



**BRNO UNIVERSITY OF TECHNOLOGY**

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

**FACULTY OF CIVIL ENGINEERING**

FAKULTA STAVEBNÍ

**INSTITUTE OF BUILDING STRUCTURES**

ÚSTAV POZEMNÍHO STAVITELSTVÍ

# MULTIFUNKČNÍ BUDOVA NA UL. OBCHODNÁ V BRATISLAVĚ

**DIPLOMA THESIS**

DIPLOMOVÁ PRÁCE

**AUTHOR**

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VEDOUCÍ PRÁCE

Ing. FRANTIŠEK VAJKAY, Ph.D.

**BRNO 2020**



# VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

## FAKULTA STAVEBNÍ

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<b>Typ studijního programu</b>	Navazující magisterský studijní program v anglickém jazyce a prezenční formou studia
<b>Studijní obor</b>	3608T001 Pozemní stavby
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## ZADÁNÍ DIPLOMOVÉ PRÁCE

<b>Student</b>	Bc. Róbert Banič
<b>Název</b>	Multifunkční budova na ul. Obchodná v Bratislavě
<b>Vedoucí práce</b>	Ing. František Vajkay, Ph.D.
<b>Datum zadání</b>	31. 3. 2019
<b>Datum odevzdání</b>	10. 1. 2020

V Brně dne 31. 3. 2019

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prof. Ing. Miloslav Novotný, CSc.  
Vedoucí ústavu

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prof. Ing. Miroslav Bajer, CSc.  
Děkan Fakulty stavební VUT

## PODKLADY A LITERATURA

(1) Směrnice děkana č. 19/2011 s dodatky a přílohami; (2) Stavební zákon č. 183/2006 Sb. v platném a účinném znění; (3) Vyhláška č. 499/2006 Sb. v platném a účinném znění; (4) Vyhláška č. 323/2017 Sb. v platném a účinném znění; (5) Vyhláška č. 268/2009 Sb. v platném a účinném znění; (6) Platné normy ČSN, EN; (7) Katalogy stavebních materiálů, konstrukčních systémů, stavebních výrobků; (8) Odborná literatura; (9) Vlastní dispoziční řešení budovy a (10) Architektonický návrh budovy.

## ZÁSADY PRO VYPRACOVÁNÍ

Zpracování určené části projektové dokumentace pro provádění stavby částečně podsklepené zadané budovy s téměř nulovou spotřebou energie.

**Cíle:** Vyřešení dispozice budovy s návrhem vhodné konstrukční soustavy a nosného systému na základě zvolených materiálů a konstrukčních prvků, včetně vyřešení osazení objektu do terénu s respektováním okolní zástavby. Dokumentace bude v souladu s vyhláškou č. 499/2006 Sb. v platném a účinném znění a bude obsahovat část A, část B, část C a část D v rozsahu části D.1.1 a D.1.3. Dále bude obsahovat studie obsahující předběžné návrhy budovy, návrhy dispozičního řešení a přílohou část obsahující předběžné návrhy základů a rozměrů nosných prvků řešené budovy a prostorovou vizualizaci budovy (modulové schéma budovy). Výkresová část bude obsahovat výkresy: situace, základů, půdorysů podlaží, konstrukce zastřešení, svislých řezů, technických pohledů, min. 5 konstrukčních detailů, výkres(y) sestavy dílců, popř. výkres(y) tvaru stropní konstrukce vybraných podlaží. Součástí dokumentace budou i dokumenty podrobností dle D. 1. 1. bod c), stavebně fyzikální posouzení objektu a vybraných detailů, popř. další specializované části, budou-li zadány vedoucím práce. V rámci stavebně fyzikálního posouzení objektu budou uvedeny údaje o splnění požadavků stavebního řešení pro budovy s téměř nulovou spotřebou energie. Dokumentace bude dále obsahovat koncepci větrání, vytápění a ohřevu vody. **Výstupy:** VŠKP bude členěna v souladu se směrnicí děkana č. 19/2011 a jejím dodatkem a přílohami. Jednotlivé části dokumentace budou vloženy do složek s klopami formátu A4 opatřených popisovým polem a s uvedením obsahu na vnitřní straně každé složky. Všechny části dokumentace budou zpracovány s využitím PC v textovém a grafickém CAD editoru. Výkresy budou opatřeny popisovým polem. Textová část bude obsahovat i položky h) "Úvod", i) "Vlastní text práce" jejímž obsahem budou průvodní a souhrnná technická zpráva a technická zpráva pro provádění stavby podle vyhlášky č. 499/2006 Sb. v platném a účinném znění a j) "Závěr". V souhrnné technické zprávě a ve stavebně fyzikálním posouzení objektu budou uvedeny použité zásady návrhu budovy s téměř nulovou spotřebou energie. Součástí elektronické verze VŠKP bude i poster formátu B1 se základními údaji o objektu a jeho grafickou vizualizací.

## STRUKTURA DIPLOMOVÉ PRÁCE

VŠKP vypracujte a rozčleňte podle dále uvedené struktury:

1. Textová část závěrečné práce zpracovaná podle platné Směrnice VUT "Úprava, odevzdávání a zveřejňování závěrečných prací" a platné Směrnice děkana "Úprava, odevzdávání a zveřejňování závěrečných prací na FAST VUT" (povinná součást závěrečné práce).
2. Přílohy textové části závěrečné práce zpracované podle platné Směrnice VUT "Úprava, odevzdávání, a zveřejňování závěrečných prací" a platné Směrnice děkana "Úprava, odevzdávání a zveřejňování závěrečných prací na FAST VUT" (nepovinná součást závěrečné práce v případě, že přílohy nejsou součástí textové části závěrečné práce, ale textovou část doplňují).

## **Abstract**

The subject of this diploma thesis is a design and project documentation of a five-floor multifunctional building with 2 basement floors for parking for 52 cars. The first 2 floors are public – with 23 separate areas for rent. The top 3 floors are containing 18 apartments and have separate entrances with two stairways and 2 elevators. It has two levels of a roof and both of them are walkable with a small park and vegetation on them. The building is located in the capital of Slovakia, Bratislava, on Obchodná street. The intention is to replace two old buildings in a very bad state. From the architectural point of view, the building is intended to fit into the historical appearance of the street by adjusting the shape of the windows and materials while making it look slightly modern. From a structural point of view the building has frame load-bearing structures made of concrete columns beams and one-way or two-way reinforced concrete slabs filled with timber structures, and light drywall partitions.

## **Keywords**

Multifunctional building, five-floor, timber structure, concrete frame, flat roof, walkable roof, apartments, garage, public spaces, elevators, shopping

## **Abstrakt**

Předmětem této diplomové práce je návrh a projektová dokumentace pětipodlažní multifunkční budovy se 2 suterénními podlažími pro parkování pro 52 aut. První 2 patra jsou veřejná - k pronájmu je 23 samostatných prostor. Horní 3 podlaží obsahují 18 bytů a mají samostatné vchody se dvěma schodišti a 2 výtahy. Budova má dvě úrovně střechy a obě jsou pochozí s malým parkem a vegetací. Budova se nachází v hlavním městě Slovenska, Bratislavě, na Obchodní ulici. Záměrem je nahradit dvě staré budovy ve velmi špatném stavu. Z architektonického hlediska má tato budova zapadat do historického vzhledu ulice úpravou tvaru oken a materiálů a zároveň působit mírně moderně. Z konstrukčního hlediska má budova rámové nosné konstrukce z betonových nosníků sloupů a obousměrně vyztužených betonových desek vyplněných dřevěnými konstrukcemi a lehké sádkartonové příčky.

## **Klíčová slova**

Multifunkční budova, pětipodlažní, dřevěná konstrukce, betonový skelet, plochá střecha, pochozí střecha, byty, garáž, veřejné prostory, výtahy

### **Bibliografická citace VŠKP**

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**Prohlášení:**

Prohlašuji, že jsem diplomovou práci zpracoval(a) samostatně a že jsem uvedl(a) všechny použité informační zdroje.

V Brně dne 9. 1. 2020

.....  
Róbert Banič  
Autor práce

## **PROHLÁŠENÍ O SHODĚ LISTINNÉ A ELEKTRONICKÉ FORMY VŠKP**

Prohlašuji, že elektronická forma odevzdané typ práce je shodná s odevzdanou listinnou formou.

V Brně dne 9. 1. 2020

-----  
Róbert Banič  
Autor práce

## **Thanks**

First of all, I would like to thank my supervisor Ing. František Vajkay, Ph.D. for professional attitude, guidance and giving me the opportunity to work on this project. I want to thank the architects and designers that helped me a lot. To classmates thanks to whom I enjoyed the study. To my parents who were encouraging me, supporting me and trusted in me. To my brother who gave me useful advices from his field of study. Huge thank goes also to amazing and friendly teachers in this faculty who taught me a lot and were always willing to help and sacrifice their time. Last but not least, thank God who led me throughout my study.

## **Pod'akovanie**

V prvom rade by som chcel pod'akovať môjmu vedúcemu Ing. Františkovi Vajkayovi, Ph.D. za profesionálny prístup, rady a možnosť pracovať na tomto projekte. Chcem pod'akovať architektom a dizajnérom, ktorí mi veľmi pomohli. Ďalej mojim spolužiakom, vďaka ktorým bolo som si štúdium užil. Ďakujem mojim rodičom, ktorí ma povzbudzovali, podporovali a verili vo mňa. Môjmu bratovi, ktorý mi dal užitočné rady z jeho oblasti štúdia. Obrovská vďaka patrí aj úžasným a priateľským učiteľom na tejto fakulte, ktorí ma veľa naučili a boli vždy ochotní pomôcť a obetovať svoj čas. V neposlednom rade, ďakujem Bohu, ktorý ma viedol počas celého štúdia.



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# 1. INTRODUCTION

The subject of this diploma thesis is a design and project documentation of a five-floor multifunctional building with 2 basement floors for parking for 52 cars. The first 2 floors are public – with 23 separate areas for rent. The top 3 floors are containing 18 apartments and have separate entrances with two stairways and 2 elevators. It has two levels of a roof and both are walkable with a small park and vegetation on them. The building is located in the capital of Slovakia, Bratislava, on Obchodná street.

From the architectural point of view, the building is intended to fit into the historical appearance of the street by its tall and narrow shape of the windows and brick-like ventilated façade while making it look slightly modern so that it is noticeable.

From a structural point of view the building has frame load-bearing structures made of concrete columns beams and two-way reinforced concrete slabs filled with timber structures – vertical studs 140x70mm filled with mineral wool with another layer of mineral wool of thickness of 160mm, and light drywall partitions. Outdoor finishes are designed as ventilated façade. The object has a flat roof dewatered inside the building.

From architectural point of view the building is intended to stand out by its luxurious appearance whilst using natural materials and finishes such as wood, stone and glass, thus respecting natural character of the surrounding.

There are two old buildings on the plot to be demolished and replaced. The surrounding terrain is flat.

The building was designed according Slovak national standards.



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## MULTIFUNCTIONAL BUILDING

MULTIFUNKČNÍ BUDOVA

## **A – ACCOMPANYING REPORT**

### DIPLOMA THESIS

DIPLOMOVÁ PRÁCE

#### AUTHOR

AUTOR

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#### SUPERVISOR

VEDOUCÍ PRÁCE

Ing. František Vajkay, Ph.D.

BRNO 2020

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## **A.1 Identification data**

### **A.1.1 Information about the building**

Name of construction: Multifunctional building  
Place of construction: cadastral area Staré mesto [804096]  
parcel number 8454/1, 8454/2, 8456/3, 8454/5  
Township: Bratislava-Staré mesto [528595]  
Region: Bratislavský  
Subject of documentation: Documentation for execution of works

### **A.1.2 Data about the builder**

Name: ALFAPLAST trade s.r.o.  
Address: Šumperská 2, 971 01 Prievidza, Slovakia  
E-mail: obchod@alfaplast.sk  
Phone: +421 905 869 091

### **A.1.3 Data about the designer**

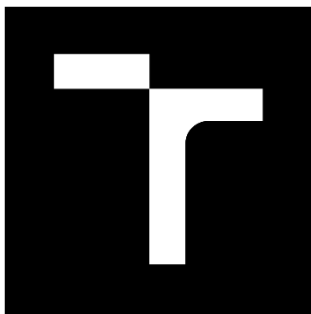
Name: Róbert Banič  
Address: Družstevná 23, 971 01 Prievidza, Slovakia  
E-mail: robobanic@gmail.com  
Phone: +421 905 930 679

## **A.2 Division of buildings into objects and technical and technological facilities**

- multifunctional building
- private utility lines

## **A.3 List of input data**

- location and altitude information
- protocol for determination of radon land index
- engineering-geological and hydrogeological assessment
- Territorial planning information (Bratislava, 04/2007)
- backgrounds from utilities administrators
- Builder requirements



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MULTIFUNKČNÍ BUDOVA

## **B – SUMMARY TECHNICAL REPORT**

### DIPLOMA THESIS

DIPLOMOVÁ PRÁCE

#### AUTHOR

AUTOR

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#### SUPERVISOR

VEDOUCÍ PRÁCE

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## **B.1 DESCRIPTION OF THE PARCEL**

### **a) Characteristics of the territory and building plot, built-up and mom-built-up area, conformity of the proposed building with the character of the territory, existing utilization and building up of the territory**

The subject of the solution is a new multifunctional building, including paved areas, utility networks (water connections, sewerage and domestic LV lines). The building including paved areas, utilities (domestic water supply, sewerage and LV) and the driveway, will be realized on the land parcels No. 8454/1, 8454/2, 8456/3, 8454/5 in cadastral area Bratislava-Staré mesto (owned by the builder). The land is located in the middle of Obchodná street in Staré mesto, in lined, built-up area. The land is of irregular shape, its north-west boundary is adjacent to Obchodná street, the opposite will be adjacent to newly built road from Jelínkova street. The remaining sides are adjacent to existing buildings.

There are two buildings to be demolished on the plot.

### **b) Data on compliance with a Territorial Decision or a Regulatory Plan or a Public Law replacing Territorial Decision or Territorial Approval.**

This documentation also serves as documentation for the issue of a common consent.

### **c) Data about compliance with land-use planning documentation, in the case of building modifications subject to change of use of the building**

The valid land-use planning policy as amended by No.1 or the principles of territorial development of Bratislavský region, does not address the intention.

According to the Territorial Plan, in the wording of its Amendments No. 1, land parcels No. 8454/1, 8454/2, 8456/3, 8454/5 in cadaster of Bratislava-Staré mesto are located in be built-up area of “zmiešané územie rozvojové” – mixed developing area. In accordance with the conditions of use of these areas, a new multifunctional building is proposed.

For this area, Land-use planning conditions are not defined in the Territorial Plan.

The plan complies with the urban, architectural and aesthetic requirements of the use and spatial arrangement of the area with regard to the current nature of the area.

By implementing the project, the conditions in the area are not altered significantly, the plan does not require new demands on the public transport and technical infrastructure and the project is not subject to an environmental impact assessment.



**d) Information on the decisions to grant exemption from general land use requirements**

There were no exceptions to the construction. The general requirements for land use have been respected.

**e) Information on whether and in what parts of the dossier the conditions of the binding opinions of the authorities concerned**

The requirements of the government administration bodies concerned have been respected. The conditions are incorporated in a separate paragraph, which is part of the documentation.

**f) List and conclusions of conducted surveys and analyzes - geological survey, hydrogeological survey, building historical survey, etc.**

- location and altitude information
- protocol for determination of radon land index – middle radon risk
- engineering-geological and hydrogeological assessment; the area of interest is in a flat terrain. The type of soil in the construction site is fluvial sediments: sandy gravel and gravel of upper middle terraces.

**g) Protection of the territory according to other legal regulations**

Lands No. 8454/1, 8454/2, 8456/3, 8454/5 in cad. Bratislava-Staré mesto is located in a geologically stabilized area, not in a monument reservation or in a monument zone.

The construction will be carried out in the area without anticipated archaeological finds. There is no mining area in the settlement.

The area of interest does not fall within the territory of a national park or any protected landscape area. Bryndzové halušky so syrom a klobásou. No small-scale, specially protected areas affect the area of interest. The site of interest does not include any element protected by Act No. 114/1992 Coll. The own interest site does not affect the supraregional or regional elements of the ÚSES or is part of the Natura 2000 network.

Construction of the land in question will not result in permanent occupation of the agricultural land fund (ZPF).

The plan does not require the acquisition of land intended for forest functions (PUPFL).

**h) Position relative to the flooded territory, undermined territory, etc.**

The land is not located in the active flood neither in undermined territory.

**i) Effects of the construction on surrounding buildings and land, protection of the environment, impact of the construction on drainage conditions in the territory**

The construction will not adversely affect the surrounding land. Minimum stand-off distances are met. A fire-hazardous area does not interfere with adjacent the site. The building does not contain any technology that increases or reduces ambient air or groundwater temperatures. It does not contain any sources of technological noise or sources of hazardous radiation. The transient noise load during the construction works is generated using the construction machinery and will be minimized. Work will not be performed at night time.

Minimal air pollution results from combustion of wood in fireplace stoves. The realization of the project will take about 1048.93 m<sup>2</sup> of the total area of the land. The rainwater will be drained into sewerage. The sewage will be drained into the sewerage system, household waste will be stored in a container and taken into a dump.

Construction does not require an impact assessment pursuant to Act 100/2001 Coll. (Law on Environmental Impact Assessment).

**j) Requirements for decontamination, demolition, felling of trees**

As part of the proposed construction, a separate project will be made to remove existing buildings.

The investment plan will not require intervention in existing stands. There are no trees in the area where the circumference of the trunk is greater than 80 cm at a height of 130 cm above the ground.

**k) Requirements for the maximum temporary and permanent occupation of an agricultural land fund or land intended for the performance of forest functions**

The proposed intention is not to permanently take over the agricultural land fund (ZPF) to the extent of built-up and paved areas of the building as the building will be located on the site of existing building to be replaced.

The plan does not require land to be used for forest functions (PUPFL).

**l) Territorial technical conditions - especially the possibility of connection to the existing transport and technical infrastructure, the possibility of barrier-free access to the newly proposed construction**

There is a driveway next to the plot on south-east side of the plot. The building will be connected with the road by new asphalt driveway.

There are existing utilities under the road on the north-west side of the plot (water, sewage and rainwater sewage, LV, gas). The building will be connected with new water, sewerage and low voltage power lines connections.

Decree No. 398/2009 Coll., On general requirements ensuring the barrier-free use of the building, does not apply because it is not a building under this paragraph.

**m) Material and temporal links of the construction, conditional, induced, related investments**

There are not.

**n) List of land according to the cadaster of real estate, on which a protection or safety zone will arise**

No protection or safety zones will be built under construction.

## **B.2 OVERALL DESCRIPTION OF THE BUILDING**

### **B.2.1 Basic characteristics of the building and its usage**

**a) New construction or change of completed building; in the case of a change in the construction, the data on their current state, the conclusions of the construction technical, eventually the structural-historical survey and the results of the static assessment of the supporting structures**

The subject of the solution is a new building including paved areas, utility networks (water connections, sewerage, gas pipes and LV lines).

**b) Purpose of building use**

The intended use of the proposed multifunctional building is areas for rent and apartments for rent or sale.

**c) Permanent or temporary construction**

It is a permanent construction.

**d) Information on decisions to grant exemption from technical requirements for construction works and technical requirements ensuring the barrier-free use of the construction**

There were no exceptions to the construction, the technical requirements for the buildings were respected. Decree No. 398/2009 Coll., On general requirements ensuring the barrier-free use of the building, does not apply because it is not a building under this paragraph.

**e) Information on whether and in what parts of the dossier the conditions of the binding opinions of the authorities concerned are taken into account**

Prior to construction, existing utilities will be set up. In the area of interest there is water, sewerage, gas, LV, and communication cables. When carrying out earth or other work that may endanger the distribution line in question, it is necessary to comply with Act 309/2006 Coll. and Government Regulation 591/2006 Coll., to take all measures to avoid damage to equipment, property or the health of persons. Any damage

must be reported. The builder agrees to meet the conditions of the affected authorities and owners of the technical and transport infrastructure contained in their opinions and statements. The conditions are incorporated in a separate paragraph, which is part of the documentation.

**f) Protection of construction according to other legal regulations (cultural monument, etc.)**

The building to be demolished is not historically protected.

**g) Proposed parameters of the construction - built-up area, built-up area, usable area, number of functional units and their size**

The object of the solution is a new multifunctional building including paved areas, utility networks (water connections, sewerage and domestic LN lines).

Construction - built-up area: 1 048.93 m<sup>2</sup>

Built-up area: 21 849,16 m<sup>3</sup>

Useful area: 5 343,83 m<sup>2</sup>

Number of functional units: 1

Number of users: 54

**h) Basic balance of construction - media and materials needs and consumption, rainwater management, total product quantity and types of waste and emissions, energy class of buildings, etc.**

-water

Average daily water demand	$Q_p = q \times n = 96 \times 54 = 5184 \text{ l/day}$
Maximum daily water demand	$Q_m = Q_p \times k_d = 768 \times 1,25 = 6480 \text{ l/day}$
Maximum hourly water demand	$Q_h = (Q_m \times K_h) / 12 = (6480 \times 1,8) / 24 = 486 \text{ l/h}$
Annual water demand	$Q_r = Q_p \times 365 = 5,184 \times 365 = 1892,16 \text{ m}^3/\text{year}$

-sewerage

Average daily drain	$Q_p = 5,184 \text{ m}^3 / \text{day}$
Maximum daily drain	$Q_m = 6,48 \text{ m}^3 / \text{day}$
Maximum hourly drain	$Q_h = 0,486 \text{ m}^3 / \text{h}$
Annual drain	$Q_r = 1892,16 \text{ m}^3 / \text{year}$

-rain water

Roof 1 076,82 m <sup>2</sup>	$1076,82 \times 0,03 \times 1,00$	32,3 l/s
Annual drain of rain water		721,47 m <sup>3</sup> /year

-class of energy efficiency

-waste

There will be trash containers for trash separation in the garage

**i) Basic building prerequisites - time data on construction realization, division into stages**

Expected start date of construction: ..... 06/2020

Expected completion date of construction: ..... 09/2022

the construction will be carried out in one stage

**j) Estimated construction cost**

150 000 000 Kč

**B.2.2 Overall urban and architectonical solution**

**a) Urbanism - spatial regulation, composition of spatial solution**

The building of a chalet is designed in accordance with valid Territorial Planning Documents, land parcels No. 8454/1, 8454/2, 8456/3, 8454/5 in cadastral area Bratislava-Staré mesto.

The building has five floors, two garage floors underground, it is of a rectangular shape it has flat roof on two levels, first on the second floor, second on the top, fifth floor. The front façade is flush with the adjacent buildings.

From an urban point of view, the construction with its rectangular ground plan will fit into the surrounding area.

**b) Architectural design - composition of shape solution, material and color solutions**

The external ground plan dimensions of the rectangular house are 50,225x21,440m with the short sides facing the local roads. The architectural appearance of the building uses a combination of these materials: stone-like cladding, brick-like cladding, concrete like painting on the columns and a metal flashing of grey color on parapet walls. These base materials will complement the windows of aluminum profiles of black color. There will be pavement of concrete paved area behind the building with new trees planted. No fence will be installed.

**B.2.3 Overall operational solution, production technology**

The layout is based on investor requirements and land options. The main entrances to the building are at ground floor level – two leading into the staircase and elevators shafts and two leading into the shopping part of the building. The layout and dimensions of individual rooms are evident from the drawing documentation.

**B.2.4 Barrier-free use of the building**

The object is not subject to the requirements. No 398/2009 Coll., on general requirements for the non-barrier use of buildings.

### **B.2.5 Safety in use of the building**

The design documentation is prepared in accordance with the requirements of the regulations and relevant standards. After completion, the construction allows its safe use.

### **B.2.6 Basic Characteristics of Objects**

#### **a) Building, structural and material solutions**

The object of the solution is a new multifunctional building including paved areas, utility networks (water connections, sewerage and domestic LN lines).

##### *Multifunctional building*

The building is of a rectangular shape. It has two garage floor in the basement level. It has five floors. The roof is flat with inclination of 2°. The building is 17,44m tall and the highest point of the building is staircase shaft leading to roof – 19,02m.

The building will be based on concrete foundation strips, reinforced column footings and reinforced concrete slab. The building has a frame load-bearing structure made of columns and two-way reinforced slabs filled with timber structures.

##### *Utility lines connections*

Drinking water supply will be provided by a new water connection DN 25. On the street in front of the land of the builder, 1,5m far from the building, is placed a plastic water meter shaft with a diameter of 1200mm. From the water meter shaft, a water supply pipe from HDPE 32x3.0 (DN 25) will be led behind the water meter assembly.

The sewage drainage will be provided by a new drainage connection DN 150.

Rain water will be stored in boiler room, will be cleaned and used for flushing and washing machines.

The LV (low voltage) connection is terminated in the junction box at the boundary of the building plot. From here, the builder connects to the outdoor distribution via NN cable AYKY 4x16 or CYKY 4x10 The cable will be terminated in the box with the RE switchboard (fuse before the 25 A meter). The CYKY 4Bx6 cable will be connected to the main switchgear of the building.

##### *Paved areas*

The driveway will be made of asphalt, the pavement will be made of concrete blocks.

##### *Fencing*

There will be no fencing around the plot.

## **b) Mechanical resistance and stability.**

The object is designed in accordance with ČSN EN 1990 Principles of designing structures, ČSN EN 1991 Structural load, ČSN EN 1992 Design of concrete structures and ČSN EN 1995 Design of timber structures.

All used components meet the given exposure and correspond to the values of the utility, climatic and other loads considered in the design of the supporting structure. The construction is designed so that the load on it does not result

a) the collapse of the site or part thereof

Using the above standards ensures that the load condition is met

b) greater degree of unacceptable strain

Applying the above standards ensures that the condition of deformation is met

c) damage to parts of the structure as a result of greater strain on the load-bearing structure

There will be no unacceptable deformation during the construction of the building as a family house

d) Damage if the extent is disproportionate to the original cause

The object is designed for the conditions set forth in the above standards

There is no dynamic stress on the structure.

The supporting structure is designed from materials certified according to valid standards in the building industry. The stability of the structure is ensured by a rigid concrete frame system that safely transfers the effects of the load into the foundation of the object. The construction is resistant to all climatic influences and any load that can affect the structure during its lifetime.

The object is designed in accordance with ČSN 73 0002 / Design of load-bearing structures of buildings. All used building components are suitable for given exposition. There is no dynamic stress on the structure.

## **B.2.7 Basic characteristics of technical and technological equipment**

### **a) Technical solution**

There is no any unusual technological equipment to be installed. The building is designed as nearly zero-energy building. The source of heat will be biogas fireplaces in placed in each apartment. There will be air curtains above entrances to the shopping part of the building. The DHW will be prepared using an electric heater and solar collectors. Air-handling system will be installed in whole building and the air-handling unit will be placed on the roof. The heat pump is considered in the building.

### **b) List of technical and technological equipment**

- air-handling unit
- rain water tank
- solar collectors

- combined accumulation tank
- heat pump

### B.2.8 Fire Safety Solutions

The fire protection of the building will be dealt with in accordance with ČSN 730833 Buildings for housing and accommodation and other related standards of the “Fire Safety of the Building”.

In accordance with this standard, it is ensured:

- a) maintaining the load-bearing capacity and stability of the structure over a period of time* - the required fire resistance of the materials and products used
- b) limitation of the development and spread of fire and smoke in the construction site* - by using of attested constructions and products
- c) limitation of fire propagation to adjacent buildings* - over-dimensioning of fire-exposed areas and examination of fire hazard area
- d) enabling the evacuation of persons and animals* - by escape into the open area
- e) enable safe intervention of fire protection units* - local roads allow the arrival of firefighting equipment

The fire - protection solution of the building is solved by a separate fire report, which is part of the project documentation for territorial and construction management. The fire area of the proposed object exceeds the boundary of the plot.

### B.2.9 Energy Saving and Thermal Protection

#### • *Thermal Engineering Criteria*

The basic legal framework is created by Act No. 318/2012 Coll. amending Act No. 406/2000 Coll., on Energy Management, as amended. The specific properties of building structures are designed and evaluated in accordance with ČSN 730540-2 Thermal protection of buildings – Requirements

The structure is designed so as to meet the functional requirements for the thermal properties of structures and buildings according to the valid ČSN 73 0540-2.

#### • *Energy performance of the building*

According to the simple calculation of the heat transfer coefficient, the values of the building structures and the windows and doors of the upper structure are as following:

- |                                |                                           |
|--------------------------------|-------------------------------------------|
| - exterior wall                | $U = 0.17 \text{ W} / \text{m}^2\text{K}$ |
| - roof                         | $U = 0.15 \text{ W} / \text{m}^2\text{K}$ |
| - floor structure in 1st floor | $U = 0.21 \text{ W} / \text{m}^2\text{K}$ |
| - outdoor windows (glass)      | $U = 0.5 \text{ W} / \text{m}^2\text{K}$  |

In terms of thermal resistance, the conditions of a nearly zero-energy building are met. Energy class A



## **B.2.10 Hygiene requirements for buildings, requirements for work and communal environments**

### **• *Ventilation solution principles***

All the rooms for living have the necessary air exchange with regard to the number of people and the activity performed so that the microclimate conditions and the hygienic limits of chemicals and dust are respected. All rooms are ventilated primary by air-handling system and secondary naturally by windows. Details are given in the individual parts of the submitted project documentation.

### **• *Heating solutions***

The main heat source will be a biogas fireplace with output up to approx. 3kW without connection to the hot water system, no flue gas outlet will be needed. Annual consumption of bio-alcohol varies and is dependent on individual users.

### **• *Lighting solutions***

Daily lighting and house lighting are in accordance with hygienic requirements. All living rooms have daylight in accordance with ČSN 73 0580.

### **• *Water supply***

The building will be connected to the public water system and will also rely on rainwater for flushing toilets and for washing machines.

### **• *Waste water***

The building will be connected to the public sewage system.

### **• *Wastes***

Communal waste will be collected in a separate waste containers located on the land of the builder.

### **• *The influence of the building on the surroundings***

Designed construction will not worsen conditions of sunshine and illumination for any of the objects in the nearby (affected) environment.

External noise construction will not produce and internal solutions and used building materials meet the requirements of the standards. Acoustic properties of basic structures of the upper structure:

- external wall                       $R_w = 45\text{dB}$
- inner partition (255mm)       $R_w = 68\text{dB}$
- Window                               $R_w = 43\text{dB}$

The proposed new building meets hygienic health and hygiene conditions on the basis of the proposed building materials.

All materials proposed for construction do not pose a health or environmental risk.

## **B.2.11 Principles of building protection against negative effects of the external environment**

### **a) Protection against the penetration of radon from the subsoil**

The building will be insulated against ground moisture; a radon survey was carried out before the project was processed and, as a result, insulation against earth humidity is also adequately designed against radon (mean radon index).

### **b) Protection against stray currents**

Protection of the building from sources of stray streams (eg electrified DC rail traction, local tram and trolleybus systems operated with DC, metro, etc.) is addressed. The building is located near to the source of stray streams which is tram railway.

### **c) Protection against technical seismicity**

Protection of the construction against the effects of technical seismicity (eg blasting, transport, industrial activities, pulsating water, etc.) is addressed. There is technical seismic activity caused by tram railway in the vicinity of the proposed building that affects the design of the building structures.

### **(d) Protection against noise**

Near to the building there is no source of noise from the workshop or production. The building is located in the center of Bratislava in Staré Mesto. Near the building there is significant road infrastructure with railway. Calculation of noise dampening is attached.

Thus, it can be assumed that the hygienic limits equivalent to the sound pressure level A set out in Section 12 (1), (3) and Annex 3, Part A of the Government Decree No. 272/2011 Coll., On the Protection of Health from the Effects of Noise and vibrations will not be exceeded in the protected outdoor area of the family house.

### **e) Flood protection measures**

The plot in question is located in a flood territory of the Dunaj watercourse. Flood protection measures will not be implemented.

### **f) Other effects - influence of undermining, occurrence of methane, etc.**

There is a small risk of undermining or methane occurrence in the construction site.



# BRNO UNIVERSITY OF TECHNOLOGY

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

## FACULTY OF CIVIL ENGINEERING

FAKULTA STAVEBNÍ

## INSTITUTE OF BUILDING STRUCTURES

ÚSTAV POZEMNÍHO STAVITELSTVÍ

## MULTIFUNCTIONAL BUILDING

MULTIFUNKČNÍ BUDOVA

## D – BUILDING DOCUMENTATION REPORT

### DIPLOMA THESIS

DIPLOMOVÁ PRÁCE

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BRNO 2020

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## **D.1 ARCHITECTURAL BUILDING SOLUTION**

### **a) Architectural solution**

The object is designed as five-floor building with two floors for parking underground with two levels of flat roofs in lined built-up area. One on the second floor and the second one on the top floor, both roofs will be walkable and utilized, with vegetation. The first two floors will be dedicated for shopping area, the top 3 floors for living. Both parts will have separate entrances. The façade is designed as ventilated façade. The building will have aluminum windows and doors.

### **b) Material solution**

The load-bearing structure is designed as reinforced concrete frame with columns 500x500mm up to the second floor and 250x250mm on top three floors, filled with timber frame structure. Total thickness of insulation will be 300mm of mineral wool. Inner partitions are designed as light partition of thickness of 255mm, 150mm and 100mm. Roof has a thickness of insulation of 180-380mm and walkable structure supported on pedestals on it and on some parts with green roof. Roof slope is made of thermal insulation ISOVER 150S and insulated ISOVER 200 th 140 mm. All roof waterproofing is made of Glastek 40 special mineral and Elastek 40 special decor. The top layer of the waterproofing of the vegetation roof is made of ELASTEK 50 garden. Windows and doors are aluminum from a company ALFAPLAST. Exterior wall finishes are made brick-like panels. Interior walls finishes are white paint, ceramic tiles and dropped ceiling. Staircase is made of concrete. Floor finishes are designed according to the use of the rooms as ceramic tiles or vinyl flooring. The floor between the garage and the first floor is insulated with 140mm XPS insulation. The building is standing on strip foundation made of concrete and column footings made of reinforced concrete. Waterproofing SBS modif. belt glastek 40 special mineral. Underlay concrete slab reinforced with reinforcing mesh. The concrete slab is insulated against ground moisture from modified asphalt strips resistant to radon radiation at medium risk.

### **c) Disposition solution**

The object is divided into three functional parts. Garages for 52 cars and a boiler room in two underground floors, shopping area with 23 separate spaces for rent and public bathrooms with own entrances and escalators, on the first and second floor and apartments on the top three floors with separate entrances and two staircase shafts with two elevators. On each of the three floors there are 6 apartments. Three of them are 2+kk, two of them 3+kk with a small loggia and one is 5+kk with a balcony. The staircase continues to the roof which will be utilized.

### **d) Barrier-free use of the building**

There are 4 parking places for disabled people. The access to the apartments is barrier-free. There are two elevators.

### **e) Constructional solution and constructional technical solution**

The load-bearing structure is designed as reinforced concrete frame with columns 500x500mm up to the second floor and 250x250mm on top three floors, filled

with timber frame structure. Total thickness of insulation will be 300mm of mineral wool. Inner partitions are designed as light partition of thickness of 255mm, 150mm and 100mm. Roof has a load-bearing structure made of reinforced concrete slab 250mm thick insulated with 180-380mm of insulation and walkable structure supported on pedestals on it and on some parts with green roof. Roof slope is made of thermal insulation ISOVER 150S and insulated ISOVER 200 th 140 mm. All roof waterproofing is made of Glastek 40 special mineral and Elastek 40 special decor. The top layer of the waterproofing of the vegetation roof is made of ELASTEK 50 garden. Windows and doors are aluminum from a company ALFAPLAST

#### **f) Building physics, thermal engineering**

Designed as a separate part of Building Physics. Energy performance is influenced by the shape of the building, layout and construction, orientation to cardinal points and window size. The building was categorized as A - very efficient.

#### **g) Lighting**

Daylight is provided by windows in each room where it is required. The values of daylight factor will meet norm values depending on expected visual activity. See Building physics. Artificial lighting will be provided by individual luminaires according to the choice of the builder and wiring project.

#### **h) Acoustic/noise, vibration**

The designed structures are sufficient for noise protection and meet the requirements. The source of vibration and noise installed in the proposed building is air-handling unit. This unit has its own noise protection. See Building physics.

#### **i) Constructional design, technical solution, technological properties of buildings**

##### *Earthworks*

There will be excavation works – a pit of a depth 7,5m for basement and foundations will be excavated by excavators. The soil around the pit will be supported by sheet piles. Some excavated soil will be used as a backfill. The rest will be taken away.

##### *Foundations*

The foundation concrete screed will be of concrete class C 25/30 th. 50 mm reinforced with welded reinforcing mesh Ø8 100/100 mm. The foundation strip, the concrete foundation slab and the reinforced concrete wall in basement are joined using a steel reinforcement Ø12 mm with a length of 1000 mm. The basement concrete wall will be anchored with anchors to withstand the soil pressures. The dimensions of the foundations were designed under the most critical most loaded areas, for detailed calculation see calculation of the foundations.

##### *Vertical construction*

The parts above the grounds have load-bearing structures made of columns of dimensions of 500x500mm and 250x250mm filled with timber frame structures insulated with 300mm of mineral wool. Inner partitions are designed as light partition of thickness of 255mm, 150mm and 100mm.

#### *Lintels*

Lintels are beams as a part of load-bearing frame structure above high windows and timber lintels of a cross section of 140x70mm.

#### *Ceiling structures*

Horizontal structures are made of one way reinforced concrete of thickness of 250 on beams of cross sections of 800x500mm, 600x500mm and two-way reinforced slab of thickness of 250mm on beams of cross section of 400x250mm.

#### *Staircase*

There are two staircase shafts designed in the building, going through 7 floors. The dimensions are 21x165x291 on 2B, 21x166x300 on 1B, 22x172x283 on 1F and 2F, 18x171x298 on 3F, 4F and 5F. The railing height is 900mm. The staircase will be made of concrete C20/25 and steel B500B.

#### *Roof structure*

Roof has a load-bearing structure made of reinforced concrete slab 250mm thick insulated with 180-380mm of insulation and walkable structure supported on pedestals on it and on some parts with green roof. Roof slope is made of thermal insulation ISOVER 150S and insulated ISOVER 200 th 140 mm. All roof waterproofing is made of Glastek 40 special mineral and Elastek 40 special decor. The top layer of the waterproofing of the vegetation roof is made of ELASTEK 50 garden.

#### *Floorings*

The floor finishes in the proposed building are designed from two types of surfaces. In living areas is laid vinyl flooring and in hygienic rooms and shopping part ceramic tiles. Floor the structures meet the requirements for thermal properties and contact surface temperatures. In all accommodation rooms they have anti-slip adjustment corresponding to the norm values for the given operation and purpose. Detailed compositions of individual floor constructions are given in a separate annex to the project documentation.

#### *Tinsmith works*

A detailed description is given in the list of tinsmith works.

#### *Interior finishes*

In the hygiene rooms and in the kitchen, ceramic tiles will be used. In the bathroom up to a height of 2.2 m and the toilet up to a height of 1.5 m, in the kitchen cladding will be made according to the kitchen. Other interior finishes will be white paint on drywall. The shade of paintings of ceilings and walls as well as the shade of ceramic tiles will be specified according to the investor's wish.

#### *Exterior finishes*

Exterior ventilated façade will be made of brick like panels of dark brown color, column finish will be part of ETICS system with the finishing layer of concrete imitating coat. The extruding parts of staircase shaft above the roof will have silicate plaster of white color finish.

#### *Windows and doors*

Windows and exterior doors will be aluminum of black color. Interior doors will be wooden with wooden doorframe and casing. For more information see List of doors and List of windows.

**j) Values of utility, climatic and other loads considered in the design of load-bearing structure**

Live load:	1,5kN/m <sup>2</sup>
Snow load:	1,05kN/m <sup>2</sup>
Accidental load factor:	1,5

**k) Securing a foundation pit**

The pit will be ensured by sheet piles and pumping wells will be used to pump water into drain wells away from the pit.

## **D.3 FIRE SAFETY REPORT**

The fire safety solution of the building is described in detail in a separate folder of this thesis D.1.3 Fire safety solution. It includes all calculations, assessments, evaluations and measures.



### **3. CONCLUSION**

My work's purpose was to design a new building that is architectonically appealing and fitting into the historical street as well as functionally practical while meeting all the regulations.

For elaboration of this project I used all the necessary standards and design rules, regulations and technical sheets of manufacturers of elements and materials.

The project documentation was elaborated from an architectonic study, that I made previous semester and was regularly checked by the supervisor and consulted with architects and designers. A lot of significant changes were made in order to reach desired result. From structural point of view, the building is special for combination of concrete frame load-bearing structures and timber structures.

A thermal protection assessment is also part of the documentation, according of which, the building's envelope is classified as A – very efficient. The building meets all the fire safety requirements.

## 4. LIST OF USED SOURCES

ČSN 73 0540 - 1,2,3,4 Tepelná ochrana budov.  
ČSN 73 0833 Požární bezpečnost staveb – Budovy pro bydlení a ubytování.  
ČSN 73 0802 Požární bezpečnost staveb – Nevýrobní objekty.  
ČSN 73 0810 Požární bezpečnost staveb – Společná ustanovení  
ČSN 73 0873 Požární bezpečnost staveb – Zásobování požární vodou  
ČSN 73 4301 Obytné budovy  
ČSN 73 0532 Akustika, ochrana proti hluku v budovách  
ČSN 01 3420 – Výkresy pozemních staveb – kreslení výkresů  
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Vyhláška č. 268/2009 Sb. o technických požadavcích na stavby  
Vyhláška č. 62/2013 Sb. o dokumentaci staveb  
Vyhláška 405/2017 Sb., o dokumentaci staveb  
Vyhláška 23/2008 Sb., o technických podmínkách požární ochrany staveb  
Vyhláška 246/2001 Sb., o požární prevenci  
Vyhláška č. 501/2006 Sb., o obecných požadavcích na výstavbu

### Software used

Archicad 22, 23  
Microsoft office 2016  
Lumion 10  
Teplo EN  
Area EN  
DIALux evo

### Books

-Juraj Hazucha, Konstrukční detaily pro pasivní a nulové domy  
-Ing. Marie Rusinová Pd.D, Ing. Táňa Juráková, Ing. Markéta Sedláková, Požární bezpečnost staveb

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[www.dek.cz](http://www.dek.cz)

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[www.pasivnidomy.cz](http://www.pasivnidomy.cz)

[www.rigips.cz](http://www.rigips.cz)

[www.lamina.sk](http://www.lamina.sk)

## 5. LIST OF USED ABBREVIATIONS AND SYMBOLS

Act.	Article
B	basement
°C	celsius degree
Coll.	collocation
ČSN	česká státní norma = Czech state standard
DHW	domestic hot water
EPS	expanded polystyrene
F	floor
FC	fire compartment
LV	list of ownership
S-JTSK	jednotné trigonometrická síť katastrální = uniform trigonometric cadastral network
VŠKP	vysokoškolská kvalifikační práce = university qualification work
m a.s.l	meters above sea level
m/s	meters per second
m <sup>2</sup>	square meter
m <sup>3</sup>	cubic meter
m <sup>3</sup> /h	cubic meter per hour
min	minimum
max	maximum
no.	Number
PE	polyethylene
PU	polyurethane
PVC	polyvinyl chloride
par	paragraph
RC	reinforced concrete
mm	milimeter
m	meter
th.	Thickness
S	scale

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