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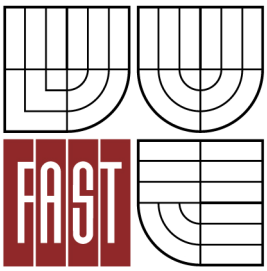

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

# DETACHED FAMILY RESIDENCE
RODINNÝ DŮM

BAKALÁŘSKÁ PRÁCE
BACHELOR'S THESIS

AUTOR PRÁCE — ERIK VAŇO
AUTHOR

VEDOUCÍ PRÁCE — Ing. FRANTIŠEK VAJKAY, Ph.D.
SUPERVISOR

BRNO 2015

# VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
# FAKULTA STAVEBNÍ

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|---|---|
| **Studijní program** | B3607 Civil Engineering |
| **Typ studijního programu** | Bakalářský studijní program s výukou v anglickém jazyce a prezenční formou studia |
| **Studijní obor** | 3608R001 Pozemní stavby |
| **Pracoviště** | Ústav pozemního stavitelství |

# ZADÁNÍ BAKALÁŘSKÉ PRÁCE

| | |
|---|---|
| **Student** | Erik Vaňo |
| **Název** | Rodinný dům |
| **Vedoucí bakalářské práce** | Ing. František Vajkay, Ph.D. |
| **Datum zadání bakalářské práce** | 30. 11. 2014 |
| **Datum odevzdání bakalářské práce** | 29. 5. 2015 |

V Brně dne 30. 11. 2014

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| ..... | ..... |
| prof. Ing. Miloslav Novotný, CSc.<br>Vedoucí ústavu | prof. Ing. Rostislav Drochytka, CSc., MBA<br>Děkan Fakulty stavební VUT |

**Podklady a literatura**

Studie dispozičního řešení stavby, katalogy a odborná literatura, Zákon č.183/2006 Sb., Zákon č. 350/2012, kterým se mění zákon č. 183/2006 Sb., Vyhláška č.499/2006 Sb.,Vyhl. č. 62/2013, kterou se mění vyhláška č. 499/2006 Sb.,Vyhláška č.268/2009 Sb., Vyhláška č.398/2009 Sb., platné ČSN, Směrnice děkana č. 19/2011 a dodatky.

**Zásady pro vypracování**

Zadání VŠKP: Projektová dokumentace stavební části k provedení novostavby rodinného domu vedený pod názvem "Detached Family Residence".
Cíl práce: vyřešení dispozice pro daný účel, návrh vhodné konstrukční soustavy, nosného systému a vypracování výkresové dokumentace včetně textové části a příloh podle pokynů vedoucího práce. Textová i výkresová část bude zpracována s využitím výpočetní techniky. Výkresy budou opatřeny jednotným popisovým polem a k obhajobě budou předloženy složené do desek z tvrdého papíru potažených černým plátnem s předepsaným popisem se zlatým písmem. Dílčí složky formátu A4 budou opatřeny popisovým polem s uvedením seznamu příloh na vnitřní straně složky.
Požadované výstupy dle uvedené Směrnice:
Textová část VŠKP bude obsahovat kromě ostatních položek také položku h) Úvod (popis námětu na zadání VŠKP), položku i) Vlastní text práce (projektová dokumentace dle vyhlášky č. 499/2006 Sb.) a položku j) Závěr (zhodnocení obsahu VŠKP, soulad se zadáním, změny oproti původní studii).
Příloha textové části VŠKP v případě, že bakalářskou práci tvoří konstruktivní projekt, bude povinná a bude obsahovat výkresy pro provedení stavby (technická situace, základy, půdorysy řešených podlaží, konstrukce zastřešení, svislé řezy, pohledy, detaily, výkresy sestavy dílců popř. výkresy tvaru stropní konstrukce, specifikace, tabulky skladeb konstrukcí – rozsah určí vedoucí práce), zprávu požární bezpečnosti, stavebně fyzikální posouzení stavebních konstrukcí.

**Struktura bakalářské/diplomové práce**

VŠKP vypracujte a rozčleňte podle dále uvedené struktury:

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

.....

Ing. František Vajkay, Ph.D.
Vedoucí bakalářské práce

**Abstrakt**

Predmetom bakalárskej práce je spracovanie projektovej dokumentácie novostavby rodinného domu v Rosicích u Brna na parcele č. 240, katastrálne územie Rosice u Brna. Dom je dvojposchodový, nepodpivničený a bude slúžiť pre štvorčlennú rodinu.
Stavba je založená na základových pásoch, zvislé konštrukcie sú tvorené betónovými tvárnicami systému KB-Blok. Stropné konštrukcie sú riešené pomocou monolitických dosiek a filigránov. Strecha nad 2NP je plochá a nad garážou sa nachádza zelená terasa s prístupom z troch strán budovy.

**Klíčová slova**

Rodinný dom, novostavba, Rosice u Brna, dvojposchodový, nepodpivničený, zelená terasa, betónové tvárnice, plochá strecha

**Abstract**

The goal of this bachelor thesis is preparation of project documentation of a new detached house in Rosice u Brna. House is situated on plot n. 240 in cadastral area Rosice u Brna. The house is two-storey building without basement and will be used by family of four.
Building is designed on foundation strips, vertical structures are made of concrete blocks, system KB-Blok.
Ceiling structures are solved by monolithic slabs or filigrans. The roof is designed as flat roof and terrace over the garage is made of green terrace system with access from three sides of the house.

**Keywords**

Detached house, Rosice u Brna, two-storey building, without basement, green terrace, concrete blocks, flat roof

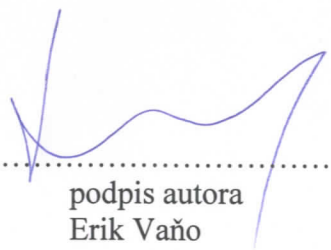
**Bibliografická citace VŠKP**

Erik Vaňo *Rodinný dům.* Brno, 2015. 36 s., 112 s. příl. Bakalářská práce. Vysoké učení technické v Brně, Fakulta stavební, Ústav pozemního stavitelství. Vedoucí práce Ing. František Vajkay, Ph.D.

**Prohlášení:**

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

V Brně dne 27.5.2015



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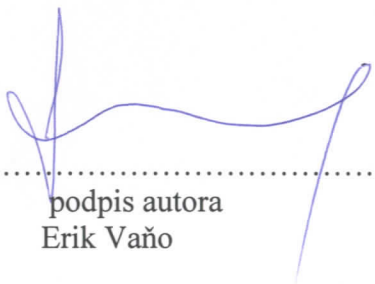
podpis autora
Erik Vaňo

# PROHLÁŠENÍ O SHODĚ LISTINNÉ A ELEKTRONICKÉ FORMY VŠKP

**Prohlášení:**

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

V Brně dne 27.5.2015



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podpis autora
Erik Vaňo

**Poďakovanie:**

Týmto by som rád poďakoval vedúcemu bakalárskej práce Ing. Františkovi Vajkayovi, Ph.D. za odborné vedenie, ochotu, podporu a cenné rady ktoré mi pri riešení práce poskytol.

**Thanks:**

I would like to thank my supervisor of bachelor thesis Ing. František Vajkay, Ph.D. for the mentoring, willingness, encouragement and valuable advice during the elaboration of the bachelor project.

V Brně dne 27.5.2015

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podpis autora
Erik Vaňo

# CONTENT (OBSAH)

# INTRODUCTION

The bachelor's thesis is focused on solution of project documentation of detached house according to legislation and standards ČSN. House is situated in the outskirts of small town Rosice u Brna, South Moravia. The object is constructed as two-storey building without basement. Disposition of the house is 5+kk. I chose rectangular shape of the building with flat roof and green terrace because of my interest in this field of civil engineering. Load bearing walls are made of concrete blocks and ceilings are monolithic or from filigran panels. The thesis is aimed to architectural and construction design.

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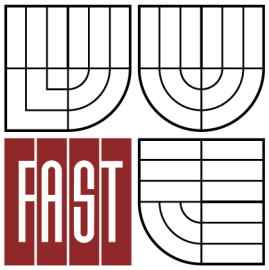

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# A - ACCOMPANYING REPORT

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# CONTENT

# A.1 Identification data

## A.1.1 Information about the object

a) Name: Detached Family Residence

b) Location: Rosice u Brna, cadastral area Rosice u Brna, plot # 240

c) Subject of the documentation : The subject is construction of new detached family house

## A.1.2 Information about investor

a) Name: Miloš Kašička

b) Address: Toopoľová 14, 957 01 Dolné Ozorovce, Slovakia

Phone: +421903 333 333

## A.1.3 Information about supplier

a) Name of company: FAST VUT Brno, Veveří 95, 602 00 Brno

b) Name of designer: Erik Vaňo, Hroznová 1186/19, 911 05 Trenčín

# A.2 The list of input documentation

Photo documentation of the plot, cadastral maps of chosen locality, valid legislation and standards ČSN for project documentation, Land use plan

# A.3 Information about the plot

a) The plot # 240 in cadastral area Rosice u Brna is in built-up area in suburb of the town. Area of plot is 2566 $m^2$

b) There is no existing utilisation of the plot. Surrounding plots are already built-up

c) The plot is considered as building estate according to municipal plan and is not situated in any reservation or protected area

d) The plot is almost flat with slight slope from north to south. All the rainwater passing the plot is soaked into the ground

e) For locality of this object is valid municipal plan of town Rosice u Brna. This documentation is in compliance with the municipal plan

f) All the general requirements according to decree # 501/2006 Sb. are followed

j) There is no effect on surrounding plots

## A.4 Information about the object

a) It is new two-storey building without basement.

b) The building is meant to be area for living according to decree # 501/2006 Sb.

c) The building is considered as permanent strusture.

d) According to law the building is not subject protection as cultural monument etc.

e) Design and project documentation follow the general technical rules for construction according to existing decrees and standards.

f) Project documentation of the building meet all the requirements of concerned authorities and follow the existing decrees and standards.

g) There are no needs for any special exemptions.

h) Built area: 136,8 $m^2$

Paved areas: 97 $m^2$

Floor area: 172,2 $m^2$

The object is designed as one housing unit for family of four.

j) Estimated date of start of construction is april 2016

k) Estimated price of object is 3 900 000 Kč

## A.5 Division of structure into objects and technical and technological parts

CO.01 - Detached family house

CO.02 - Sewer connection

CO.03 - Gas connection

CO.04 - Water connection

CO.05 - Electricity connection

CO.06 - Communication connection

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# B - SUMMARY TECHNICAL REPORT

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# CONTENT

# B.1 Description of the site territory

a) The plot is situated in suburb area of town Rosice u Brna. All the surrounding plots are already built-up. The terrain is almost flat in whole area. Road and main communications are accessible from to northern side of the plot.

b) According to geological survey the base course for the construction is mainly consisted of loess soil. The level of underground water is over 3 m under estimated foundation pads. There is no risk of radon occurrence.

c) Object is not situated in any zone under protection.

d) The plot is not situated in flood area or undermined area.

e) Object is not affecting surrounding area

f) There are requirements for felling several trees which are situated on the construction site

g) The area where the plot is situated is considered as area for constructions according do municipal plan so there are no requirements for agricultural land fund .

h) All the public networks as road, sewerage network, gas network, water network, low voltage network and communication network are situated on north side of the plot and all connections are prepared on the plot borders. By the connections are not affected any other surrounding plots or networks. Entrance road to plot must be constructed.

i) The object is not limited with any special investments nor special timetables.

# B.2 Overall description of the object

## B.2.1 Purpose of the object

Built area: 136,8 $m^2$

Paved areas: 97 $m^2$

Floor area: 172,2 $m^2$

The object is designed as one housing unit for family of four.

## B.2.2 Urban and architectural solution

a) The building will be situated in built-up area of town Rosice u Brna. In this area are mainly detached and semi detached houses. Across the road are newly built row houses with flat roofs. The house will be placed in accordance to required spacing from neighbouring objects.

b) Investor is planning two storey family house with attached garage. The house is divided for day part which is first storey with kitchen, living room, working room and ground terrace. Second storey is more night part with bedrooms(one is parent room with its own wardrobe room), sauna and sunny terrace situated over garage which is accessible from 3 rooms. Living room and kitchen on the first ground and two bedrooms will be situated to the south, south-east. Bathrooms, technical room and entrance are situated to the north. The house has cubic shape with flat roof and elevated parapet wall roof deck. The surface on terrace on the second floor is covered with vegetation layer.

## B.2.3 Disposition solution and technology prescription

The entrance to the building is situated on the north side. After entrance there is entrance hall where is possible to enter main hall or garage on the left side. From the main hall are accessible all rooms on the first floor and also staircase. On the south side of the house there are living room connected with kitchen which are meant to be main dayroom part of the house. on the opposite site of the hall are bathroom, toilet and technical room. On the second floor there are 3 bedrooms. Parents bedroom has its own wardrobe room. On the north site is situated bathroom with sauna and its own entrance to balcony and further to green terrace.

## B.2.4 Usage by disabled people

There are no requirements for adjustments of the facilities for disabled people.

## B.2.5 Safety during serviceability of the building

The building is designed according to existing decrees and standards for safety usage, mechanical resistance and stability, health and safety of persons, environment impact, protections against noise and energy savings. There are no further special requirements.

## B.2.6 Basic technical descriptions of the structures

### Foundations

Foundations are designed according to current standards. Designed foundations are strip foundations made of 3 layers of lost shuttering and plain concrete of width 500mm and deep 500mm beneath. For the foundations is used concrete C16/20. Under the reinforced concrete column is designed foundation pad of dimensions 700 x 900 mm from the same concrete. For concrete slab is designed plain

concrete C16/20 of 100mm thickness. Into concrete will be inserted KARI net with diameter 8mm x 150/150 mm. Under the foundation slab will be gravel subbase of thickness 100 mm.

Before putting concrete to foundations strip there must be inserted grounding rod according to project of electrical installations and also there have to be skipped openings for conductions of technical equipment.

Horizontal insulation is designed against ground humidity with higher requirements for safety of constructions. Insulation designed is HYDROBIT V60 S35.

**Vertical structures**

All vertical structures are designed from concrete blocks KB Blok.

Peripheral and inner load bearing walls are made of KB 1-20 A Přírodní (200mm), partitions made of KB 1-10 A Přírodní (100mm). Structural engineer will design reinforcement in given parts of walls. For external walls is recommended thermal insulation EPS 150 S of thickness 200mm. As the building facade will be used Cembrit system of hanged air ventilated facade from ceramic blocks.

**Horizontal structures**

Ceiling over first floor is designed as monolithic reinforced concrete slab. The thickness of slab will be 200mm and concrete grade is C20/25, the reinforcement is designed and approved by structural engineer according to valid standards. Ceiling over second floor is made of pre-casted reinforced concrete panels - FILIGRAN of thickness 60mm. There must be added KARI net of Ø8mm x 150/150 and structure will be covered by concrete C20/25 to final thickness 200mm. Dimensions of slabs and panels are according to project documentation.

Terrace on the second floor is finished by ICOPAL system of green roofs with possibility of person movement.

**Roof structure**

There is designed simple 3 layered flat roof made of vapour barrier foil (FOALBIT Al S240), thermal insulation of minimal thickness 200mm (EPS 150 S) and waterproof (modified bitumen membrane ELASTOBIT) Drainage of the roof is solved by 2 roof outlets TOPWET TW 75 BIT S and the slope is 2%. Slope will be created by sloping wedges made of EPS 150 S. Under the outlet must be placed concrete pavement because of washout gravel.

**Windows and doors**

There are designed triple glazed windows SLOVAKTUAL PASIV OL for better thermal protection. The entrance doors are also designed in accordance to energy savings and were chosen SLOVAKTUAL HEORAL 72.

## B.2.7 Basic characteristics of building services

**Heating**

The heating of the object is secured by gas condensation boiler BUDERUS Logamax plus with the power of 5,3 - 14,8kW, which will be installed in technical room #b 1.07. The boiler is compacted with the hot water storage tank of capacity 120l. There are designed heating elements KORAD Plan according to project documentation.

**Gas connection**

The object will be connected to estimated HUP on the border of the plot. There will be only one pipe connected to condensation boiler.

**Plumbing**

There is designed water connection pipe DN 32 with entrance shaft on the area of plot. Estimated daily usage of water is 125l/person/day. In the house are situated two toilets, one bidet, 2 showers, 1 bath and 5 basins.

Sewerage system will be connected by PP pipe DN 150 to public sewerage network. Entrance shaft is situated on the plot.

**Electricity and electrical installations**

The object will be connected to low voltage electrical network by connection wire and electric supply meter will be situated on the borders of the plot.

Electrical installations will be supplied from electrical distribution box placed in technical room # 1.07.

## B.2.8 Fire safety solution

The fire safety is solved in accordance to existing decrees and standards and further information can be found in attachment D.

## B.2.9 Principals in energy saving

Energy saving solution is made in accordance to ČSN 73 0540 - 2.

### B.2.10 Hygienic, working and communal environment requirements

**Ventilation**

The ventilation of the object is solved naturally by windows. The kitchen hood is placed above the cooker.

**Heating**

Heating is solved by central heating supplied from the condensation boiler placed in technical room and distributed in heating elements in every room.

**Water supply**

The supply of potable water is provided by connection to local water network.

**Waste water**

Waste water and also rain water is drained to local waste water network.

### B.2.11 Protection of the building against negative effects

There is no danger of any external negative effects such as radon occurrence, high seismicity or possibility of floods.

## B.3 Connection to technical infrastructure

There are designed all necessary connections to public networks. CO.02 Sewer connection is DN 150 and 25m long and the entrance shaft is placed on the plot area. CO.03 gas connection is gas pipe DN 32 with HUB placed on the border of the plot and length 11m. CO.04 water supply connection is DN 32 with length of 10,5m and entrance shaft placed on the plot area. CO.05 electrical connection is solved by low voltage cables of length 10,2m.

## B.4 Transportation solution

The plot is connected directly to public communication from the north side. There is possibility of parking two cars.

## B.5 Solution of vegetation and landscaping

There are several trees which has to be cut before the start of construction works. Landscaping will be easily done because the terrain is almost flat.

## B.6 Description of building impact on environment

The object has only minimal impact of the environment which is solved by sewerage system which is connected to public sewerage network. The object fulfill all the requirements according to valid decrees and standards.

During the construction process there will be reduced the impact on the surrounded environment. The waste materials will be treated according to act n. 185/2001 about the waste materials. Next according to decree 383/2001 Sb. about details of waste material treatment and the attachment n. 1 to decree 381/2001 Sb. Catalog of waste materials. Materials will be separated into given containers and driven to waste dump. Waste water will be piped into sewerage system.

| Code of waste type | Name of waste material type | Category of waste | Treatment |
|---|---|---|---|
| 17 01 01 | Concrete | O | Transportation to waste dump |
| 17 01 06 | Mixtures of concrete, bricks, tiles and ceramic products containing dangerous substances | N | Transportation to dump of dangerous substances |
| 17 02 01 | Timber | O | Transportation to timber dump |
| 17 02 03 | Plastics | O | Transportation to plastics dump |
| 17 02 04 | Glass, plastic and wood containing hazardous substances or contaminated by hazardous substances | N | Transportation to dump of dangerous substances |
| 17 04 05 | Iron and steel | O | Transportation to iron dump |
| 20 01 01 | Paper and cardboards | O | Transportation to paper dump |
| 20 03 01 | Mixed municipal waste | O | Transportation to municipal waste dump |

## B.7 Protection of population

All the necessary requirements are fulfilled.

## B.8 Organizational principles during the construction

The object is connected to main communication via second road on the northern side of the plot. The electric and water connection must be built before the start of construction of building. All the prescriptions and health and safety rules will be obeyed. Before the start of work must be cut 20cm of tillage and kept for further usage. There is no need of transportation of soil. The soil will be distributed on the plot according to project documentation.

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# D - ARCHITECTURAL - STRUCTURAL SOLUTION

## TECHNICAL REPORT

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# CONTENT

# D.1 General information about the object

## D.1.1.a Information and parameters of the object

- Title: Detached family residence
- Location: Rosice u Brna (plot # 240)
- Investor: Miloš Kašička
- General contractor: FCE VUT Brno
- Planner: Erik Vaňo
- Built area: 136,8 $m^2$
- Floor area: 172,2 $m^2$
- Built in space of house: 673 $m^3$
- Paved areas: 97 $m^2$
- No. of floors: 2

## D.1.1.b Architectonic and dispositional solution

Investor is planning two storey family house with attached garage. The house is divided for day part which is first storey with kitchen, living room, working room a ground terrace. Second storey is more night part with bedrooms(one is parent room with its own wardrobe room), sauna and big sunny terrace which is accessible from 3 rooms. Living room and kitchen on the first ground and two bedrooms will be situated to the south, south-east. Bathrooms, working room and entrance are situated to the north.

## D.1.1.c Basic characteristics of the object

Investor has ordered a new realization project for Detached family house. Project was made with accordance to urban regulations of town Rosice u Brna. It is a house of rectangular floor plan with flat roof.

Building is made of concrete blocks - construction system KB Blok. Roof is flat. Ceiling over first floor is monolithic slab with balconies from the north and south side and green terrace over the garage. Ceiling over second floor is made of FILIGRAN system. Staircase is monolithic reinforced concrete. Partitions - concrete KB blocks. Other parts of the object: garden adjustments, road, pavement, fencing.

In order to pass building approval all connections and utilities must be connected to the object.

Construction site will have its own site diary with a regular construction supervision.
All construction workers will be educated in most recent safety regulations.
All garbage produced during construction process will be moved to a legal junkyard.
No environmental damage is supposed to be done.
Layout, location, size of windows and cladding are designed towards the smallest possible heat losses of the object.

## D.1.2 Area setup and excavation works

At the beginning of works must be done the surface treatment such as cutting down the trees. It is required to remove at least 200 mm of the topsoil which will be stored on the site and later used for final landscaping works. The topsoil is removed only from the area of planned object and one meter around. A surveyor will be called for building lay and afterwards must be set the project zero point by benches and ropes. The zero point is at height +298,000 m.a.s.l. Excavations for foundation strips are done with JCB excavator in the depth of 1350mm from the project zero. Before starting of foundation work must be called structural engineer and building supervisor to review the load bearing capacity of the soil in the foundation pit. The excavated soil will be taken away to nearby collecting place.

## D.1.3 Foundations

The base concrete for foundation strips beneath the foundation masonry is designed from concrete C16/20 with the width of 500mm with accordance to load bearing capacity of the soil. Foundation strips are in the depth from -1,350m up to -0,850m to the project zero point. The foundation masonry is made of three layers of concrete blocks (KB Blok 1-20 A) used as permanent formwork and reinforced with reinforcement Ø 12 mm designed by structural engineer. The formwork will be filled with the concrete C16/20. Foundation slab will be of thickness 100mm reinforced with 2 KARI sieves 150 x 150 - 8 mm and also made of concrete C16/20. Beneath the slab will be layer of graded gravel 16-32 mm of thickness 100mm. There is no need for drainage pipes because of the low level of underground water.
There will be 2 holes in the foundation strip prepared for water and sewerage connections and 2 whole in formwork for gas and electricity connections.

On the outer side of permanent formwork will be placed 150mm of thermal insulation XPS STYRODUR 2800 C to avoid thermal bridges in the plinth area. The XPS insulation will be extended to the height of 300mm above the ground level which is designed in -0,250m to the object zero point.
The waterproof insulation is designed HYDROBIT V60 S and will be extended to the height of 300mm above the expected ground level.

## D.1.4 Vertical structures

All vertical structures are made from concrete blocks - KB Blok system.
Main load bearing walls are from blocks KB 1-20 A of thickness 200mm and high load bearing capacity 10 kPa. Blocks are reinforced and filled with concrete C20/25 on given parts designed by structural engineer. The last layer of blocks beneath the reinforcement ring is from ring blocks KB 101-20 A to secure the racing of concrete.
Peripheral walls are insulated by thermal insulation BACHL EPS 150 S of thickness 200mm to fulfill the standards of thermal protection of buildings ČSN 73 0540.
There is designed air ventilated outer facade. The system which is being is Cembrit system of air ventilated facades. The main supporting structure for facade is made of steel and is anchored to load bearing wall by chemical anchors. Facade is finished by ceramic blocks Cembrit Express of dimensions 400 x 800mm and thickness of 8mm. Whole peripheral wall composition is 450mm thick.
Internal partition walls are constructed from concrete blocks KB 1-10 A of thickness 115mm.
All internal walls are finished with the lime plaster.

## D.1.5 Horizontal structures

### D.1.5.a Ceiling over first floor

The ceiling structure over the first floor is designed simple supported monolithic slab of thickness 200mm. Concrete used for slabs is C20/25 and reinforcement is designed by structural engineer B500B of thickness and placing according the project documentation. There are differences between the height placing of slabs over the garage and rest of the house. The lowest level of slab over the garage is +2,500m and

the slab continues to the outside with the support of Schöck Isokorb system type K, with thermal insulation of thickness 80mm to secure the thermal bridges.

The slab over the rest of the house is at lowest point +2,700m and is placed on the reinforcement ring. The place where the upper slab meets the terrace slab is jump of 200m and there is needed to be used Schöck Isokorb system type K-HV to secure the thermal bridges.

Balcony slab is also monolithic reinforced concrete slab with the lowest height of +2,600m and is enwrap by thermal insulation EPS 150 S from both sides to secure thermal bridges.

### D.1.5.b Ceiling over second floor

Ceiling over second floor is made of FILIGRAN panels of thickness 60mm. There must be added KARI sieve 150 x 150 - 8mm a additional reinforcement designed by structural engineer over the hangs. The structure will be covered by concrete C20/25 up to thickness 200mm. The hangings will be enwrap by thermal insulation EPS 150 S of thickness 100mm to minimize thermal bridges.

## D.1.6 Roof structure

Roof structure is designed as single flat roof system with parapet wall deck.

The composition of roof is simple three layered. As a vapour barrier is used foil Foalbit AL S240 from. Second layer is thermal insulation BACHL EPS 150 S of thickness 200mm. for securing the slope there are slope wedges also from EPS 150 S designed according to project documentation. The highest point is at the level +6,300m and lowest is +6,200m.

As waterproof layer is used 2 layers of modified bitumen membrane Elastobit of thickness 5mm each.

There are two rainwater outlets Topwet TW 75 BIT S of diameter 70mm on the north and south side of the roof.

Parapet wall deck is made of reinforced concrete and is high 450mm, whole deck is enwrap by thermal insulation of thickness 100mm, from the sides by EPS 150 S and from the top XPS 2800 C. On the top of parapet wall deck are OSB laths anchored through the insulation to masonry. On laths there will be metal sheet sloped to 5% in roof direction.

## D.1.7 Terrace

The terrace is designed on principal of green flat roof system from ICOPAL company. Whole composition of the terrace is composed from 8 layers. As the first layer is used penetration coating Siplast Primer which has to be slathered of the base concrete. Second layer is vapour barrier foil Foalbit AL S40. Thermal insulation EPS 150 S is applied on the vapour barrier to secure the proper heat transfer. Thickness of insulation is 200mm over the garage area and 100mm on the balcony sides. Insulation will be covered by supporting layer Icolep L 30. The main waterproof layer is from protection fleece Graviflex 5,2 Green roof which is bitumen membrane modified by SBS caoutchouc and the special function of protection against the penetration of plant roots. Next layer is from drainage board Icodren 10 Speed Drainage, which works as a drainage layer with high discharge capacity of drainage mat and protection against mechanical damage of the main waterproof layer. Last layer before the vegetation layer is filter fleece 7x Icomat 140, which is basically nonwoven geotextile which absorbs and keeps the humidity for the plants and has a very good ability of air circulation. The top vegetation layer id Icomat Green 317 of thickness 54mm. The vegetation is mainly consists of mosses, herbs and sedum.

The parapet wall deck is based on the similar principal as on the flat roof with the difference of placing the thermal insulation and the structure of the wall. The wall is composed of one layer of bricks HELUZ Family of thickness 200mm and thermal insulation inside the brick to fulfil the thermal requirements , next two layers are from concrete blocks KB 1-20 A as the rest of the house. Thermal insulation EPS 150 S is only on one side of the wall just to keep the surface with load bearing wall.

## D.1.8 Floor finishes

### D.1.8.a Finishes on 1$^{st}$ floor

All floor finishes on the first ground floor are composed 100mm of thermal insulation EPS 150 S to secure heat losses to the ground . Insulation is covered with vapour barrier PE foil to avoid the leak of the fresh levelling concrete. The levelling concrete layer is only 40mm thick to fulfil standards. There is no floor heating in the house. The top layer of floors depends on the room. In the garage there is recommended to use ceramic tiles Kreta from Siko company. This tiles of dimensions 300 x 300mm have high load bearing capacity and are freeze resistant. Ceramic tiles

will be also placed in the kitchen, bathroom and toilet. The type is up to the investor. The rest of the floors will be finished with laminate floating floor placed on underlayment layer ISOFLEX ECO. All corners with the floating floor will be finished with wooden floor molding.

### D.1.8.b Finishes on 2nd floor

Floor finishes on the second are composed of 40mm of thermal insulation EPS 150 S used as a sound barrier. Then there is separation PE foil against the leak of fresh concrete.. Levelling concrete is of thickness 50mm. Finalizing material is used different in bathroom, sauna and toilet - ceramic tiles and in the rest of the rooms and hall is used floating laminate floor.

## D.1.9 Staircase

Stairs are designed as reinforced concrete monolithic stair. The used concrete is C20/25 and steel B500B. The reinforcement is designed by the structural engineer.
There is designed U shape flight with 17 steps with the total height of 3000mm. The height of each step is 176,5mm and width 265mm. The slope of the staircase is 33,7°.
Width of the stair flight 1200mm. There is designed foundation under the first step of staircase. Staircase is supported from the sides by the load bearing walls and also there is designed special supporting girder under the last step.
Railing is fixes to the wall at height 900mm.

## D.1.10 Openings

Window openings are provided with triple glazed windows Slovaktual Pasiv OL.
This is a plastic window with excellent insulation properties designed for low-energy and passive houses with 85mm construction depth. The window has improved thermal and acoustic insulation properties. The heat transfer coefficient of whole window is 0,8 $W/m^2.K$. All windows are protruded into the thermal insulation to avoid thermal bridges. This is achieved by special system for protruded windows shown in Detail B. There is need for special sealing tapes to prevent the entrance of humidity. This works as vapour barrier.

The designed entrance door is Slovaktual Heroal 72 from aluminium. The door has high stability and optimal thermal insulation. There is triple insulated glazing. The heat transfer coefficient is 1,2 $W/m^2.K$.

Balcony doors are based on the same system as windows Slovaktual Pasiv OL with the same properties and are also protruded do thermal insulation. There are three balcony doors, one is situated in the hall of the second floor, second is in the bathroom on the south side of the house and third are placed in the child's bedroom.

There are also entrance door to the ground floor terrace. The door is also Slovaktual Pasiv OL and used the same system as on windows and balcony doors.

All interior doors are wooden ERKADO Broadway with the wooden frame.

# Conclusion

The aim of the bachelor theses was to design the detached family residence for family of 4 and prepare most of the project documentation needed for planning permission. I chose the particular disposition of the house in accordance to fulfil all the necessities of modern family and for their best comfort. My aim was to design low energy house, with the possibility of fast construction process, therefore I used concrete ceramic block with the thick layer of thermal insulation. The house is design in the modern architectonic fashion with flat roof, green terrace and nowadays very popular air ventilated facade from ceramic blocks.

During the elaboration of the project I have met with the several problems. The main one was that I had to change the material for ceiling over first floor and also change the elevation of the slabs over garage and balcony slabs to avoid thermal bridges and keep the lower price. Next I had to change the disposition of the house slightly such as placement of the boiler or exhaust hood in the kitchen.

# List of sources

## Legislation


Zákon č. 183/2006 Sb. o územním plánování a stavebnímu řádu (stavební zákon)

Zákon č. 185/2001 Sb. o odpadech a o změně některých dalších zákonů

Vyhláška č. 499/2006 Sb. o dokumentaci staveb

Vyhláška č. 501/2006 Sb. o obecných požadavcích na výstavbu

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

Vyhláška č. 246/2001 Sb. o požární prevenci

Vyhláška č. 268/2009 Sb. o technických požadavcích na stavby

Vyhláška č. 383/2001 Sb. o podrobnostech nakládání s odpady

Vyhláška č. 381/2001 Sb. katalog odpadů


## Standards


ČSN 01 3420 - Výkresy pozemních staveb - kreslení výkresů

ČSN 73 4301 - Obytné budovy

ČSN 73 0540 - Tepelná ochrana budov

ČSN 73 0580 - Denní osvětlení budov

ČSN 73 0532 - Akustika, ochrana proti hluku v budovách

ČSN 73 0802 - Požární bezpečnost staveb - Požadavky na požární odolnost stavebních konstrukcí

ČSN 73 0810 - Požární bezpečnost staveb - Společná ustanovení

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

ČSN 73 0873 - Požární bezpečnost staveb. Zásobování požární vodou


## Webpages


| | |
|---|---|
| http://www.kb-blok.cz/ | masonry material |
| http://www.bachl.cz/ | thermal insulation |
| http://www.cembrit.cz/ | air ventilated facade system |
| http://www.icopal.sk/ | waterproof and green roof system |
| http://www.icopal.pl/ | waterproof and green roof system |
| http://www.baumit.cz/ | plasters |
| http://www.jika.cz/ | tiles |
| http://www.slovaktual.cz/ | windows and doors |

| | |
|---|---|
| http://www.dvere-erkado.cz/ | internal doors |
| http://www.internetovestavebniny.sk/ | extruded polystyrene |
| http://www.cad-detail.cz/ | details |
| http://geoportal.cuzk.cz/ | maps |
| http://www.cuzk.cz/ | cadastre |
| http://www.tzb-info.cz/ | |
| http://www.buderus.sk/ | condensation boilers |
| http://www.usskorad.sk/ | heating elements |
| http://www.prefa.cz/ | filigran |

## Software used

Microsoft Office 2010

AutoCAD 2014

ArchiCAD 16

Teplo 2010

Area 2010

# List of abbreviations

VŠKP - vysokoškolská kvalifikačná práca

ETDs - electronic thesis and dissertation

ČSN - česká štátna norma

mm - millimetre

m - metre

n. - number

th. - thickness

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D.1.3.b - Layout of fire hazard

**Folder 6 - E.1 Evaluation of building physics**

E.1.1 Thermal evaluation of compositions

E.1.2 Protocol of thermal evaluation building envelope

E.1.3 Thermal bridges

# Attachments

See individual folders of the bachelor's thesis Folder 1, Folder 2, Folder 3, Folder 4, Folder 5 and Folder 6