i badań przeprowadzono analizę diagnostyczną konstrukcji, która pozwoliła na wyznaczenie dopuszczalnych wartości obciążeń powierzchni stropowych. Wyniki wykonanej analizy konstrukcji w stanie istniejącym okazały się dalece niezadowalające nie tylko z punktu widzenia planowanych, znacznych obciążeń magazynowych. Analiza wykazała bowiem, że konstrukcja jest już znacznie przeciążona w aktualnym stanie jej obciążenia.

Słowa kluczowe: adaptacja, diagnostyka konstrukcji żelbetowych, wzmocnienie

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