VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

DETACHED FAMILY RESIDENCE
SAMOSTATNĚ STOJíCí RODINNÝ DŮM

BAKALÁŘSKÁ PRÁCE
BACHELOR´S THESIS

AUTOR PRÁCE
AUTHOR

MATEJ ROŠTÁR

VEDOUCÍ PRÁCE
SUPERVISOR

Ing. FRANTIŠEK VAJKAY, PhD.

BRNO 2016

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
FAKULTA STAVEBNÍ

Studijní program	B3607 Civil Engineering
Typ studijního programu	Bakalářský studijní program s výukou v anglickém jazyce a prezenční fromou studia
Studijní odbor	3608R001 Pozemní stavby
Pracoviště	Ústav pozemního stavitelství

ZADÁNÍ BAKALÁŘSKÉ PRÁCE

Student	Matej Roštár
Název	Detached Family Residence
Vedoucí bakalářské práce	Ing.František Vajkay, Ph.D.
Datum zadáni bakalářské práce	30.11.2015
Datum odevzdání bakalářské práce	27.5.2016

V Brně dne 30.11.2015

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prof. Ing. Miloslav Novotný, Csc.	prof. Ing. Rostislav Drochytka, Csc., MBA
Vedoucí ústavu	Děkan fakulty stavební VUT

Podklady a literatura

(1) směrnice děkana č.19/2011 s dodatkem 1 a přílohami 1, 2, 3 a 5; (2) studie dispozičního,
konštrukčního a architektonického řešení stavby; (3) katalogy a odborná literatura; (4) Zákon o územním plánování a stavebním řádu (stavební zákon) č. 183/2006 Sb. ve znění zákona č. 350/2012 Sb.; (5) Vyhláška č. 499/2006 Sb. ve znění vyhlášky č. 62/2013 Sb.; (6) Vyhláška č. 268/2009 Sb.; (7) Vyhláška č.398/2009 Sb.; (8) platné normy ČSN, EN, ISO včetně jejich změn a dodatků.

Zásady pro vypracování (zadání, cíle práce, požadované výstupy)

******* Zadání VŠKP (BP)*** Zpracování projektové dokumentace (dále PD) pro provedení stavby stevbního objektu. Objekt je situován na vhodné stavební parcele. V rámci zpracování PD je nutné vyřešit rovněž širší vztahy, tj. zázemí objektu, venkovní parkovácí plochy, napojení objektu na stávající inženýrské sitě, technickou a dopravní infrastrukturu atp.
*** Cíle práce *** Vyřešení dispozice zadaného objektu s návrhem vhodné konštrukční soustavy a nosného systému stavby na základě zvolených materiálů a konštrukčních prvků.
PD objektu bude rozdělena na textovou a přílohovou část. PD bude obsahovat výkresy situace, základů, půdorysů všech podlaží, konstrukce zastřešení, svislých řezů, technických pohledů, 5 detailů, výkresy sestavy dílců popř. výkresy tvaru stropní konstrukce, specifikace a výpisy skladeb konstrukcí. Součástí dokumentace bude i stavebně fyzikální posouzení objektu a vybraných detailů, požární zpráva a další specializované části, bodou-li zadány vedoucím BP.
*** Požadované výstupy *** BP bude členěna v souladu se směrnicí děkana č. 19/2011 a jejím dodatkem a přílohami. Výkresová, textová a přílohová část PD bude vložena do složek s klopami formátu A4 opatřených popisovým polem a uvedením obsahu na vnitřní straně každé složky. Všechny části PD budou zpracovány na bílem papíru s využitím PC v textovém a grafickém CAD editoru. Výkresy budou opatřeny popisovým polem. Textová část bude obsahovat také položku h) "Úvod" , i) "Vlastní text práce" jejímž obsahem budou průvodní a souhrnná technická zpráva a technická zpráva pro provádění stavby podle vyhlášky č. 499/2006 Sb. ve znění vyhlášky č. 62/2013 Sb. a j) "Závěr" . BP bude mít strukturu dle pokynu umístěném na www.fce.vutbr.cz/PST/Studium.

Struktura bakalářské/diplomové práce

VŠKP vypracujte a rozčleňte podle uvedené struktury:

1. Textová část VŠKP zpracována podle Směrnice rektora "Úprava, odevzdávaní, zverejňování a uchovávaní vysokoškolských kvalifikačních prací" a Směrnice děkana "Úprava, odevzdání, zverejňování a uchovávání vysokoškolsých kvalifikačních prací na FAST VUT" (povinná součást VŠKP)
2. Přílohy textové části VŠKP zpracované podle Směrnice rektora " Úprava, odevzdávaní, zverejňování a uchovávaní vysokoškolských kvalifikačních prací" a Směrnice děkana "Úprava, odevzdání, zverejňování a uchovávání vysokoškolsých kvalifikačních prací na FAST VUT" (nepovinná součást VŠKP v případě, že přilohy nejsou součastí textové části VŠKP, ale textovou část doplňují).

.....
Ing.František Vajkay, Ph.D.

Vedoucí bakalářské práce

Abstrakt

Táto bakalárska práca sa zaoberá riešením dvojpodlažného rodinného domu na parcele 985/101 v Babiciach nad Svitavou. Parcela sa nachádza v katastrálnom území Babice nad Svitavou. Návrh rodinného domu sa zaoberá architektonickým, technickým a stavebným riešením objektu podľa požiadavok investora. Objekt je navrhnutý ako drevostavba z lepených laminatových nosných profilov v obvodových stenách odizolovaných tepelnou izoláciou a z vonkajšej strany obitých perodrážkovými profilmi z lepeného laminátového dreva. Objekt je zatrešený šikmou sedlovou strechou. Cieľom tohto návrhu je vytvoriť zdravú a komfortnú drevostavbu s nízkymi nákladmi na chod.

Kľúčové slová

drevostavba, sedlová strecha, šikmá strecha, Babice nad Svitavou, lepené lamelové drevo

Abstract

This bachelor thesis orients itself toward solution of double-storey detached family residence situated on plot 983/101 in Babice nad Svitavou. The plot is situated in cadastral region of Babice nad Svitavou. The design of family residence concerns about architectonical, technical and structural solution according to the request of investor. The object is designed as timberstructure from glue-laminated timber load-bearing profiles in peripheral walls insulated by mineral thermal insulation and covered by external planks from glue-laminated timber.The object is covered by pitched saddle roof. The main aim of this work is to create healthy and comfortable timberstructure with low expenses during usage.

Key words

Timberstructure, saddle roof, pitched roof, Babice nad Svitavou, glue-laminated timber

Bibliografická citace VŠKP

Matej Roštár *Detached Family Residence.* Brno, 2016. 36 s., 80 s. příl. Bakalárske práce. Vysoké učení technické v Brně, Fakulta stavební, Ústav pozemního stavitelství. Vedoucí práce Ing. František Vajkay, Ph.D

Declaration:

I declare, that I worked out this bachelor thesis alone and that I stated all used sources of information.

Prohlášení:

Prohlašuji, že jsem bakalářskou prácu dělal samostatně a že jsem uvedl všechny použité informační zdroje.

V Brně, dne 27.5.2016

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Podpis autora

Matej Roštár

Thanks:

I would like to thank my supervisor Ing. František Vajkay, Ph.D., for the proper leading, support, motivation and useful advices he has been providing me during the elaboration of this project.

Poďakovanie:

Chcel by som poďakovať mojmu vedúcemu práce za správne vedenie, podporu, motiváciu a užitočné rady, ktoré mi poskytoval počas vypracovania tohto projektu.

V Brně, dne 27.5.2016

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Podpis autora

Matej Roštár

Content:

Introduction

This bachelor´s thesis concerns about architectonical, technical and structural solution of family house in Babice nad Svitavou. The object is considered to be detached and low energy. It is constructed from glue-laminated timber profiles and it has two floors. The shape of the object can be considered as rectangular with additional part for entrance and technical room. The second floor is only placed above the main rectangle, additional part is covered by the monopitched roof. The main aim of this thesis was to create comfortable family residence for a young family and to secure the low costs during lifetime of the structure. It is designed for four members family. According to the building envelope the object is low-energy house of class B. The structural system in vertical direction is constructed from glue-laminated timber profiles insulated by mineral thermal insulation and covered by glue-laminated planks from the external side. The object stands on pit foundations and it is covered by saddle roof.

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A – ACCOMPANYING REPORT

BAKALÁŘSKÁ PRÁCE
BACHELOR´S THESIS

AUTOR PRÁCE
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VEDOUCÍ PRÁCE
SUPERVISOR
Ing. FRANTIŠEK VAJKAY, PhD.

BRNO 2016

Content:

A.1 Identification

A.1.1 Information about the project

Name:	Detached family residence
Location:	Babice nad Svitavou, cadaster Babice nad Svitavou, parcel number 983/101

A.1.2 Information about the builder

Name:	Ladislav Roštár
Address:	Jilemnického 1181/4, 977 01 Brezno, Slovak republic
Phone number:	+421 911 563 656

A.1.3 Information about the designer

Name:	Matej Roštár
Address:	Jilemnického 1181/4, 977 01 Brezno, Slovak republic
Phone number:	+421 948 176 404
Email:	matej.rostar@gmail.com

A.2 The list of input data

The input documents which had been used during elaboration of this project are the decision of building office, cadastral map of the area, topographic map of the area and the map of public engineering networks.

A.3 Information about the parcel

The parcel number 983/101 in the cadastral region Babice nad Svitavou, which is used for construction of the new object is very slightly sloped to almost flat with maximal vertical gain of approximately half meter on whole area. Slope is decreased to the southwest. There is new access road to the parcel which is cca.7 m wide and it is covered by asphaltic cover. There are public networks of sewage, electricity and potable water under the surface. The parcel is of rectangular shape with total area of 947 m^2 . The parcel is in neighborhood with five other parcels, borders of these parcels are not given by any fence. In close neighborhood there are no building objects when looking

west and when looking north there are new family houses. The neighbor parcel 983/100 is also owned by the investor. The parcel is covered by short grass and has no trees or bushes. The possible obstacles which would cause complication during the building process are not found. Soil type found on this parcel is loess. Investor of the building is also the owner of the parcel.

A.4 Information about the object

The object which will be erected on the parcel is going to be completely new and its main purpose is to provide a comfortable and healthy living space for four-member family. Its estimated lifetime should be 50 years in service. The building object is of rectangular shape with additional part on the northwest side which is the entrance part. The object has two floors and the second floor is situated only above the main rectangle. This new object is according to the thermal evaluation classified as low-energy house of class B. The estimated duration of erection is approximately 12 months and the estimated cost of the rough construction is approximately 3 000 000 Kč (111 000 €).

Total built-in area:	220,66 m^2
Built-in area without the terrace and paved areas	141,00 m^2
Built-in volume:	589,44 m^3
Total usable area:	209,12 m^2
Usable area of the 1st floor:	112,84 m^2
Usable area of the 2nd floor:	96,28 m^2
Number of users:	4
Number of bedrooms:	3

A.5 Division of the objects into parts

The new construction object is divided into 7 objects according to the coordination situation. There are following objects found in the plot: FAMILY HOUSE, GARAGE, SUMMER HOUSE, SWIMMING POOL, SEWER CONNECTION, ELECTRICITY CONNECTION and POTABLE WATER CONNECTION. Despite all the listed objects, this bachelor thesis mainly concerns about the family house itself.

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B – SUMMARY TECHNICAL REPORT

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MATEJ ROŠTÁR

VEDOUCÍ PRÁCE
SUPERVISOR

Ing. FRANTIŠEK VAJKAY, PhD.

BRNO 2016

Content:

B.1 Description of the parcel

The parcel number 983/101 in the cadastral region Babice nad Svitavou, which is used for construction of the new object is very slightly sloped to almost flat with maximal vertical gain of approximately half meter on whole area. Slope is decreased to the southwest. There is new access road to the parcel which is cca.7 m wide and it is covered by asphaltic cover. There are public networks of sewage, electricity and potable water under the surface. The parcel is of rectangular shape with total area of 947 m^2 . The parcel is in neighborhood with five other parcels, borders of these parcels are not given by any fence. In close neighborhood there are no building object but when looking west and north there are new family houses. The parcel is covered by short grass and has no trees or bushes. The possible obstacles which would cause complication during the building process are not found. Soil type found on this parcel is loess. Investor of the building is also the owner of the parcel. Before the start of construction works it is necessary to cut the grass, otherwise there not any obstacles blocking the construction process. There are no protected, flood or undermined areas at the location.

B.2 General description of the object

B.2.1 Purpose of the object

The main aim of the building object is to create comfortable, low-cost and healthy place ideal for family living. The maximum number of people in the house is four. The most ideal option would be two adults and two children.

B.2.2 Urban and architectural solution

The parcel is situated on the relatively flat terrain. The entrance to the object is facing south side. Also the most used rooms are facing south due to ensure of sunlight during the day and through the whole year. The object is approximately in the middle of the north-south direction and on the right side of the west-east direction. It is located in this way, because in front of the house garage will be built also on the right side so according to the requirements of investor it provides some kind of privacy protection

when sitting on the terrace. Behind the house there is swimming pool and ot the top left corner of the parcel summer house will be built. From the architectonical point of view, object is divided into two parts. First is the parents part which is the first floor and the children part which in on the second floor. On the first floor there is a bathroom connected directly to the parents bedroom, corridor, small office, separated toilet and lavatory, technical room (it includes boiler, accumulation tank, dryer and washer) in the entrance part, small buttery for the storage of food and big living room connected with dinning room and partially separated kitchen. The most used part is living room with the kitchen and dinning room so it is placed on the south south-east. The second floor consists of mutual bathroom for both children, corridor, sauna with cloakroom and bathroom, storage room mostly for clothes. The most used part of the second floor are two bedrooms for children oriented to the south with big terrace. External facade of the object is created from glue-laminated planks (tatran profile like) which are three times coated (one time basic, two times color coating Belinka TOPLASUR shade - 13). The socle is covered by the stucco external plaster which is put on the STYRODUR insulation. The eurodoors and eurowindows dark brown colored are used to make contrast between the facade and openings. The roof is typical saddle roof which has to be braced by ties at the same height as the rafters are put on the load-bearing wall. Planes of the roof are sloped to the west and east. The roof above the entrance is mono-pitched oriented to the west. On the main object roof there will be five tubular solar panels used for heating the water and support for heating of swimming pool. The load-bearing elements of the roof are rafters and the ridge at the top which is fixed to the ties. The roof will be covered by tile-like steel sheet. The services connection will be built as new connected to the public networks.

B.2.3 Urban and architectural solution

The disposition of the object was designed to serve the family in a pleasant and comfortable way. The second floor is almost entirely used by children except the sauna which is situated next to the staircase, but all other spaces are used mainly by children. For a pleasant seizing of the days during summer, children have common terrace (balcony) situated on the south side. The parents bedroom has its own bathroom to secure the privacy of adults. The most used spaces such as dinning room, living room

and the kitchen are connected together in favor of creating pleasant space to socialize and communicate.

B.2.4 Usage by disabled people

The object is not suitable for disabled people, so this fact was not even considered during the design of the object. There is no free entrance to the object for people using wheelchairs.

B.2.5 Safety during usage

In this object, there are not any special requirements during usage.

B.2.6 Basic characteristics of the object

Foundations

The building object is built on the strip foundations. The depth of the foundations is 1,2 m and width is 0,4 m according to the basic calculation. The foundation pit has to be extended 0,5 m to the external side due to placement of thermal insulation. In the span between the foundations, geotextile is put on the soil and it is covered by compacted gravel. On the compacted gravel layer which is 200 mm thick, concrete with KARI grid is put. Total thickness of concrete layer is 200 mm. The diameter of reinforcement and grade of concrete should be determined by the structural design.

Hydro insulation

The hydro insulation has to be put on the concrete layer to protect internal environment against moisture. Fatrafol P 922 was used and it was placed on the whole area of the object. Another important place which has to be protected against water is the ceiling which is under the balcony. For the hydro insulation in this place, two layer of Bitagit 35 were used. Also the decking on the timber joists was coated by the rubber-asphaltic coat to improve the protection against penetration of the water into load-bearing joists and thermal insulation which is put between joists.

Vertical load-bearing elements

The peripheral wall is composed of glue-laminated load-bearing timber profiles of thickness 120 mm, which are insulated by mineral thermal insulation from the external side and the facade of the object is made of glue-laminated timber planks of thickness 40 mm. In the layer of thermal insulation there are put laths of dimensions 60x160 mm which are not load-bearing, they are used as a support for thermal insulation and facade planks which are screwed to them. Mineral thermal insulation is protected by diffusive foil Mastermax 3 TOP from the external side and from the internal side there water vapour barrier Knauf LDS 0,04 which deny the access of moisture into thermal insulation. Both foils are designed to be put directly on the material, so it is not necessary to leave there any air cavity. The thickness of the wall is 320 mm and its total heat transfer coefficient U = 0,207 W/m^2.K.

Horizontal load-bearing elements

The slab above the first ground floor is constructed from the glue-laminated timber joist. The dimensions of the joists are 100 x 250 mm. The joists are placed on the peripheral load-bearing profiles and they are fixed by screws. Between the main joists in the perpendicular direction smaller joists are used to secure better stability of the slab. For the exact position see the drawing D 1.2.02. Between the joists there is thermal insulation ISOVER UNI which fulfills also the aim of acoustic insulation. Soffit is made of spruce timber planks th. 30 mm and is coated by two layers (one is primer and one is transparent). On the top of joist timber decking of spruce timber planks is made and it is the same as the soffit. There is no slab above the second ground floor. Soffit of the second floor is made spruce timber planks (th. 30 mm) and it is fixed to the ties of the roof .

Roof

In the building object there are two separated roofs. One is situated above the entrance part. It is mono-pitched roof constructed from the rafters. Slope of the roof is reached by the stud, which are placed on the main beam next to the peripheral wall. This main beam is supported by peripheral walls of the entrance part but it is not visible because it is hidden behind the decking of wall. The main roof is saddle roof constructed from

rafters, ties and the ridge. Ties had to be placed at the same height as the roof is placed on peripheral wall. The ridge of the roof is supported by studs which are screwed to the ties. Both roofs are covered by tile-like steel sheet.

Doors and windows

To secure the low costs of energies during usage, triple glazed windows and doors were used. Frame of the doors and windows is made from wood. Dark-brown color of the windows and doors is designed to create nice contrast between the walls and openings. Type of the windows is VEKRA Natura 94 with U = 0,7 W/m^2.K.

B.2.7 Basic characteristics of the building services

There are totally three bathrooms, one toilet, one lavatory and technical room with dryer and washing machine in the object. Two of the bathrooms are situated on the second floor. One of them is exactly above the one on the first floor so there is no problem to drain the waste water. The second one is above the office room and corridor, so for the drain of waste water some additional shafts have to be made. For the detailed view see D.1.1.01 drawing. The main water pipes, sewer pipes are going underneath the slab and the exact place of intersection with the ground is illustrated in the D.1.2.01 drawing. In the object there are totally two bathtubs, four washbasins, four closets, three showers, one sink, one washing machine and one dish washer.

B.2.8 Fire safety

For the detailed protocol of fire safety in this object see the attachment D1.3

B.2.9 Fundamentals of usage of energies

Five solar panels are used for heating of domestic water and the system is done in a way that solar panels can support central heating system. During the summer when the surplus of heat from solar panels is created, this heat is used to support the heating of swimming pool behind the house. For the storage of energy accumulation tank is used. Main heating element in the object is pellet boiler. In the first floor, floor heating system is used in the second floor radiators are preliminary planned according to the requirements of investor.

B.2.10 Hygienic, working and communal requirements

The ventilation in the building is natural secured by the windows and possibly by doors. Pellet boiler is the main device for heating system and for heating of water but the solar panels are also there to support both heating and hot water preparation. The detailed specifications of used materials for building services are specified by the designer of building service project.

B.2.11 Protection of the building against negative effects

The building object is well protected against the effects of radon. No other protection is necessary.

B.3 Connection to the infrastructure

There are three connections designed in the object. The first one is sewer connection (BO 05). It is straight almost through all its way but at the two 45° knees are used. One of this knee is connection to the public sewer. Whole length of the connection is 20 m. The second connection is electricity connection (BO 06). On the edge of the parcel, box with main circuit-breaker is placed. The length of the connection is 25 m. The other box for the object electricity distribution is placed in the entrance room. The third connection is potable water connection which is 30 m long. It has the main water-mater pit placed two meters away from the border of the parcel. In this pit there is also main valve for stop the water flow into the building.

B.4 Transportation solution

The parcel is directly connected to the road. The arrival road is not far from the main road passing though the village. There are no bike routes.

B.5 Vegetation and terrain solution

The first thing, which is necessary to be done before the start of construction is to cut the grass. 200 mm of the top soil should be removed and used for terrain edit. The terrain is very slightly sloped so the removed topsoil will be used for surfacing.

The architecture of the parcel (vegetation e.g) is up to the investor. He asked for his own arrangement of the parcel.

B.6 Description of the environmental effect of the building

The object does not have any negative effects on the environment. Only the production of waste and sewer water occur. The waste is collected into the trash container and sewer is led by pipes to the public sewer system. On the other hand, building object has good effect on the environment. It is created mostly from the natural materials and the affect the environment minimally.

B.7 Protection of the inhabitants

All needed requirements are fulfilled.

B.8 Organizational principles during construction

The first thing which has to be done is to build connection of water and electricity. Water will be mainly used for drinking, washing or mixing of concrete and the electricity is used for running of the machines and tools. Drainage of the parcel can be natural. The parcel lies next to the access road so it is not necessary to build any new road. The construction waste which will be produced during construction works should be separated into parts. It should be divided into plastic, timber and sewage. Timber waste can be used in the future by the investor so it can be stored. Plastic waste should be collected and transported to the recycling place. For the sewage mobile dry toilet (ToiToi type e.g) should be used. There is not expectation of big soil movement only in case of foundation digging. Soil from the foundations can be used for surfacing of the parcel. It is important for workers to use proper clothes, shoes and wear protective helmets during the construction process.

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C – TECHNICAL REPORT

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VEDOUCÍ PRÁCE
SUPERVISOR
Ing. FRANTIŠEK VAJKAY, PhD.

BRNO 2016

Content:

C.1 General information about the object

Investor:	Ladislav Roštár, Jilemnického 1181/4, 977 01 Brezno
Location:	Babice nad Svitavou, cadaster Babice nad Svitavou, parcel no. 983/101
Built-in area:	220,66 m^2
Useable area:	209,12 m^2
Built-up volume:	589,44 m^3
Total height:	7 m
No. of floors:	2

C.2 Earthworks

Before the start of construction works it is necessary to cut the grass and flatten the surface for the easy movement of construction machines. Then it is required to remove 200 mm of topsoil from the ground. The removed topsoil can be stored on upper right part of the parcel (north-east direction). The removed topsoil is used after finishing of construction for surfacing of the parcel because it is slightly sloped. Also it can be used for backfills. Then it is important to set project zero by the help of benches and ropes, so it is possible to measure the depth of the foundation pit. Two benches on the each side of the corners should be used. There is only one depth of all foundations and it is 1200 mm. Total depth measured from the project zero is 1440 mm. Extended pit from external side around the foundation should be digged. It is necessary to do, because of the insulating process of the foundation by STYRODUR in thickness of 140 mm. Width of the extended pit at the bottom should be 500 mm and the slope of the edge of the pit should be 60°. It should be marked out with lime cement for a good visibility. The project´s zero is set to the 483,000 meters above the sea level. The depth of the pit should be measured many times to secure the accuracy and proper depth of the foundations.

C.3 Foundations

The foundations are made of the concrete blocks, so it is not necessary to use formwork in the pits. The concrete blocks are filled with the concrete and at the top of the

reinforced concrete slab is made. Grade of the concrete and exact position of the reinforcement should be calculated by structural designer. Before the concrete slab si put on the whole area of future object, geotextile has to be put on the soil. Then layer of gravel should be put and compacted at total height of 200 mm. When this preparation of the base is done, concrete can be put on it. Then it should be vibrated. It is necessary to put fixers to attach the load-bearing timber profiles which will be erect after hardening of concrete. For the placement of this layer of concrete formwork at the top of the concrete blocks should be made. It is recommended to remove the formwork after 7 days. Concrete should be left to harden for at least three weeks. During this period insulation of the foundation can be made. STYRODUR of thickness 140 mm should be used for the insulation. When hardening of concrete is finished, hydro insulation should be put on it. For the hydro insulation it is designed to use Fatrafol P922 which is 1,5 mm thick. Application of the Fatrafol P922 must be provided by the specialized workers. Process of application can be found on the webpage of the producer. Basically, it is put on the concrete by the help of gas bomb and fire burner. This hydro insulation should be overlapping through the edge of the concrete slab to secure proper hydro insulation of the structure. The roll of the hydro insulation is two meters wide so the belts should be overlapping at least by 10 % of the overall width.

C.4 Vertical load-bearing structure

Vertical load-bearing structure in this case peripheral walls are made from glue-laminated timber profiles of thickness 120 mm. After the finishing of the first floor, joists of the slab should be placed on the wall and then the construction of the wall is being resumed till it is finished at prescribed height on the second floor. At the position of foundation these timber profiles are screwed to the previously put fixers which are concreted to the base slab. Load-bearing profiles are connected by dovetail joint and it is not overlapping. When the load-bearing part is finished, placement of the lathing of dimension 60x160 mm is done. These laths are put 1 meter from each other and are fixed to the load-bearing wall by screws. This lathing does not have load-bearing function, it is used only to support the external facade made from 40 mm thick glue-laminated timber planks and for easier placement of thermal insulation between them. Under the laths water vapour barrier must be placed to protect the thermal insulation

against the moisture. These laths are also placed around the openings in a way, that they copy the opening dimensions. When the whole structure is lathed and insulated, diffusive foil is put on the laths ad it is fixed by the drawing-pin. After this act, timber planks serving as a external facade are placed. They are fixed be screws to the laths. At the corner they are cut to the 45°angle and covered by the angular bead. The external timber planks are coated by three layers of coating (one is primer and two are the colored coat Belinka TOPLASUR - shade 13.)

C.5 Horizontal load-bearing structure

In the building object there is one horizontal load-bearing structure and it is the slab above the first ground floor. It is constructed from glue-laminated timber joists of clear span 7360 mm. Cross-sectional dimensions of the joist are 100 x 250 mm. The joist are placed on the load-bearing wall and are properly fixed to it by the screws or anchors to secure the fixed connection and the stability. These joist are also braced by the perpendicular joists screwed to the main joists. The mineral insulation ISOVER UNI is used between the joists. Soffit of the slab is done from spruce timber profiles (tatran profile) thickness 30 mm. On the top of the joist there is decking made of the same profiles as the soffit. Then the separation PE foil is used and the self-nivelating screed is put on it. There are two types of floor finishes. One is made from ceramic tiles (toilet, bathrooms, cloak room) and one is made from massive french spruce timber (bedrooms, storage room, sauna). Also on the balcony there is different type of floor finish. This is the most important part because it has to be properly insulated against the water. On the self-nivelating screed two layers of Bitagit 35 and the impermeable gravel carpet is made at the top as the surface finish.

C.6 Roof structure

There are two roof structures covering the building. The first one is situated above the entrance part, which is only one-story. This roof is mono-pitched and it is constructed from the rafters. Rafters are fixed on the studs which are supported by the main beam which is going along the load- bearing wall. Main beam has the dimension of 160 x 250 mm. Studs which are used to create the slope to the left side (from the point of view of entrance). Dimensions of the studs are 100 x 160 mm and are connected to the main

beam by the tenon connection. Rafters are screwed to the studs and by the help of tenon connection also fixed to the load-bearing wall. The roof is covered by tile-like steel sheet. The main roof is constructed above the second floor of the building object. It is pitched saddle roof. Rafters are fixed by the help of screws to the load-bearing wall. To improve the stability of the wall, ties are connected to the rafters at the point of connection of rafters to the wall. On the top there is a ridge of dimensions 200 x 250 mm. The ridge is supported by the studs which are fixed to the ties. Soffit is made of timber planks fixed to the ties. Also the roof above the ties is covered by the timber planks. Thermal insulation is put between rafters and it is protected by diffusive foil from the external side and by water vapour barrier from the internal side. Above the main rafters on both roofs there are additional smaller rafters. They are used for placement of additional thermal insulation to satisfy the U- value requirement. On the additional rafters or laths there is in perpendicular direction placed timber lathing (40 x 40 mm) and the distance between them is 350 mm according to the requirements of the producer of the tile-like steel sheet cover to correctly support the roof cover.

C.7 Partitions

The partitions in the building object are made of timber construction, which is filled by mineral insulation securing the acoustic requirements. On both sides it is covered by tatran profile planks from spruce timber and they are coated by two layers of coating (one primer and the second one transparent). All the connections are done by using nails. The timber profiles used for the construction of the partitions are recommended to have the dimensions 60 x 80 mm. The mineral insulation is protected by diffusive foil form and water-vapour barrier to deny the access of moisture in it.

C.8 Floor above the ground

The basic layer of the floor is described in C.3 Foundation paragraph. When this base works are done, floor can be finished. On the hydro insulation STYRODUR th. 100 mm is placed. It should be as precise as possible not to create thermal bridges in the floor. On this layer of STYRODUR, polystyrene is placed. For the exact composition of floor see the D1.1.06. The spaces around the peripheral walls must be properly tightened because anhydrite screed will be poured on it and it is necessary to deny the scouring.

Before the pouring of concrete, separation foil must be placed on the polystyrene and floor heating tubes are put on it. Dilatation layer must be put all around the walls, because without this layer, screed which is heated would be cracking. Also it is used to separate the timber from the screed. When the screed is hardened after approximately 4 weeks, it is necessary to be grinded with emery paper because it tends to drift out the sediments. Then the dust from created by grinding should be cleaned by industrial vacuum cleaner. There two types of flooring on the first ground floor. One has the ceramic tiles on the top and the second one has timber flooring. Ceramic tiles are placed of the flexible adhesive thickness max. 5 mm. When placing the timber flooring, separation layer XPS 3 mm thick must be placed under the flooring. It can not extend 3 mm because it is not recommended to use thicker layer which is placed on heated floor.

C.9 Staircase

The stairs are designed as wooden custom made with 18 steps. The shape of the staircase flight is in the letter U. The height of the step is 166,67 mm and the width is 280 mm. The height of the railing is 900 mm. The pitch of the staircase is 30,76°. For the detailed calculation see the E folder – Calculation of stairs. The exact design will be discussed with the carpenter. The staircase is planned to be lightweight so it does not require any foundations. They will be fixed to the joists on the slab. On the bottom part they will be screwed to the floor.

C.10 Openings

For the filling of the openings there are used triple glazed windows VEKRA Natura 94 with U = 0,7 W/m^2.K. The frame of the window is constructed from the oak timber. Also doors are produced by this company and have U-value = 0,7 W/m^2.K. The windows are fixed by the help of steel plates to the lathing on the peripheral wall. For the detailed view of window fixing see the details. On the both external and internal sides casing from the spruce timber is used to cover the laths on the sides. This casing is fixed by screws and foamed by the extensive fire-resistant foam. It is recommended to use specialized workers for the correct fixing of windows, because it is important from the point of view of thermal evaluation.

C.11 Chimney

There is only one chimney in the building object. It is triple-layered anti- corrosive chimney, which is used for pellet boiler. This chimney is protected by the insulation inside to deny the creation of condensate which is undesired for the boiler on natural fuel. Internal diameter for the chimney flue is 150 mm, external diameter is 300 mm. The chimney does not require any protection because it is made of rustless metal. Only necessary thing is to put the head on the top of the chimney to protect the flue against the rain water flowing down. This type of chimney is fixed to the external wall. The height of the chimney is 6,5 m.

Conclusion

The main aim of this thesis was to create healthy, nice and comfortable place to live for a family. The design was based on the investor´s requirements. There are few changes in the disposition compared to the study due to the change of staircase flight to spare the place. The goal of the project was done as the documentation to the realisation of the building object has been elaborated.

List of used sources

Used standards

ČSN 73 4301 – Obytné budovy

ČSN 73 0532 – Akustika, ochrana proti hluku v budovách

ČSN 73 0802 – Požární bezpečnost staveb

ČSN 73 0580 – Denní osvětlení budov

ČSN 73 0540 – Tepelní ochrana budov

Legislation

Vyhláška 499/2006 Sb., o dokumentaci staveb

Zákon č. 183/2006 Sb., o územním plánování

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

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

Webpages

www.vekra.cz

www.isover.sk

www.knauf.sk

www.schiedel.cz

www.thermomaster.sk

www.supellex.cz

www.maslen.sk

www.tzb-info.cz

www.fatrafol.sk

Used softwares

AutoCAD 2013

ArchiCAD 2018

Microsoft Office 2010

Adobe Acrobat Reader

List of abbreviations

ČSN – česká státní norma

mm – milimeter

m – meter

U – heat transfer coefficient

th. – thickness

e.g – for example

W – watt

K – Kelvin

no. – number

List of attachments

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4. TECHNICAL REPORT

FOLDER B – STUDIES

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6. D 1.1.06 – COMPOSITIONS
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FOLDER D 1.3 – FIRE SAFETY

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2. D 1.3. 02 – FIRE HAZARD SITUATION

FOLDER E – CALCULATION OF THE STAIRS, THERMAL EVALUATION OF BUILDING ENVELOPE, GEOLOGICAL REPORT

1. CALCULATION OF THE STAIRS

2. THERMAL EVALUATION OF BUILDING ENVELOPE

3. GEOLOGICAL REPORT

Attachements

See the individual folders on the bachelor´s thesis – folder A, folder B, folder C, folder D, folder E