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1 BACKGROUND DOCUMENTS

- Project documentation
- Czech National Standards
 - ČSN 73 0810 – Fire safety of buildings, Common provisions
 - ČSN 73 0818 – Fire safety of buildings, Inhabitants
 - ČSN 73 0802 – Fire safety of buildings, Non-production buildings
 - ČSN 73 0873 – Fire safety of buildings, Water supply for fire systems
 - ČSN EN 13501 – Fire classification of construction products
- Public notices
 - No. 23/2008 Coll., about technical conditions for fire safety of buildings
 - No. 268/2011 Coll., about technical requirements for buildings
 - No. 246/2001 Coll., about assessment of conditions for fire safety

2 BRIEF DESCRIPTION OF BUILDING

2.1 GENERAL DESCRIPTION

The project documentation is concerned by a new building – Object “P” in a new campus University Residential Centre. It consists of student apartments, library and two lecture halls. Object “W” is solved in another project documentation. According to the task, this report solves in detail only the ground floor of the building.

2.2 LAYOUT

Entrances – the building can be accessed by four entrances (the other two are purpose only). Three entrances lead from protected escape ways. All entrances have clear width 1 800 mm and are equipped with emergency door handle (horizontal bar).

Floors – the building has three floors. The upper two floors are composed only from student apartments, 14 flats in each floor. The capacity is one, three or four people per apartment. There are three stairwells – protected escape ways, which create main corridor for people.

Area, floor area – the total object “P” built-up area is 1 776,12 m². Area of library is 636,74 m². and the two lecture halls have area 78,62 and 75,38 m² respectively. The sum of areas of all apartments is 2 086,97 m².

2.3 CONSTRUCTIONS

Foundations – are composed from reinforced concrete raft based on piles. Under the floor of the ground floor there is an installation channel which concentrates many service pipes. Clear height of the channel is 1 550 mm.

Vertical constructions – the main load-bearing elements are reinforced concrete columns, locally substituted by reinforced concrete walls (200 mm). Between the columns is infill masonry – hollow block masonry with acoustic properties Heluz AKU 25 (250 mm). This all is covered by ventilated facade with layer of thermal insulation – PIR (polyisocyanurate) panels Kingspan Kooltherm K15 in thickness 130 mm. The cladding is hanged on aluminium profiles and is made from fibrecement panels – Cembrit Metro.

Horizontal constructions – the floor structures are made from reinforced concrete. The static scheme is two-way reinforced slab with thickness 250 mm. Ceilings are plastered by lime cement plaster or covered by suspended ceilings with fire protection properties (Knauf RED 12,5 mm). The space above the suspended ceiling is used for service pipes and, in the ground floor, for ventilation ducts.

Roof – the load-bearing element of the roof is the same as the other floor structures (reinforced concrete slab 250 mm). It is an extensive green roof. The upper layer is formed by the substrate. Between these two layers is thermal insulation. Its minimal thickness is 220 mm and more because it creates the sloping layer. The roof is accessible by two entrances.

2.4 PURPOSE OF THE OBJECT

The purpose of the object is to combine student living with studying – there are 15 apartments on the upper two floors. In the first floor there are 9 apartments designed for disabled persons. In the ground floor there are two parts – one is library and the other is composed of two lecture halls. Both these parts can be also used by public. Concerning the fire safety, there are no special demands. No hazardous purposes are planned.

2.5 LOCATION DESCRIPTION

The object is located in the city of Brno, between Štefánikova and Staňkova Street (Královo Pole, Ponava) in the place of former barracks. Now the location is a brownfield. Together with the project documentation of Objekt “W” it creates a new way of utilization of the area. The neighbouring buildings are mainly residential. The distances between the neighbouring objects are sufficient and fulfilling standards. The terrain is flat, without any difficult conditions.

3 FIRE CHARACTERISTICS

- The building is assessed according to ČSN 73 0802 as a non-production building.
- Fire height of the building is $h = 7,25$ m.
- The construction system is DP1.

4 DIVISION INTO SECTORS

The building is divided into 44 fire sectors. Technical rooms and apartments are each separate fire sector. Other areas are mainly combined into greater units. There are three protected escape ways.

The areas and division to fire sectors can be seen in attached sheets and drawings. Summary is shown in the table below:

Fire sectors					
Ground floor		First floor		Second floor	
Sector	Degree	Sector	Degree	Sector	Degree
N1.01/N3	II.	N1.01/N3	II.	N1.01/N3	II.
N1.02	I.	N2.01	III.	N3.01	III.
N1.09/N3	I.	N2.02	II.	N3.02	II.
N1.03	II.	N2.03	II.	N3.03	II.
N1.04	III.	N2.04	II.	N3.04	II.
N1.05/N3	II.	N2.05	II.	N3.05	II.
N1.06	IV.	N2.06	II.	N3.06	II.
N1.07	III.	N2.07	I.	N3.07	I.
N1.08/N3	II.	N1.05/N3	II.	N1.05/N3	II.
N1.10/N3	I.	N2.08	I.	N3.08	I.
		N2.09	II.	N3.09	II.
		N2.10	II.	N3.10	II.
		N2.11	II.	N3.11	II.
		N2.12	II.	N3.12	II.
		N2.13	II.	N3.13	II.
		N2.14	II.	N3.14	II.
		N2.15	II.	N3.15	II.
		N2.16	II.	N3.16	II.
		N2.17	II.	N3.17	II.
		N1.08/N3	II.	N1.08/N3	II.
		N1.09/N3	I.	N1.09/N3	I.
		N1.10/N3	I.	N1.10/N3	I.

5 FIRE RISK, DEGREE OF FIRE SAFETY

The areas and division to fire sectors can be seen in attached sheets and drawings together with classification into degrees of fire safety according to ČSN 73 0802.

6 EVALUATION OF RESISTANCES OF CONSTRUCTIONS

Green roof is stated according to regulation No. 268/2011 Coll., paragraph 7 – $B_{\text{roof},t1}$

For buildings with fire height lower than 12 m are fire strips not demanded. However, the solution with concrete wall, PIR insulation and fibrecement facade fulfills the conditions for fire strips. Height difference for roof is not required, the building stands alone.

Construction	Demand	Real structure
External walls		
Ground floor – masonry, no stability demand	EI 30	EI 180 / EW 180 DP1
Ground floor – concrete, ensuring stability	REI 60	REI 180 / REW 180 DP1
First floor – masonry, no stability demand	EI 30	EI 180 / RE 180 DP1
First floor – concrete, ensuring stability	REI 45	REI 180 / REW 180 DP1
Second floor – masonry, no stability demand	EI 30	EI 180 / RE 180 DP1
Second floor – concrete, ensuring stability	REI 30	REI 180 / REW 180 DP1
Internal walls		
Ground floor – masonry, bracing wall	REI 60 DP1	REI 180 DP1
First floor – masonry, bracing wall	REI 45 DP1	REI 180 DP1
Second floor – masonry, bracing wall	REI 30 DP1	REI 180 DP1
Internal partitions		
Ground floor	EI 30 DP1	EI 60 DP1
First floor	EI 15 DP1	EI 60 DP1
Second floor	EI 15 DP1	EI 60 DP1
Floor structures		
Ground floor – with suspended ceiling	REI 60 DP1	REI 90 DP1
Ground floor – without suspended ceiling	REI 15 DP1	REI 240 DP1
First floor – without suspended ceiling	REI 45 DP1	REI 240 DP1
Second floor – with suspended ceiling	REI 30 DP1	REI 90 DP1
Second floor – without suspended ceiling	REI 30 DP1	REI 240 DP1
Columns		
Ground floor	REI 60 DP1	REI 120 DP1
First floor	REI 45 DP1	REI 120 DP1
Second floor	REI 30 DP1	REI 120 DP1

7 EVALUATION OF MATERIAL PROPERTIES

Fire reaction class is stated according to ČSN EN 13501.

Material	Fire reaction class
Masonry	A1
Mineral wool	A1
Reinforced concrete	A1
Ceramic tiles	A1
Fibre cement panels	A1
Plasterboard	A2, s1, d0
PIR panels	B, s1, d0
EPS 150 S	B
Laminate flooring	C, s1
Marmoleum flooring	C, s1

8 EVACUATION

In the object there are three protected escape ways (PEW). The ČSN 73 0802 states the maximal length for PEW type A is 120 m. For the object the maximal length is 59 m. Protected escape ways are listed in attached table. The maximal length of the non-protected escape way is 29 m, which fulfils the standard.

The protected escape ways will be separated from other fire sectors by smoke-tight door with automatic closing systems. Ventilation will be provided by windows. It is restricted what object can be placed in PEW, the list is given by ČSN 73 0802.

In the case of fire the electronic fire signalling system will unlock and open all exits from the building and opens all windows in PEW to ensure sufficient air exchange.

Doors on escape ways have to allow quick and easy pass, the shape of ironwork should prevent trapping of clothes. Doors should be provided with ironwork, which allows opening them from the other side than it was locked (in the case of emergency).

The amount of persons evacuated by escape way is stated by ČSN 73 0818. Then, according to ČSN 73 0802, number of needed escape strips can be calculated. Width of one strip is 550 mm. The attached table shows that the maximal width of an escape way is $3 \times 550 = 1\,650$ mm which is fulfilled by all escape ways. This has to be fulfilled also by doors. Minimal clear height of door is 2 000 mm. All obstacles which can decrease these dimensions must be removed.

The building has two elevators. One of them is meant for evacuation; it can be used in the case of fire (see drawing). The dimensions of the cabin are 1 200 x 2 100 mm.

The evacuation elevator will have energy source to be operational without power source for 45 minutes. The speed of the elevator will be designed to keep duration of one way under 2,5 minutes. The elevator shaft will be protected against smoke. The receptionist will be responsible for the elevator and will operate it in the case of fire.

The shaft of the evacuation elevator is made from plastered masonry with fire reaction class A1. The evacuation elevator will be marked in the cabin and also on the door from external side. The other elevator, which is not for evacuation, will have sign "Don't use in the case of fire".

9 FIRE HAZARDOUS AREA

Fire hazardous area is calculated according to the standard ČSN 73 0802, appendix F. The results are defined in the situation plan.

Ground floor								
Position	h_u [m]	l [m]	S_{po} [m ²]	S_p [m ²]	p_o [%]	Sector	p_v [kg/m ²]	d_1 [m]
1	2,15	1,90	4,09	4,09	100	N1.07	57,00	4,91
	2,30	5,35	6,65	12,31	54	N1.06	69,13	3,48
2	1,50	3,00	3,00	4,50	67	N1.04	51,06	3,65
	2,20	21,50	19,80	47,30	42	N1.03	27,58	2,45
3	0	0	-	-	-	-	-	-
4	4,02	9,26	37,23	37,23	100	N1.03	27,58	6,04
5	4,02	54,34	172,74	218,45	79	N1.06	69,13	10,68
6	0	0	-	-	-	-	-	-

10 WATER FOR EXTINGUISHING

Due to ČSN 73 0873 internal hydrants are demanded for the object. The ground floor (which is solved by this report) contains four hydrants. The used type a fire hose system which consists of hose reel, inlet valve, 20 m long lay-flat hose with reach 30 m and a shut-off nozzle. The hydrants will be in wall boxes located 1,1 m above floor.

External sources of water for extinguishing are underground hydrants located in the Štefánikova Street. There are four of them which are closer than demanded 100 m specified in ČSN 73 0873, tab. 1 for building with larger area than 2 000 m² and they cover the whole building. The dimension DN150 fulfils the standards. Static pressure of the hydrant must be at least 200 kPa.

11 ACCESS ROADS

According to standard ČSN 73 0802 all objects must have an access road to allow action of fire fighters. For the object as access roads can be used Štefánikova Street and the northern parking lot. From there the entrances are less than 20 m far and also paved areas can be used.

In the case that the building is lower than 12 m there is no need to have a boarding area for the fire brigade.

Entrances and roads to the plot useable for arrival of fire fighting vehicles have at least 3,5 m of clear width to fulfil the requirements of the standard ČSN 73 0802.

12 FIRE EXTINGUISHERS

According to regulation No. 23/2008 Coll. each fire sector will be equipped with fire extinguishers. Their amount is calculated in an attached table Fire extinguishers.

They are placed according to public notice No. 246/2001 Coll. and according to public notice No. 23/2008 Coll. free passage to the fire extinguisher must be kept.

The type will be PG6 – 6 kg powder extinguisher 113B. It is useable for categories A, B and C.

13 TECHNICAL EQUIPMENT

Heating of the building is done by heat exchanger which will be located in the technical room (1002). This device is also used for domestic hot water (DHW). Technical room will be separated fire sector with access only for authorized persons.

Ventilation will be both natural and forced and there will be two operational units – one in room 1003 and the other in room 1022. The ventilation system has built-in recuperation unit. The inlets and outlets will be placed in vertical shafts leading to the roof. The shaft and the ventilation technical room are together separate fire sector. The ventilation ducts will be placed between reinforced concrete floor structure and suspended ceiling made from plasterboards. Where the ventilation duct crosses a border of a fire sector it will be equipped with fire damper according to standards to prevent smoke from spreading.

The standard ČSN 73 0802:2009 states the requirements for service pipes. If the clear area of the pipe is more than 40 000 mm² it (which is true for the ventilation ducts) it will be surrounded by materials with fire reaction class A1 (plastered masonry wall).

There will be two elevators located in protected emergency ways. The type is Schindler 3300 with integrated engine. It causes no additional fire risk.

14 SPECIAL REQUIREMENTS FOR CONSTRUCTIONS

There are no special requirements.

15 FIRE SAFETY DEVICES

According to the Fire safety plan all rooms will be equipped by automatic fire detectors and fire alarm systems. This is done following the regulation No. 23/2008 Coll.

It consists of heat and smoke detectors or it can be activated manually by fire alarm button. In the reception (room 1013) will be installed electronic fire signalling central. Also there will be accessible telephone for fire reporting. Manual fire alarm buttons will be located to be clearly visible and reachable without any obstacles. They will be marked according to regulation.

Acoustic fire signalling devices must be placed to be audible for every inhabitant of the object. There will be two types of signalling devices – acoustic fire signalling and emergency speakers. Acoustic fire signalling device will be in every room. Emergency speaker control will be located in the reception (room 1013) and from there evacuation can be controlled and conducted. It has to fulfil requirements of ČSN EN 60846 and ČSN EN 60849. Both devices will be equipped by accumulators to be fully operational in the case of fire for at least 15 minutes.

Fire safety devices will be placed according to the Fire safety plan drawing. They will be periodically checked by a responsible person (or a company).

16 SAFETY SIGNS AND LIGHTING

The fire extinguisher and the main power switch (“total stop”) must be marked by signs according to ČSN ISO 3864, ČSN 01 0813 and according to public notice No. 11/2002 Coll.

Escape ways must be marked according to ČSN ISO 3846 where the exit is not directly visible. These marks must ease the evacuation process. Therefore, changes of direction of escape (horizontally and vertically) and must be marked by signs and arrows. This is valid also for crossings of escape ways.

Escape ways must be lightened by natural or artificial light at least during the working hours of the object. Non-protected escape ways must have artificial light in every place where is standard wiring. Protected escape ways must have emergency lighting. Emergency lighting is designed according to ČSN EN 1838.

Emergency lighting must be working in the case of fire for 15 minutes in type A protected emergency ways. This is valid also for non-protected emergency ways (15 minutes). Every emergency light will be equipped by accumulator to meet the required 15 minutes of working time without power connection.

Emergency lights will be placed in all rooms according to the Fire safety plan drawing.

17 CONCLUSION

The building Object "P" is a three-storey building. The ground floor serves for education, there is a library and two lecture halls. The upper two floors consist of apartments for students.

Constructions – the construction system is a monolithic reinforced concrete skeleton with columns as main load-bearing elements. Non-load bearing external wall are made from hollow block masonry Heluz AKU 25 (250 mm). PIR panels are the thermal insulation inside the ventilated facade. Internal walls are either masonry (the same as external – Heluz AKU 25) or made from plasterboards – Knauf partitions. If the plasterboard partition creates a border of a fire sector it will be coated with Knauf RED type plasterboard.

Horizontal constructions will be made from reinforced concrete in thickness 250 mm. It is a two-way reinforced slab. In many rooms there is a suspended ceiling made from Knauf plasterboards. The roof is green, extensive type. The thermal insulation is EPS 150 S. There are two entrances to the roof.

Escape ways – There are three protected escape ways – stairwells. They will be divided from other fire sectors by smoke-tight door and equipped with lighting working without power supply. There is one emergency elevator which can be used in the case of fire.

Electronic systems – All rooms in the ground floor (which is solved by this report) will be equipped with automatic fire detectors connected to electronic fire signalling central. Evacuation can be controlled by emergency speakers and acoustic fire signalization.

Final notes – fire hazardous area does not exceed to neighbouring objects or plots.

For final inspection approval will be presented valid tests and certificates according to act No. 22/1997 Coll., public notice No. 246/2001 Coll. and others.

The building fulfils the conditions of fire safety.