



VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA STAVEBNÍ

FACULTY OF CIVIL ENGINEERING

ÚSTAV POZEMNÍHO STAVITELSTVÍ

INSTITUTE OF BUILDING STRUCTURES

BYTOVÝ DŮM

RESIDENTIAL BUILDING

MAIN TEXT PART OF BACHELOR'S THESIS

BAKALÁŘSKÁ PRÁCE

BACHELOR'S THESIS

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BRNO 2020

Abstrakt

Předmětem této bakalářské práce je zpracování projektové dokumentace bytového domu. Nachází se v Brně, katastrálním území Nového Lískovce. Bytový dům leží na svahu a je orientován na jižní stranu. Má dvě nadzemní podlaží a ve druhém patře je balkon. Střechy jsou ploché zelené střechy, přičemž dvě menší střechy mají sklon 3% a větší 5%. Na východní straně je garáž a balkon. Celá stavba rodinné rezidence je ze železobetonu a zdiva s hlavním využitím na konstrukčních materiálech firmy HELUZ. Izolační materiály jsou všechny od společnosti ISOVER. Výkresová dokumentace nezbytná pro realizaci této obytné budovy byla zpracována v počítačovém programu AutoCAD. Součástí práce je požární, akustické a tepelně technické řešení.

Klíčová slova

Bytový dům, HELUZ, ISOVER, železobeton, zdivo konstrukce, ploché zelené střechy, AutoCAD

Abstract

The subject of this bachelor thesis is to elaborate project documentation for a residential building. It is located in Brno, the cadastral area of Nový Lískovec. The residential building lays on a slope land and is oriented to the south side. It has two above ground floors, with a balcony on the second floor. Roofs are flat green roof with the two smaller roofs having a slope of 3% and the bigger 5%. On the east side there is the garage and balcony. The whole construction of the family residence is from reinforced concrete and masonry with main use on construction materials from the company HELUZ. The insulation materials are all from the company ISOVER. The drawing documentation necessary for the realization of this residential building was elaborated in AutoCAD computer program. Part of the work is fire, acoustic and thermal-technical solutions.

Keywords

Residential building, HELUZ, ISOVER, reinforced concrete, masonry construction, flat green roof, AutoCAD

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stavitelství. Vedoucí práce Ing. Karel Struhala, Ph.D.

Declaration:

I declare, that I worked out the Bachelor's Thesis independently and that I stated all used information sources.

Prohlášení:

Prohlašuji, že jsem vypracoval bakalářskou práci samostatně a že jsem uvedl všechny použité informační zdroje.

V Brně dne 23.5.2020

.....

podpis autora

Adérito Cláudio Lopes de Almeida

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Introduction

The aim of this Bachelor's Thesis is focused on the elaboration of project documentation for a residential building on a slope terrain. To use the plot of 568 m² in a way, which the built-up area would be significant comparing with the total area of the plot. Place the building in a position to avoid extra excavation works and effectively backfill the needed parts of the land. The building is designed from reinforced concrete and masonry construction, from the PREFABRNO, HELUZ and YTONG companies namely. The building is oriented to the south side, designed with one underground floor, two aboveground floors and flat green roofs as a shelter to cover the building. All Czech standards, laws and regulation are followed for the design of this family house.



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A. ACCOMPANYING REPORT

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A. ACCOMPANYING REPORT

.1. Identification data

.1.1. Building data

1. Name of construction: Residential building
2. Place of construction: Parcel number 845
Brno, Jihomoravský
Cadastral area: Nový Lískovec

3. The subject of project documentation

This project documentation solves a new residential building with two aboveground floors and one underground floor in a plot area of 568 m², showing all solutions in drawings and text documents for the successful erection of the building.

.1.2. Information of the builder

.1.3. Information of the designer of the project documentation

Adérito Cláudio Lopes de Almeida, Kolejní 2, 612 00 Brno-Kralovo Pole, Czech Republic

.2. Division of buildings into objects and technical and technological units

- Residential building
- New utility lines

.3. List of input data

- Extract from cadastral map- information about the parcel and neighbouring parcels
- Landscaping and altitudinal measuring of the land
- Protocol for the determination of radon index of the land
- Requirements of the investor



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B. TECHNICAL REPORT

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B. TECHNICAL REPORT

B.1 Description of the construction site

a) Characteristics of the territory and building plot, constructed and unconstructed territory, the conformity of the proposed building with the character of the territory, the existing utilization and the building of the territory

The main goal was to use the plot of 568 m² in a way, which the built-up area would be significant comparing with the total area of the plot. Position the building in a spot so one of its face acts as a retaining wall, holding the land where the slope change is greater in order to avoid extra excavation works and effectively backfill the necessary places. Afterwards, with focus on taking the best advantage of the sunlight for the division of each room compartment. The new residential building including paved areas, utility networks (water connections, sewerage, gas, rain water, data and electricity) and fencing, will be erected on the land parcels No. 845, cadastral area – Nový Lískovec (owned by the investor). The plot is located in a calm zone, with basically no traffic. Its shape is irregular, with the south side facing the road and the west side facing a full vegetation area. Furthermore, the plot has no vegetation or animals that brings any restraint to proceed with the construction.

b) Information on compliance with the zoning decision or regulatory plan or public contract by zoning decision replacing or zoning consent

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

c) Data on compliance with land-use planning documentation, in the case of building modifications conditional on a change in the use of the building

In accordance with the conditions of use of these areas, a residential area in this particular case, a new residential building is proposed. 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 significantly altered, 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 decisions taken to grant exemption from the general land use requirements

There were no exemptions 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 are taken into account

The requirements were respected and are processed in a separate paragraph which is a part of the project documentation.

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

- Data from cadastral map- information about the parcel and neighbouring parcels
- Landscaping and altitudinal measuring of the land
- Protocol on the determination of radon index of the land
- Engineering-geological and hydrogeological assessment; the area of interest is in a sloped terrain. Thy type of soil in the construction site is F3 MS – sandy loam, load bearing capacity Rdt is 275 kPa.

g) Territory protection under other legal regulations

Land parcel number 845 in the cadastral area Nový Lískovec is not located in a monument reservation or in a monument zone. The construction will be carry out on a parcel without anticipated archaeological finds. There is no mining area in the settlement. The plan does not require the acquisition of land intended for forest functions (PUPFL).

The land is not a part of any national park or protected area. The land does not have any protected element according to the law no. 114/1992 Coll. The land is not a part of Natura 2000 network.

h) Location with respect to the flood plain, undermined area, etc.

The land is not located on a flood or mined area.

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 buildings standoff distance does not exceed the neighboring parcels. On the west side of the residence is a green area. The land does not contain any sources of technological noise or sources of hazardous radiation. The transient noise load during the construction works is generated by the use of the construction machinery and will be minimized. Work will not be performed after 6pm. The recycle on site will be made. The built up area on this land is 157 m². The rainwater and waste water will be drained into the respective public drained system.

j) Requirements for sanitation, demolition, felling of trees

The parcel is free of any current buildings or trees. There are no trees which are higher than 130 cm and thicker than 80 cm. It will be no demolition on this parcel.

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

The land parcel 845 is owned by the investor. Permanent requirement for ZPF occupation: Built-up area: 157 m²
Paved area: 84 m²

According to the cadastral map, this land type is garden. The whole area of this land is 568 m². The top soil will be excavated to a depth of 35cm (20 + 15cm). The removed soil will be kept on the land for further use.

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

The communication road is adjacent to the south and east side. There will be no changes to the communication road. New paved area will be made on the parcel 845 to connect the communication road and garage.

Existing utilities (water, sewage and rain sewers, data, gas, electricity) are adjacent to the south and east part of the site. The new building will be connected with new connections from the south communication road.

Law 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 time links of the construction, conditional, induced, related investments.

None.

n) A list of the land according to the cadastral map on which the construction is placed and carried out

Parcel number: 845, cadastral region Nový Lískovec [610283], no. LV. 2618, area. 568 m², type of parcel: Land registry parcel, type of the land: garden.

o) List of land according to the cadastral map, on which a protection or security zone is established

The standoff distance does not extend to neighbouring parcels.

B.2 GENERAL DESCRIPTION OF BUILDING

B.2.1 Basic characteristics of the construction and its use

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

Design of a new residential building including paved areas, utility networks (water connections, gas, sewerage, data and electricity) and fencing.

b) Purpose of building use

Building for living.

c) Long-term or short-term building

The building is long-term.

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

According to Decree. No. 398/2009 Coll., The general requirements for the barrier-free use of the building do not apply because the building does not belong under this requirements.

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

The requirements of the concerned authorities and connection network are processed in the project documentation.

Before the start of the construction, all the network connection will be marked. In the area of interest there is water, sewerage, gas, electricity of low voltage and data cable. When carrying out earth-works 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. The requirements are processed in the paragraph which is a part of the project documentation.

f) Protection of construction according to other legal regulations

It is not a subject to other building protection regulations

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

Built up area: 157 m²

Pavement area: 84 m²

Plot area: 568 m²

Number of functional units: 1 Number of users: 5

h) The basic balance of the construction - needs and consumption of media and masses, management of rainwater, total product quantity and types of waste and emissions, energy class of buildings, etc.

- Rainwater:

Roof (residential building): 87,32 m2	$87,32 \times 0,030 \times 1,00$	2,62 l/s
Roof (garage): 40,02 m2	$40,02 \times 0,030 \times 1,00$	1,20 l/s
Roof (above 1st floor): 28,49 m2	$28,49 \times 0,030 \times 1,00$	0,85 l/s
Annual water runoff:		82,34 m3/year

- Gas:

The gas will be used in rare occasions

- Water:

Average daily water demand $Q_p = q \times n = 96 \times 5 = 480$ l/day

Maximum daily water demand $Q_m = Q_p \times k_d = 480 \times 1,25 = 600$ l/day

Maximum hourly water demand $Q_h = (Q_m \times K_h) / 12 = (600 \times 1,8) / 12 = 90$ l/h

Annual demand $Q_r = Q_p \times 365 = 0,48 \times 365 = 175,2$ m3/year

- Sewerage:

Average daily drain $Q_p = 1,15$ m³ / day

Maximum daily drain $Q_m = 1,44$ m³ / day

Maximum hourly runoff $Q_h = 0,216$ m³ / h

Annual runoff $Q_r = 419,75$ m³ / year

- Energy class: B
- Waste:

Common waste will be thrown in the dustbin on the south side of the plot.

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

Assumed date for starting of the construction is 07/2020

Assumed date for finishing of the construction is 07/2021

j) Indicative construction costs

3.1 million CZK

B.2.2 Urban and architectural design solution

a) Urbanism - spatial regulation, composition of spatial solution

The terrain of the land is sloped. It has a steep elevation from South to North and East to West directions with a non uniform shape of the plot. Pentagonal shape, the longest sizes facing North and South respectively. The plot is placed in the centre of the plot, more to the North in order to avoid extensive excavation works, letting the walls facing North and West hold a significant part of the original land in slope.

Main entrance is situated on the South side of the house. Entrance hall is in the underground floor connected to other non-private spaces such as the garage, utility room, small toilet and pantry. In order to have some natural lighting in the corridor, in the staircase we have a window that can illuminate the entrance. This same staircase moves us to the private section of the house, directly to the kitchen/ dining room and the living room. Through the corridor is a storage closed to the home office and the laundry right beside the master bedroom with a suite, to make easy the daily routine of the couple with the house cleaning and professional works. In this same floor we have most of the windows facing South to embrace a good amount of natural daylighting, two windows on the North side (living room, home office) and one in the bathroom facing west.

The staircase continues to the second floor, an area intended to be more chilled. A family room was settled to be a place where the relatives, visits or any group of friends come over to spend some joyful time together while the living room will be the most used room to gather together in common moments. A small balcony is on the East, from where we can see the green roof on top of the garage below. If we go through the family room, we have a study room, bathroom, children's bedroom and a bedroom to make all 5 members of the family feel at ease even when friends or relatives come over for the weekend or any commemorative moments. All bedrooms have a window of 2 m, the others have 1,3 m with the exception of the bathroom. The rooms are oriented to the South and West side.

The distance of the front facade from the street boundary is 4,97 m.

From the urban point of view, the building will fit into the neighboring area.

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

The underground floor is partially surrounded by land, respectively in the North and West side. From the upper view the shape of the house is almost rectangular with the exception of a 50 cm wall that changes the shape, in the corner between the staircase and the garage.

The residential building's shape varies according to the floor. Disregarding the change direction of 50 cm wall length the underground floor has length 13,6 m and width 7,4 m. First floor has length 15,65 m and width 7,4 m. Second floor has the length 11,8 m and 7,4 m width, disregarding the balcony with dimension of 2 m x 3,3 m.

All three roofs will be flat green roofs with slope 5% for the bigger in drainage direction North and 3% for the smaller roofs in West and East direction for the drainage.

The façade will be covered with grey and white acrylic plaster. Special look will be over the walls in contact with the soil, having dimpled membrane in its face to allow them to breath. avoid condensation and other issues. On the west side of the house due to the great pressure from the land, besides the concrete (BTB) masonry wall a gabion wall with width 0,9 m, length 2,5 m, height 3 m laid on 40 cm basecourse is placed to help hold the soil. The interior surface finish of the vertical and horizontal structures will be made with a natural plaster, lime-based paint, to secure them to breath and the rest of structures inside the building have the same surface finish to maintain a pleasant view to the eyes of the residents.

The windows and exterior door will have a grey colour aluminium wooden frame. The interior doors will be from wood.

The walkable pavement on the land will be from ceramic tiles .

B.2.3 Total operational solution, production technology

Disposition solution is made according to the requirements of the investor. The main entrance is on the underground floor, which leads to the entrance/ cloakroom and other utility compartments. The door on the left from the entrance leads to the utility room and pantry; the door on the right leads to the garage.

On the first floor we can access all private compartments such as kitchen/ dinning room which are connected to the living room. Through the corridor we have the storage, home

office, laundry and a master bedroom with a suite.

The second floor, for the children and leisure are the balcony, family room, a corridor that leads to the bathroom, children's bedroom and bedroom.

B.2.4 Barrier-free use of the building

The family house is not subject to the requirements. no. 398/2009 Coll., On general requirements ensuring the barrier-free 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, construction and material solutions

The aim of the design is a new residential family building including paved areas, utility networks (water connections, gas, sewerage, data and electricity) and fencing.

Residential building: The shape varies according to the floor. Disregarding the change direction of 50 cm wall length the underground floor has length 13,6 m and width 7,4 m. First floor has length 15,65m and width 7,4 m. Second floor has the length 11,8 m and 7,4 m width, disregarding the balcony with dimension of 2 x 3,3 m.

All three roofs will be flat green roofs with slope 5% for the bigger in drainage direction North and 3% for the smaller roofs in West and East direction for the drainage.

The façade will be covered with grey and white acrylic plaster. Special look will be over the walls in contact with the soil, having dimpled membrane in its face to allow them to breath. avoid condensation and other issues. The height of the building from the FGL is 9,68 m.

The building is constructed on foundation strips from concrete C20/25 and reinforced concrete slab with thickness of 200 mm. External load-bearing walls are made from load-bearing HELUZ UNI 30 and BRAND FORMWORK BLOCKS – BTB 40/30/25 (P+D) supporting the soil on the North and West side. Walls from HELUZ are thermally isolated with ISOVER EPS 70 F and BTB from SYNTHOS XPS PRIME S 30 L.

Utility network connections: There are 5 connection to the building.

- Connection of water pipes with drinking water that is about 7 m long. There is a water meter shaft on the edge of the plot.
- 2 Connections of rainwater sewerage one 9,35 m long and the other is about 26,5 m long, it will transport the water from the 3 flats green roof of the family house to the rainwater sewage. There is a plastic inspection shaft in each connection with the diameter 500 mm
- Connection of sewerage system is 5.6 m long and it has a sewerage inspection shaft with the diameter 600 mm
- Connection of low voltage powerline is 15 m long with the electrometer box situated in the entrance next to the fence.
- Connection of low pressure gas pipe is 6,15 m long with the main gas closure situated in the entrance next to the fence.

Paved areas: The paved areas will be done by ceramic pavement tiles

Fencing: Fencing adjacent to the road will be done by wire mesh with blue mesh foil and the rest of the fencing will be without the blue mesh foil.

b) Mechanical resistance and stability

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

All used components meet the given requirements and correspond to the values of the utility, climatic and other loads considered in the design of the supporting structure. The structure is designed so that the load acting on it doesn't damage the structure.

The object is designed for the conditions set forth in the above standards. Limiting conditions of the object's location Situation of the object

- Altitude: 320.40 m.a.s.l.
- Snow area: II

No dynamic stress is acting on the structure. The main loadbearing structure is made from certified components from the company HELUZ and the construction is processed according to their rules and requirements.

B.2.7 Basic characteristics of technical and technological equipment

a) Technical solution

The main source of heat will be electric heaters. The DHW will be prepared using the boiler connected to the attached chimney HELUZ IZOSTAT. The heat pump or air-conditioning system is not considered in the building. The toilets and bathrooms will be ventilated by ventilators.

b) List of technical and technological equipment

- Electric heaters
- Condensing boiler

B.2.8 Fire safety solution

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. For more information see fire safety solution annex of fire safety report.

B.2.9 Energy saving and thermal protection

Energy saving solution is made in accordance with ČSN 73 0540 - 2. The energy performance of the building was assessed as B - very economical. For more information, see Annex in Folder 6_Building Physics.

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

Ventilation: Ventilation of the house is ensured by natural ventilation via windows and doors. Bathroom and toilets is ventilated by ventilators.

Hot water storage: Condensing boiler (VAILLANT VU 246/5-3 EcoTEC Plus) connected to the attached chimney HELUZ IZOSTAT will provide the hot water.

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

Heating solution: The main heat source will be electric heating.

Water supply: The building will be connected to the public water system.

Sewerage: The building will be connected to the public sewerage system.

Flue system: Flue system is designed in the form of a chimney system HELUZ IZOSTAT. DN 160 mm. The chimney is designed as a two-layer chimney system consisting of a thin-walled isostatic liners and chimney fittings polished, with the fire resistance of EI 90. The chimney will be made from the products of reaction to fire class of at least A2, type of construction DP1. Complies with the provisions of § 8 of Decree No. 23/2008 Coll. Flue design will conform to DIN EN 1443 and CSN 73 4201. The final approval will be documented inspection, including the revision of flues to be conducted in accordance with Government no. 91/2010 Coll. According to par. 8.1 of ČSN 734201 for year-round operation of equipment on gas fuels, the inspection and cleaning must be done once a year.

The influence of the building on the surroundings: The building will have no influence on the surrounding building, it will neither shade nor obstruct the neighboring buildings. External noise construction will not be produced and internal solutions and used building materials meet the requirements of the standards.

B.2.11 Principles of building protection against adverse effects of the external environment

a) Protection against penetration of radon from the subsoil

The building will be insulated against ground moisture therefore it is also well designed to protect against radon.

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 not addressed. The building is not located near to the sources of alien streams.

c) Protection against technical seismicity

It is not addressed. Negative effects such as blasting, transport, industrial activities, pulsating water, etc; are not around the vicinity of the proposed building.

d) Protection against noise

Around the vicinity of the residential building there is no source of noise from the workshop or production. The heating of the family house will be done by electricity and a heat pump is not installed in the house. The nearest main road is located roughly 300 meters away. Nearby streets are only for arriving at the houses in the locality, so we do not consider them a source of above-limit noise. See Annex Folder 6_Building physics for protection against noise.

e) Flood protection measures

The parcel is not located in the flood territory.

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

There are no mines or methane in the proposed area.

B.3 CONNECTION TO TECHNICAL INFRASTRUCTURE

- Connection to public water supply: The family house will be connected to the public water supply by 7 m long connection pipe, DN25.
- Connection of rainwater sewerage with one 9,35 m long pipe and 26,5 m long pipe, both DN 125, it will collect and transport the rain water from the 3 flat green roofs of the building. There is a plastic inspection shaft located in both connections.
- Connection of sewerage system with 5,6 m long, DN160 and a sewerage inspection shaft with the diameter 600 mm.
- Connection of low voltage powerline is 15 m long with the electrometer box situated in the entrance next to the fence.
- Connection of low pressure gas pipe is 6,15 m long with the main gas closure situated in the entrance next to the fence.

B.4 TRANSPORT SOLUTIONS

a) Description of the transport solution including barrier-free accessibility and use of the building by persons with reduced mobility or orientation

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. The road connection is adjacent to the south and east side of the parcel.

b) Connection of the territory to the existing transport infrastructure

The main road is adjacent to the south and east side of the parcel, with the entrance to the parcel located on the south side. The entrance to the parcel by car is 4,5 m wide and is connected to the existing road by lowered curbs. The paved area will be done by concrete tiles.

c) Transport at rest

There will be a parking place for 2 cars on the east side of the house.

d) Walking and cycling trails

Around the vicinity of the parcel there is a very narrow walking trail located adjacent to the main communication road of Kluckova street. The cycling trail is non existing in this area.

B.5 SOLUTION OF VEGETATION AND RELATED TERRESTRIAL ADJUSTMENTS

a) Landscaping

Landscaping will only be done by the extraction of the top of the soil and the soil will be stored on site and later used for minor landscaping changes.

b) Used vegetation elements

Vegetation elements are not processed in the documentation.

c) Biotechnical measures

No biotechnical measures will be done.

B.6 DESCRIPTION OF THE ENVIRONMENTAL CONDITION AND ITS PROTECTION

a) Effects on the environment - air, noise, water, waste and soil

- Air

Main heat source are electric heaters. It will have no negative effect on the environment.

- Noise

No technological units are installed on the parcel. The building will have no negative effect on the environment.

- Water

Around the vicinity of the area there is no water stream or river. The building will be connected to the main water source. The runoff water from the roof will be connected to the rainwater sewerage system.

- Waste

The building is connected to the public sewerage system. It will cause no negative effect on the environment.

- Soil

The topsoil gathered from the parcel will be stored and later used on the parcel.

b) Influence on nature and landscape - tree conservation, protection of memorable trees, protection of plants and animals, preservation of ecological functions and landscapes, etc.

- Trees conservation

There are no trees existing on parcel, no conservation is necessary.

- Protection of memorable trees

There are no trees existing on parcel, no protection is necessary.

- Protection of plants and animals

There are no animals or protected plants around the vicinity of the parcel.

- Preservation of ecological functions and landscapes

The residential building (family house) will not affect ecological functions and boundaries in the landscape.

c) Impact on the Natura 2000 system of protected areas

The family house is not located in a Natura 2000 protected area.

d) The way to take into account the conditions of the binding opinion of the Environmental Impact Assessment when it is the basis

This condition is not assessed.

e) In the case of projects falling under the Integrated Prevention Act, the basic parameters of the way to conclude on the best available techniques or the integrated permit, if issued

The proposed building does not fall under the Integrated Prevention Act.

f) Proposed protection and safety zones, extent of restrictions and conditions of protection under other legislation

The assessment of new safety and security zone is not required.

B.7 PROTECTION OF POPULATION

All the necessary requirements for the location of buildings and building solutions from the point of view of protection of population according to Decree no. 380/2002 Coll., preparation and execution of the tasks of civic protection are fulfilled.

B.8 CONSTRUCTION ORGANIZATION PRINCIPLES

a) Consumption of media and materials, and their securing

The main heating system for the building will be electric heaters and condensed boiled by the chimney. No media or materials will be consumed on the parcel.

b) Site drainage

Rainwater from the roofs will be connected to the main rainwater sewerage system.

c) Linking the site to the existing transport and technical infrastructure

The residential building will be connected to the existing road on the south side. New connection will be made (water pipes, sewerage, low pressure gas, data cable, rainwater sewage and electricity), which will be connected to the existing technical infrastructure.

d) Effect of construction on surrounding buildings and land

The family house will be built on a parcel that is owned by the investor.

e) Protection of the surrounding site and requirements for related decontamination, demolition and felling of trees

The building site will be inaccessible to third parties. This will be ensured by fencing the confined space, the fencing will be safe for people with reduced mobility and orientation. There are no trees on the parcel.

f) Maximum temporary and permanent construction occupation for the site

The length of the occupation will be as short as possible.

g) Maximum quantities produced and types of waste and emissions during construction, their disposal

Construction waste will be sorted according to the law. Waste can be sorted into: concrete, other metals, insulation material, plastic, wood, steel, gypsum, soil and rock, mixed building waste. Soil and rock will be stored on site.

h) Balance of earthworks, supply requirements or soil deposition

During the construction, 35 cm of soil layer will be taken and stored on the parcel, it will later be used for landscaping. Excavation soil will also be stored and later used on site.

i) Environmental protection during construction

There won't be any environmental risks during the construction.

j) Safety and health at work on site

During construction and preparation of the building it is necessary fulfill all the necessary laws.

k) Modifications for barrier-free use by the construction of the buildings concerned

Due to the extent of the construction it is not solved.

l) Principles for transport engineering measures

Due to the extent of the construction it is not solved.

m) Determination of special conditions for the execution of the construction - execution of the construction during operation, measures against the effects of the external environment during construction etc.

Due to the extent of the construction it is not solved.

n) Construction process, decisive partial deadlines

Expected start date of construction 06/2020

Expected completion date of construction 06/2021 the construction will take place in one stage



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INSTITUTE OF BUILDING STRUCTURES

BYTOVÝ DŮM

RESIDENTIAL BUILDING

D. DOCUMENTATION OF OBJECTS AND TECHNICAL AND TECHNOLOGICAL EQUIPMENT

BAKALÁŘSKÁ PRÁCE

BACHELOR'S THESIS

AUTOR PRÁCE

AUTHOR

Adérito Cláudio Lopes de Almeida

VEDOUCÍ PRÁCE

SUPERVISOR

Ing. KAREL STRUHALA, Ph.D.

BRNO 2020

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D. Documentation of objects and technical and technological equipment

Documentation of a building or engineering building

Architectural and construction solutions

1.1. Technical report

Purpose of the object, functionality, capacity

The design of the residential building is for permanent residence of 5 family members. The building is designed from masonry construction. The building is located on a land with area of 568 m², with neighbours around except in the West which is a completely green area. The Building is situated on the North side of the land and with entrance situated underground floor to the South side. It has 3 storeys; the underground is an utility area. The first floor is a private area for the family members and the second floor is a place for leisure and for the children.

Architectural, art, material and layout solutions

The underground floor is partially surrounded by land, respectively in the North and West side. From the upper view the shape of the house is almost rectangular with the exception of a 50 cm wall that changes the shape, in the corner between the staircase and the garage.

The residential building's shape varies according to the floor. Disregarding the change direction of 50 cm wall length the underground floor has length 13,6 and width 7,4 m. First floor has length 15,65m and width 7,4 m. Second floor has the length 11,8 m and 7,4 m width, disregarding the balcony with dimension of 2 x 3,3 m.

Main entrance is situated on the South side of the house. Entrance hall is in the underground floor connected to other non-private spaces such as the garage, utility room, small toilet and pantry. For natural lighting going upstairs we have a window that can illuminate the entrance. This same staircase moves us to the private section of the house, directly to the kitchen/ dining room and the living room. Through the corridor is a storage closed to the home office and the laundry right beside the master bedroom with a suite, to make easy the daily routine of the couple with the house cleaning and professional works. In this same floor we have most of the windows facing South to embrace a good amount of natural daylighting, two windows on the North side (living room, home office) and one in the bathroom facing west.

The staircase continues to the second floor, an area intended to be more chilled. A family room was settled to be a place where the relatives, visits or any group of friends come over to spend some joyful time together while the living room will be the most used room to gather together in normal situations. A small balcony is on the East, from where we can see the green roof on top of the garage below. If we go through the family room, we have a study room, bathroom, children's bedroom and a bedroom to make all 5 members of the family feel at ease even when friends or relatives come over for the weekend or any commemorative moments. All bedrooms have a window of 2m, the others have 1,3 m with the exception of the bathroom. The rooms are oriented to the South and West side.

The distance of the front facade from the street boundary is 4,97 m. The shape varies according to the floor. Disregarding the change in direction of 50 cm wall length the underground floor has length 13,6 m and width 7,4 m. First floor has length 15,65m and width 7,4 m. Second floor has the length 11,8 m and 7,4 m width, disregarding the balcony with dimension of 2 x 3,3 m.

All three roofs will be flat green roofs with slope 5% for the bigger in drainage direction North and 3% for the smaller roofs in West and East direction for the drainage.

The facade will be covered with grey and white acrylic plaster. Special look will be over the walls in contact with the soil, having dimpled membrane in its face to allow them to breathe. avoid condensation and other issues. The height of the building from the FGL is 9,68 m.

External load-bearing walls are made from load-bearing HELUZ UNI 30 and BRAND FORMWORK BLOCKS – BTB 40/30/25 (P+D) supporting the soil on the North and West side. Walls from HELUZ are thermally isolated with ISOVER EPS 70 F and BTB from SYNTHOS XPS PRIME S 30 L. Internal load-bearing walls are HELUZ UNI 25 and non-load bearing walls are YTONG KLASIK P2-500, width 150 mm. The facade will be covered with grey and white acrylic plaster. Special look will be over the walls in contact with the soil, having dimpled membrane in its face to allow them to breathe. avoid condensation and other issues. The interior surface finish of the vertical and horizontal structures will be made with a natural plaster, lime based paint, to secure them to breathe and the rest of structures inside the building have the same surface finish to maintain a pleasant view to the eyes of the residents. The windows and exterior door will have a grey colour aluminium wooden frame. The interior doors will be from wood. The walkable pavement on the land will be from concrete .

Barrier-free use

The building is not meant for barrier free use.

Overall operational solution

Disposition solution is made according to the requirements of the investor. The main entrance is on the underground floor, which leads to the entrance/ cloakroom and other utility compartments. The door on the left from the entrance leads to the utility room and pantry; the door on the right leads to the garage.

On the first floor we can access all private compartments such as kitchen/ dining room which are connected to the living room. Through the corridor we have the storage, home office, laundry and a master bedroom with a suite.

The second floor, for the children and leisure are the balcony, family room, a corridor that leads to the bathroom, children's bedroom and bedroom.

Design and construction technical solutions and technical characteristics of the building

The main goal was to use the plot of 568 m² in a way, which the built-up area would be significant comparing with the total area of the plot. Position the building in a spot so one of its face acts as a retaining wall, holding the land were the slope change is greater in order to avoid extra excavation works and effectively backfill the necessary places.

The shape of the building varies according to the floor. Disregarding the change direction of 50 cm wall length the underground floor has length 13,6 m and width 7,4 m. First floor has length 15,65m and width 7,4 m. Second floor has the length 11,8 m and 7,4 m width, disregarding the balcony with dimension of 2 x 3,3 m.

The building is constructed on foundation strips, depth 1,2 m, from concrete C20/25 and reinforced concrete slab with thickness of 200 mm. We use meshes $\phi 8/150$ to reinforce the slabs in contact to the soil, thus it will make easier for the works to execute it due to variation on the shape of the soil. The jump between foundation of the underground floor and first floor was made in a way that the walls from the underground connects to the strips of the first floor freely without the thermal insulation in its face to secure the hold of stress in that area. Hydroinsulation will be made from waterproofing SBS MODIFIED BITUMEN SHEETS, this hydroinsulation will cover the whole reinforce concrete slab. The thermal insulations are SYNTHOS XPS PRIME S 30 L.

External load-bearing walls are made from load-bearing HELUZ UNI 30 and BRAND

FORMWORK BLOCKS – BTB 40/30/25 (P+D) supporting the soil on the North and West side. Walls from HELUZ are thermally isolated with ISOVER EPS 70 F and BTB from SYNTHOS XPS PRIME S 30 L. On the west side of the house due to the great pressure from the land, besides the concrete (BTB) masonry wall a gabion wall with width 90 cm, length 2,5 m, height 3 m laid on 40 cm basecourse is placed to help hold the soil. Internal load-bearing walls are HELUZ UNI 25 and non-load bearing walls are YTONG KLASIK P2-500, width 150 mm. The exterior façade will be covered with grey and white acrylic plaster. Special look will be over the walls in contact with the soil, having dimpled membrane in its face to allow them to breath. avoid condensation and other issues. The interior surface finish of the vertical and horizontal structures will be made with a natural plaster, lime based paint, to secure them to breath and the rest of structures inside the building have the same surface finish to maintain a pleasant view to the eyes of the residents.

The staircase is made with precast reinforced concrete. The slabs above ground are reinforced with steel bars B500, the amount varies according to the static calculations.

All three roofs will be flat green roofs with slope 5% for the bigger in drainage direction North and 3% for the smaller roofs in West and East direction for the drainage.

Building safety

The safety of using the building will be governed by the Decree No. 324/1990 Coll., On Safety work and technical equipment for construction work, as amended.

Building physics

This part is solved in the appendix Building physics.

Fire safety

This part is solved in the appendix Fire safety.

Data on the required quality of the proposed materials and the performance.

The materials used for the construction must have the characteristics required by the standard and designed in the design documentation. The processing of the materials must be in accordance with the technological procedures specified by the manufacturers.

Description of non-traditional technological procedures and special requirements for realization and quality of designed structures

All the procedures are according to the manufacturer.

Requirements for the preparation of documentation provided by the contractor - content and extent of the production and works documentation by the contractor

All the necessary documents and drawings are assessed in the project documentation.

List of standards used

ISO 128 - 23 - Technical drawings - Display rules

ČSN 01 3420 - Drawings of building structures - drawings of building parts

ČSN 73 0600 - Waterproofing of Buildings - Basic Provisions

ČSN 73 4130 - Stairs and inclined ramps - Basic requirements

ČSN 73 0802 - Fire safety - Non-production object

ČSN 73 0580 - Daylight building lighting

CSN 73 0810 - Fire Safety of Buildings - Fire Resistance Requirements

CSN 73 0821 - Fire Safety - Resistance of Building Structures

CSN 73 0833 - Fire safety - Buildings for housing and accommodation

ČSN 73 0540 - Thermal protection of buildings

ČSN 73 0532 - Acoustics - noise protection in buildings and acoustic assessment

properties of construction products – Requirements

Drawings

D.1.1.01-Underground floor plan

D.1.1.02-First floor plan

D.1.1.03-Second floor plan

D.1.1.04-Section A-A'

D.1.1.05-Section B-B'

D.1.1.06-South and north elevations

D.1.1.07-East and west elevations

D.1.1.08-List of doors and windows

D.1.1.09-List of composition of walls and floors

D.1.1.10-List of elements

Building structural solution

1.1 Technical Report

Foundations

The building is constructed on foundation strips, depth 1,2 m, from concrete C20/25 and reinforced concrete slab with thickness of 200 mm. We use meshes $\phi 8/150$ to reinforce the slabs in contact to the soil, thus it will make easier for the works to execute it due to variation on the shape of the soil. The jump between foundation of the underground floor and first floor was made in a way that the walls from the underground connects to the strips of the first floor freely without the thermal insulation in its face to secure the hold of stress in that area. Hydroinsulation will be made from waterproofing SBS MODIFIED BITUMEN SHEETS, this hydroinsulation will cover the whole reinforce concrete slab. The thermal insulation is SYNTHOS XPS PRIME S 30 L.

Peripheral walls

External load-bearing walls are made from load-bearing HELUZ UNI 30 and BRAND FORMWORK BLOCKS – BTB 40/30/25 (P+D) supporting the soil on the North and West side. Walls from HELUZ are thermally isolated with ISOVER EPS 70 F and BTB from SYNTHOS XPS PRIME S 30 L. On the west side of the house due to the great pressure from the land, besides the concrete (BTB) masonry wall a gabion wall with width 90 cm, length 2,5 m, height 3 m laid on 40 cm basecourse is placed to help hold the soil. The exterior façade will be covered with grey and white acrylic plaster. Special look will be over the walls in contact with the soil, having dimpled membrane in its face to allow them to breath. avoid condensation and other issues. The interior surface finish of the vertical and horizontal structures will be made with a natural plaster, lime based paint, to secure them to breath and the rest of structures inside the building have the same surface finish to maintain a pleasant view to the eyes of the residents.

Floor

Floor slabs have thickness 200 mm, are reinforced with steel meshes $\phi 8/150$ and the thermal insulation SYNTHOS XPS PRIME S 30L for slabs adjacent to the ground and steel bars B500, thermal insulation EPS 100 for remaining floors. Floor finish will be done according to the type of room, either laminated flooring, ceramic floor and epoxy.

Roof

All three roofs will be flat green roofs with slope 5% for the bigger in drainage direction North and 3% for the smaller roofs in West and East direction for the drainage. The slab thickness is 200 mm made of reinforced concrete C20/25 rebars B500. Hydro insulated with SBS MODIFIED BITUMEN SHEETS, thermal insulated with EPS 100. It is a green roof fully equipped with the drainage, water accumulation layer, separation POLYETHYLENE (PE) foil, a soil 80 mm thick and an extensive vegetation of 100 mm.

Drawings

- D.1.2.01-Foundation
- D.1.2.02-Slab above underground floor
- D.1.2.03-Slab above first floor ceiling
- D.1.2.04-Slab second floor ceiling
- D.1.2.05-Green roof
- D.1.2.06-Detail A
- D.1.2.07-Detail B
- D.1.2.08-Detail C
- D.1.2.09-Detail D
- D.1.2.10-Detail E

CONCLUSION

The aim of my bachelor's thesis was to create and design a *RESIDENTIAL BUILDING* from masonry construction for a family of 5 members, on a slope terrain in a way that the plot would be well used without the need of many excavation works. The work is done according to all legal regulations valid at the time of work.

The shape of the land made the work harder in order to choose the best layout with the divisions of private and non-private compartments of the house. Considerably modification were made from the studies preparation until the last project works.

This bachelor work, ensured me that before any project work to be done it is important to foresee its final realization, so major changes will not be necessary during the design process. That was a beneficial aspects in this case, since I was not considering it much at the beginning of the project and at the end the results were very evident and satisfactories. A good schedule planning and work time-to-time also showed to be a very important characteristic while doing this type of work.

From the architectural and structural aspects of this residential building, it is assured that the house will have a good performance without the need of extra maintenance during its lifespan, since plenty of common SLS issues that affects most of the built family house such as molds, cracks, etc; were well considered during its design.

I worked out this bachelor's thesis using the knowledge that I have being taken through this whole study course. From all the teachers of different departments and mainly with the guidance of my supervisor Ing. Karel Struhala Ph. D. I could not just draw or implement different aspects in the thesis but the most important understand why it should be there and make my own personal decisions about it.

During the elaboration of this bachelor thesis, I received plenty of new information and consolidate the previous, concerning the field of Building Constructions.

LIST OF USED SOURCES

ČSN 73 0540 - 1,2,3,4 Tepelná ochrana budov.

Vyhláška 499/2006 Sb., o dokumentaci staveb

Vyhláška č. 405/2017 Sb.

JAN NOVOTNÝ. Cvičení z pozemního stavitelství pro 1. a 2. ročník Konstrukční cvičení

RUSINOVÁ, M.; JURÁKOVÁ, T.; SEDLÁKOVÁ, M. Požární bezpečnost staveb. Brno: VUT Brno, 2006.

SOFTWARE USED

Microsoft Office 2016

AutoCAD 2020

ArchiCAD 23

WEB PAGES

HELUZ available at www.heluz.com

ISOVER available at: www.isover.cz

YTONG available at: www.ytong.cz

PREFABRNO available at: www.prefa.cz

DEK available at: www.dek.cz

CEMIX available at: www.cemix.cz

SKANDOR available at: www.hornbach.cz

RAKO available at: www.rako.cz

CERESIT available at: www.ceresit.com

GUNNEX available at: www.gunnex.cz

MRELON available at: www.mirelon.com

CADASTRAL MAP available at: www.cuzk.cz

MAP, LANDSCAPE available at www.geology.cz

TZB-INFO available at: www.tzb-info.cz

DESIGNING BUILDINGS WIKI available at: www.designingbuildings.co.uk

ČSN REGULATIONS, LAWS, DECREE

ČSN 73 0833 Požární bezpečnost staveb – Budovy pro bydlení a ubytování.

ČSN 73 0580 Denní osvětlení budovy.

ČSN 73 0532 Akustika, ochrana proti hluku v budovách

ČSN 73 0540 - 1,2,3,4 Tepelná ochrana budov.

ČSN 73 0873 Požární bezpečnost staveb – Zásobování požární vodou

ČSN 73 4301 Obytné budovy

ČSN 01 3420 – Výkresy pozemních staveb – kreslení výkresů Zákon č. 183/2006 Sb. o územním plánování a stavebním řádu.

Vyhláška č. 268/2009 Sb. o technických požadavcích na stavby Vyhláška č. 62/2013 Sb. o dokumentaci staveb

Vyhláška 246/2001 Sb., o požární prevenci Vyhláška č. 501/2006 Sb., o obecných požadavcích na výstavbu

Vyhláška 23/2008 Sb., o technických podmínkách požární ochrany staveb

Vyhláška č. 405/2017 Sb.

LIST OF USED ABBREVIATIONS AND SYMBOLS

FC	fire compartment
th.	thickness
Coll.	collocation
no.	number
min	minimal
max	maximal
km	kilometer
m	meter
cm	centimeter
mm	millimeter

RC reinforced concrete

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S.2	Architectural First floor plan	SC. 1:100
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D.1.1.08	List of doors and windows'	
D.1.1.09	List of composition of walls and floors'	
D.1.1.10	List of elements	

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D.1.2.05	Green roof	SC. 1:50
D.1.2.06	Detail A	SC. 1:5
D.1.2.07	Detail B	SC. 1:5
D.1.2.08	Detail C	SC. 1:5
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D.1.3.01	Fire safety report	
D.1.3.02	Site plan	SC. 1:200
D.1.3.03	Underground floor plan	SC. 1:100
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Folder 6_Building physics

D.1.6	Building physics	
D.1.6.1	Thermal protection of building	

Folder 7_Other calculations

- A_Calculation of staircase
- B_Calculation of foundation
- C_Preliminary design-Monolithic RC slab



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RESIDENTIAL BUILDING

ATTACHMENTS

SEE SEPARATE FOLDERS OF BACHELOR'S THESIS

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FOLDER NO.2

FOLDER NO.3

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FOLDER NO.5

FOLDER NO.6

FOLDER NO.7

BAKALÁŘSKÁ PRÁCE

BACHELOR'S THESIS

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BRNO 2020

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Studijní program	B3607 Civil Engineering
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Název práce v anglickém jazyce	Bytový dům
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Jazyk práce	Čeština
Datový formát elektronické verze	PDF
Abstrakt práce	Předmětem této bakalářské práce je zpracování projektové dokumentace bytového domu. Nachází se v Brně, katastrálním území Nového Lískovce. Bytový dům leží na svahu a je orientován na jižní stranu. Má dvě nadzemní podlaží a ve druhém patře je balkon. Střechy jsou ploché zelené střechy, přičemž dvě menší střechy mají sklon 3% a větší 5%. Na východní straně je garáž a balkon. Celá stavba rodinné rezidence je ze železobetonu a zdiva s hlavním využitím na konstrukčních materiálech firmy HELUZ. Izolační materiály jsou všechny od společnosti ISOVER. Výkresová dokumentace nezbytná pro realizaci této obytné budovy byla zpracována v počítačovém programu AutoCAD. Součástí práce je požární, akustické a tepelně technické řešení

**Abstrakt práce
v anglickém
jazyce**

The subject of this bachelor thesis is to elaborate project documentation for a residential building. It is located in Brno, the cadastral area of Nový Lískovec. The residential building lays on a slope land and is oriented to the south side. It has two above ground floors, with a balcony on the second floor. Roofs are flat green roof with the two smaller roofs having a slope of 3% and the bigger 5%. On the east side there is the garage and balcony. The whole construction of the family residence is from reinforced concrete and masonry with main use on construction materials from the company HELUZ. The insulation materials are all from the company ISOVER. The drawing documentation necessary for the realization of this residential building was elaborated in AutoCAD computer program. Part of the work is fire, acoustic and thermal-technical solutions.

Klíčová slova

Bytový dům, HELUZ, ISOVER, železobeton, zdivo konstrukce, ploché zelené střechy, AutoCAD

**Klíčová slova
v anglickém
jazyce**

Residential building, HELUZ, ISOVER, reinforced concrete, masonry construction, flat green roof, AutoCAD