

## Technical report – Building Structures

Building description:	Municipal public library of Kutná Hora
Location:	street Sokolská, Kutná Hora, Czech Republic
Type of building:	Municipal public library
Area of the building:	962,02 m <sup>2</sup>
Total volume of the building:	15 392,32 m <sup>3</sup>
Number of floors above the ground:	3 floors
Number of floors below the ground:	1 floor
Statistical data of spaces:	Communication space: 703,3 m <sup>2</sup> Garages: 571.29 m <sup>2</sup> Storerooms: 294,42 m <sup>2</sup> Technical equipment: 75,32 m <sup>2</sup> Toilets: 77,69 m <sup>2</sup> Offices: 170,92 m <sup>2</sup> Study rooms (halls): 419,27 m <sup>2</sup> Open spaces with books: 868,56 m <sup>2</sup>
Roof:	non walk-able flat roof is used
Structural system:	Column system with two way waffle slab, hidden joists
Horizontal Load bearing elements:	Reinforced concrete two way waffle slab, Reinforced concrete beams, Reinforced concrete one way slab, Ceramic PTH lintels
Vertical Load bearing elements:	Reinforced concrete collumns, walls, Masonry walls with mainly filled and dividing function
Documentation consist parts:	Building structures 80 %, Concrete and Masonry Structures 15% , Foundations 5%, (other specialozations are not included in this documentation)
Prepared by:	Martin Vaníček
Checked by:	Bulding structures: doc. Ing. Vladimír Žďára, CSc. Concrete structures: Ing. Iva Broukalová, Ph.D. Foundations: Ing. Jan Salák, Csc.

a) Urban and architectural solution of the building

Municipal library was architectonally and urbanically designed by Bc. Veronika Vřešťalová as her diploma project on the Faculty of Architecture in the academic year 2015/16. With her agreement was this architectural study used as a foundation of my bachelor project, which is focused to the building structure design. Original architectural concept of the building has not been changed. In my project, I tried to respect her architectural concept in the structure design solution. Library is designed with 3 above floors, and 1 floor underground. Basement floor consist of the garages, storerooms and technical equipment. Other floor consist mainly of the open spaces with books, study rooms, toilets, communication corridors, etc. Material of the facade is ceramic cladding Klinker of red color. Windows and doors are made of wood with color of dark grey. Other material solution see the documentation.

b) Technical solution of the building

Laying out: Municipal library building is fixed to the 253,057 m. Bpv. Other detailing coordinates of the building in the terrain are not part of this project. In practice it should be done by responsible geodesy surveyor.

Excavations: Excavation works will be started after removing of the topsoil with thickness circa 300 mm. Then foundation pit will be excavated in the depth 4,35 m bellow the ground. Dimensions of the pit is 46 x 27,2 m. Sides of the pit will be sloped with respect to the ground water and soil type.

Foundations: Original subsoil is mostly composed by Loess and the load of the building is quite high that's why the foundations are designed as reinforced waterproofing concrete C25/30 white bath with the thickness of the slab 500 mm and thickness of the basement wall 300 mm. White bath has to be concreted on the compacted subsoil and 100 mm thick concrete base slab. Part of the structure with the car elevator should be separated by expansion joint. For the more sophisticated design of the foundations geological survey and engineering geological survey should be done. For the purpose of this project is this design satisfied.

Vertical load bearing structures and structure of the roof: Load bearing columns 600 x 600 mm were designed from reinforced concrete C30/37, in the maximum axis distance 8,2 m, as the main part of the vertical load bearing structure. Other vertical load bearing elements are walls made of reinforced concrete the same quality, mainly supporting the structure of the staircases. In the basement is used reinforced concrete wall on the perimeter as the part of the white bath. Structure of the flat non-walkable roof is designed in the same way as the horizontal ceiling structures it is two way waffle slab with hidden joists.

Horizontal load bearing structures: Structure of the ceiling are made of the two way waffle slab, reinforced concrete supported on the columns with the maximum thickness 380 mm. Above the columns is the slab prevented from the punching by the steel flanged collars. Slab is concreted on the plastic caps formwork. The reinforced concrete slab is made from concrete C 30/37, because of the high variable loads 7,5 KN/m<sup>2</sup>. Above the openings which span is longer than 3 m are used reinforced concrete beams. Above the other openings is used system solution of the three PTH ceramic lintels with the thermal insulation above the window. Around the slab

horizontal collar is designed with dimensions 200 x 300 mm in perimeter of the whole building to prevent the vertical settlement and deformations.

Staircases: In the building are designed two three armed staircases. First is mainly for the employees of the library and the second mainly for the guests of the library. Both staircases are made of the reinforced concrete. Boarding arm is made as a slab supported on the reinforced concrete beam on one side and landing of the staircase on the second side. Second arm is twice bent slab fixed into the reinforced concrete walls and the outlet arm is made in the same way as the boarding arm. Whole staircase has to be dilated by the trapes boxes + corbel elements in the walls and in the perimeter joint insulation to prevent vibrations of the staircase.

Elevators: Three personal elevators are designed in the building and one car elevator. Personal elevators are put into the reinforced concrete shafts with specified producer dimensions. Elevators with counterweight in the back are used. Car elevator is designed because of the insufficient slope to the garages. Car elevator is placed into the separated reinforced concrete shaft with specified producer dimensions.

Roof: Load bearing structure of the roof is designed as two way waffle slab from reinforced concrete C 30/37. The slab is covered by the sloping layer of the concrete with min. thickness 20 mm close to the water drain, and maximum thickness on the side 250 mm. 2 x Bitumen sheet with the thickness 2 x 8 mm, with the extruded polystyrene 250 mm above the hydro insulation is used. As a final layer is used clast of rock. Two water drain are used in the plan of the roof. Maximum span of the roof is 3 %.

Water (hydro) insulation: In the basement will be provided mainly reinforced waterproofing concrete (white bath). The white bath is covered by the bitumen sheet as the prevention of the radon intrusion into the building. Bitumen sheet has to be welded with a minimum overlap is 150 mm. In the roof structure double layered hydro insulation of the thickness 2 x 8 mm is used. Roof has to be perfectly covered, all the joints has to be overlapped (tight) to prevent the leakage of the water.

Radon prevention: The white bath is covered by the bitumen sheet as the prevention of the radon insulation of the building, because only the white bath cannot be designed as only insulation against the radon. Medium risk of radon is assumed. All the holes and penetrations has to be perfectly tight.

Thermal insulation: Thermal insulation of outer walls will be done by contact insulation system from expanded polystyrene thickness 150 mm. Ceiling above the basement will be insulated by the mineral wool of the thickness 200 mm. Structure of the roof is insulated by the extruded polystyrene thickness 250 mm. Floor structure is insulated by the polystyrene Styrofloor thickness 60 mm. Basement wall is insulated by the extruded polystyrene thickness 150 mm.

Thermal properties of the structures:

Outer wall:  $U = 0,19 \text{ W/m}^2\text{k}$

Basement wall:  $U = 0,23 \text{ W/m}^2\text{k}$

Roof structure  $U = 0,14 \text{ W/m}^2\text{K}$

Window and door with glazing:

Double glazed:  $U = 1,2 \text{ W/m}^2\text{K}$

Fillings of the openings: Windows and doors are made of the Euro prism wood, with double glazing with the gap filled by gas argon. This documentation do not solve exact type and dimensions of the fillings.

Partitions: Knauf gypsum board partitions are mostly used in the building because of the light weight and low stiffness and high acoustic insulation properties. First type W112 with double casing and mineral wool, thickness 200 mm, with  $R_w = 60 \text{ db}$ . Second type W111 with simple casing and mineral wool, thickness 100 mm, with  $R_w = 45 \text{ db}$ . Other partitions are made of light glass, thickness 100 mm, with glass thickness 10 mm and ALU profiles.

Surface finishes: Outer wall is covered by the red ceramic cladding Klinker. Inner walls will be covered by cement lime plaster + stucco and two layers of painting. Suspended ceiling are made of gypsum boards Knauf D112. In the study rooms and halls will be provided acoustic variant of the ceilings. Interior flooring is made of the thin layer of the leveling concrete floor about 5-10 mm, realized without joints can be filled with lot of color variants. Garage floor is made of concrete with durable polyurethane coating. On the toilets ceramic tiles will be installed.

c) Drawings included in this documentation

- 01 – Structural variant 01
- 02 – Structural variant 02
- 03 – Structural variant 03
- 04 – Basement floor plan, M 1:100
- 05 – 1<sup>st</sup> Floor plan, M 1:50
- 06 – 2<sup>nd</sup> Floor plan, M 1:100
- 07 – 3<sup>rd</sup> Floor plan, M 1:100
- 08 – Section A-A', M 1:50
- 09 – Detail 1
- 10 – Detail 2
- 11 – Detail 3
- 12 – Detail 4
- 13 – Foundations, M 1:50
- 14 – Formwork drawing 1<sup>st</sup> Floor