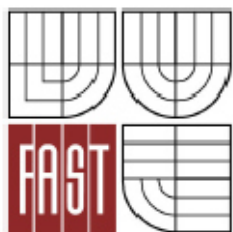




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D.1.3 FIRE SAFETY

D.1.3.02 FIRE SAFETY REPORT

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BACHELOR 'S THESIS

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BRNO 2015

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1 General data about the construction

Urban and architectural solution of the building:

The design documentation is carried out as a documentation for construction works of family residence with design office in Vysoká nad Labem, number of plot 244/3 which is connected to street Na Vinici. The family residence with the design office is detached building without basement, with two floors. The roof is designed as shed (one sloped) roof. The floor plan has rectangular shape of dimensions 10x 12 m. The plot has slightly inclined terrain.

Vertical load bearing structures are made from clay bricks Heluz and horizontal load bearing structures are from reinforced concrete. The structure of roof is designed as timber truss system, and it serves as a load bearing structure for the ceiling of first floor.

Layout solution of the building

The access to the building and arrival is proposed from the south. The entrance to the building is designed from the south as well. After the entering to the building there is vestibule from which there is possibility to continue to the corridor with staircases. The corridor leads to the open living room with kitchen, the main dominant of the open living room is in-built fire place in the wall which optically divide kitchen from the living room. In the living room there is entrance to design office. On the other side of the corridor we can enter to the technical room connected with the WC and shower, this side of the corridor is also accessible from living room . The stairs lead to the first floor.

Into the first floor we can get by the reinforced concrete once broken stairs. The children rooms with sufficient light from large windows are placed in the direction to the south. To the north there are positioned two bathrooms and guest room. The bedroom for parents is in back position facing comfort view on the west.

Constructional solution of the building

The peripheral walls will be carried out from cavity blocks HELUZ FAMILY 25, as the binder the PU foam is used. Internal load bearing walls are designed from HELUZ FAMILY 30 , as the binder the PU foam is used as well. The system of ventilated facade of external walls is used. The ventilated layer is created by the help of timber frame from laths 40 x 60 mm anchored by the steel L- shaped elements to the load bearing walls. Between the wall and frame there is thermal insulation from mineral wool in the thickness 160 mm secured from leak of water by waterproofing. The external layer of facade is designed from timber decking from Thermwood.

Ceiling structure above the ground floor is designed as reinforced concrete two way supported slab of thickness 250 mm. The concrete class C 20/25 and reinforcement B 500 B will be used, concrete cover 25 mm. For the ceiling structure above first floor the lower chords of truss system are used. Below them there is designed suspended ceiling from gypsum boards of company Knauf with layers of thermal insulation from cellulose.

The roof has the cover from metal sheets. Windows and doors are designed as wooden. All the top layers of floors are listed in the table for individual rooms.

2 Fire technical review

2.1 Sources used for creation of FSR

Technical sources of constructions

-Project for building permit

Law and other Regulations:

-Law no. 133/1998 Coll., about fire protection,

-Regulation no. 23/2008 Coll., in reading of Regulation no. 268/2011

Coll., about technical conditions of fire protection of buildings

- Regulation no. 246/2001 Coll., about determination of conditions of fire safety and power of SPD, vzpp

Standards CSN

-CSN 73 0810:04/2009- PBS - Common regulation "10"

-CSN 73 0802: 05/2009 -PBS - For non- manufacturing buildings "02"

-CSN 73 0835: -PBS- Buildings of health care and social care "35"

-.CSN 73 0818+Z1:09/1997 -PBS-Occupation of building by people "18"

-CSN 73 0873:06/2003 -PBS- Supplying by fire water

-CSN 73 4200:09/2004 - Chimneys - General requirements

-CSN 01 3495:06/1997- Drawings in Buildings and construction

Other sources

Zoufal a kol.: Hodnoty požární odolnosti stavebních konstrukcí podle Eurokódů

2.2 Fire technical characteristics

- number of floors: 2, without basement
- vertical load bearing structures: DP1 HELUZ 250 mm
TI of peripheral walls - MW of th. 160 mm
- horizontal load bearing structures: DP1 reinforced concrete slab
gypsum boards under timber structure
- constructional system: non-combustible article 7.2.8 a) "02"
- fire height: $h = 2,9 \text{ m}$ (floor of first floor)
- according to article No 4.1.1 "33" the whole building creates one fire compartment N1.1/ N2
- article No. 4.1.1 b) Fire safety grade II
- fire risk according to supplement B "02" $p_v = 45,75 \text{ kg} \cdot \text{m}^{-2}$

- attic - it is a space without fire load $p_v = 4 \text{ kg} \cdot \text{m}^{-2}$

2.3 Determination of fire compartments

ČSN 73 0833 OB1

all family house = 1 fire compartment
article 3.5 a) "33"

FH: $< 600 \text{ m}^3$...utility area
 < 3 above ground floors
 < 1 underground floor
 < 3 utility units (flats)

- if included workplace: $< 50 \text{ m}^2$
 $< 50 \text{ kg/ m}^2$
- if included garage: max. 3 cars of group 1

2.4 Evaluations of fire compartments and of its sizes

- setting of Grade of fire safety: GFS II

art. 1.1 "33": number of floors = 2
combustibility of structural system = DP1

- fire risk: according to the supplement B, standard ČSN 73 0802

$$p_v = 40 \text{ kg} \cdot \text{m}^{-2}$$

$$p'_v = (p_1 - 5) \cdot 1,15 = p_v = 45,75 \text{ kg} \cdot \text{m}^{-2}$$

2.5 Verification of fire resistance of individual constructions in fire compartment

accord. table 12 ČSN 73 0802

not any assessment for truss - OB1, floor underneath $< 200 \text{ m}^2$ art. 8.7.2
c)

item	construction	requirement	reality	note
1	External load bearing walls, ensuring stability	REI 30	REI 60, HELUZ 25	fulfills
2	Internal load bearing walls, ensuring stability	REI 30	REI 90, HELUZ 30	fulfills
3	Ceiling structure inside of the multi level compartment	RE 30	REI 60 DP1, RC slab 250 mm, cov. 25mm	fulfills

4	Ceiling structure with function of roof	EI 15	EI 15, KNAUF gypsum boards	fulfills
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- thermal insulation of facade is from mineral wool - reaction on fire A1

- Roof cover

There is fire compartment with degree of fire safety (DFS) up to degree II in the object. Roof cover is without any requirements of fire resistance in case of DFS II acc. to table 12 "02". Roof cover is located above fire protective ceiling of last over ground floor, even because of this the roof cover do not have to be fire resistant acc. to art. 8.15.11a) "02" and acc. to art. 8.15.4. b1) "02" this roof cover is not considered as area open to fire, N1.1/N2 - II, $p_v = 45,75 \text{ kg/m}^2 < 50 \text{ kg/m}^2$.

- fire strips are not required for OB1 (ČSN 730833). Height difference is not required for roof cover, the object stands detached.

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

- on facade there is the wooden cladding, see the point 2.7

Verification of material properties

Clay blocks HELUZ	reaction to fire - A1
Mineral wool	reaction to fire - A1
Plasterboards (ceilings)	reaction to fire - A2, d0
RC	reaction to fire - A1

2.6. Escape routes

- escape ways – according to 4.3 ČSN 730833, family house – length of escape ways is not considered. There are two entrances to the building. All of them at least 900 mm of clear width.

- 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).

2.7. Standoff distances

On the envelope of the building there are flammable parts that could fall out in the case of fire. Standoff distances will be evaluated on :

- radiation
- falling of burning parts

Radiation

a) facade

- wooden cladding of th. 19 mm

- assessment: fire opened area:

$$Q = H.M$$

where: Q - heat in MJ/m²

M- mass in kg/m²

H- calorific value in MJ/ kg for wood H= 17 MJ/kg

$\rho = 450 \text{ kg/ m}^3$

$$M = \rho \cdot t = 450 \cdot 0,019$$

$$M = 8,55 \text{ kg/ m}^2$$

$$Q = 17 \times 8$$

$$Q = 136 \text{ MJ/m}^2 < 150 \text{ MJ/m}^2 \dots \text{ wooden cladding is not fire opened area}$$

b) windows - fully opened areas

- according to ČSN 730802, appendix F. The results are marked in site plan.

$$p_v = 45,75 \text{ kg} \cdot \text{m}^{-2}$$

Position	h_u [m]	l_u [m]	S_{po} [m]	S_p [m]	p_o [%]	d_1 [m]
North view	1,5	9	10,5	42,3	24,82	1,42
West view	1,85	9,23	9,75	51,69	18,86	1
East view	1	5,5	3	22	13,64	0,9
South view	1,875	11,27	18	61	29,51	2,025

c) falling of burning parts assessment

$$d_2 = 0,36 \cdot h_c$$

$$d_2 = 0,36 \cdot 7,73$$

$$d_2 = 2,78 \text{ m}$$

- the range of falling parts is in the frame of plot, there is no other building in reach.

Comparison

$$d_1 < d < d_2$$

$$2,03 < d < 2,78 \text{ m}$$

d = 2,8 m.. standoff distance

2.8 Technical and technological devices

2.8.1. Connections passages

Connections passages and installations including also passages of electricity connections, are to be designed in such a way, they would pass least fire barriers – cl. 6.2.1 „10“. Constructions with these passages have to be brought to outer surfaces of pervading devices in exact composition and exact fire resistance like fire barriers have. Fire barriers can be for instance exchanged (or customized) in tightened part towards outer surfaces of certain passages provided that fire resistance will not be diminished nor type of construction will be changed (DP1 and the like).

Without further precautions distribution piping and its accessories can pass according cl. 11.1.1 „02“ through fire barriers, which are intended for distribution of non-combustible substances, by fulfilling following conditions:

- up to diameter of 40 000 mm² regardless to combustibility of used material without further measures;
- piping with clean cross-section over 40 000 mm² must be made of material with reaction to fire A1 and A2 and its eventual isolation is at least up to 1000 mm distance from both faces of fire barrier, fire barrier which is made from non-combustible building material (reaction class to fire A1 and A2)

Piping with clean diameter over 40 000 mm² and its accessories from combustible building materials must not be freely conducted through fire compartment and must be:

- assembled in building construction of type DP1 or otherwise fire protected, e.g. by cover layer with fire resistance of at least 30 minutes;
- placed in installation shaft or channel.

In building there is not designed distribution for combustible substances.

Ventilation devices can pass fire barrier up to the area of one passage – 40 000 mm² a must not have area bigger than 1/100 area of fire barrier by mutual distance 500 mm of these passages

At passages of fire barriers referred in cl. 6.2.2 „10“, except piping passages, solved must be also avoidance of fire spreading through piping matter (material) and through inner space of piping and other permeating device. This sealing is assured by help of putty, cuffs and likewise, their fire resistance is determined by required fire resistance of fire barrier, at most 90 minutes. Passages sealing is evaluated according cl. 7.5.8. ČSN EN 13501-2:2008 in these cases:

a) Fire resistance EI:

- sewage piping of reaction class to fire B – F, of clean diameter over 8000 mm², if it is vertical position of piping or over 12500 mm², if it is horizontal position of piping with deviation up to 15° (EI-UU or EI-CU);
- piping with permanent water filling or another non-combustible fluid, reaction class to fire B – F with clean diameter over 15000 mm² (EI-UC);

- piping serving to distribute compressed and not-compressed air or other non-combustible gases including ventilation distribution, reaction class to fire B – F, of clean diameter over 12000 mm² (EI-UC);
- cable and other electrical distributions created by cluster of conductors, as long as these distributions are going through one opening, have isolations (surface finishes) which spread fire and their total weight is bigger than 1,0 kg.m⁻¹ (provision does not apply to conductors and cables according „02“ a „04“ and cables which are not spreading fire according standards of council ČSN EN 50266).

b) fire resistance E-C/U or E-U/C and likewise, in all cases mentioned in point a) as regards to fire barriers passages of class EW

In case of permeating more pipelines through fire barrier according points a) and b) and have clean diameter bigger than 2000 mm² with axial distances is less than 300 mm all these pipelines must be equipped by cuffs according cl. 7.5.8. ČSN EN 13501-2:2008.

When the latter are passages according cl. 6.2.2 „10“, permeate has to be not only sealed by filling up of construction up to the top of piping but also has to be equipped with cuff according

cl. 7.5.8 ČSN EN 13501-2:2008 so that spreading of fire by pipes or by piping material will not occur for better connection between outer surface of piping and fire barrier.

Realized permeates and cable seals in this way have to be clearly marked by info label about fire- safety parameters of permeate :

- a) object marking, places in object,
- b) sequence number of cable seal,
- c) fire resistance marking of cable seal
- d) date of execution, company, address and name of practitioner, marking of producer and marking of system.

2.8.2. Heating

There is a boiler for gaseous fuels situated in service room. It is used for heating and HDW (hot domestic water). It has to fulfill conditions of public notice No. 91/2010 Coll. and ČSN 734301.

Inside the building there is one chimney combined with ventilation shaft (HELUZ KLASIK, 400x 600 mm) connected to fire place in living room. The ventilation shaft is connected for exhaust of kitchen hood. According to 8.1 ČSN 734301 the chimney must have fire resistance EI. The safe distance from combustible items must be ensured. From fire place it is 800 mm in the direction of heat flow and 500 mm in perpendicular direction to the heat flow.

Ventilation is designed as only natural one.

2.9. Devices for fire-fighting intervention

2.9.1. Access communications and boarding areas

Single-lane communication leads to object of approximately 3 m width up to 14 m distance < 20 m from main entrance to object, communication is in compliance with cl. 12.2. „02“ and is acceptable.

On single-lane communication will be prohibited parking of vehicles on this communication will be extended in place of hydrant.

Boarding area does not have to be provided, height of affected object, $h = 2,9$ m, that is up to 12 m – cl. 12.4.4. „02“.

2.9.2. Fire-water supplying

Internal hydrants are not demanded for family houses according to 4.4 b) ČSN 730873. There is no internal hydrant in the building.

External hydrants – built-up area of the building is smaller than 200 m², therefore it is necessary to have an external hydrant of dimension of DN80 in distance from the object maximally 200 m. The distance to the closest hydrant is 56 m. Static pressure of the hydrant must be at least 0,2 MPa.

2.9.3. Fire-extinguishers

According to the regulation 23/2008 Coll. there is a 6 kg powder extinguisher (113B) placed in the technical room of the building. The extinguisher is useable for categories A, B and C.
_ It is 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.

2. 9.4 Fire safety devices

According to the regulation 23/2008 Coll., every family house has to have fire or smoke detector.

There is one fire detector in the staircase hall, another one is in the kitchen. Both of them have to be checked periodically as it is stated in the manual from the producer.

3 Safety signs

The fire extinguisher and the main power switch (“total stop”) must be marked by signs according to ČSN ISO 3864, ČSN 010813 and according to public notice No. 11/2002 Coll.

4. Conclusion

The designed building is family house with two floors. Vertical load bearing structures are made from clay blocks HELUZ 25 and 30. The horizontal load bearing structure above ground floor is made of RC slab. In the first floor the ceiling is made from gypsum plaster boards KNAUF.

The roof structure is from timber truss system. The roof is designed as shed roof.

The building has II. degree of fire safety. Its constructions fulfill the conditions of ČSN 730802

the escape ways fulfill ČSN 730833. There will be one fire extinguisher in the object, located in the technical room, which is accessible from living areas and also from the garage. There will be two fire detectors in the object.

Fire hazardous area does not exceed to neighboring 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.