VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

FAMILY RESIDENCE
RODINNÝ DŮM

BAKALÁŘSKÁ PRÁCE
BACHELOR'S THESIS

AUTOR PRÁCE — PAVEL SUBALLY
AUTHOR

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

BRNO 2014

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 formou studia
Studijní obor	3608R001 Pozemní stavby
Pracoviště	Ústav pozemního stavitelství

ZADÁNÍ BAKALÁŘSKÉ PRÁCE

Student	Pavel Subally
Název	Family residence
Vedoucí bakalářské práce	Ing. František Vajkay, Ph.D.
Datum zadání bakalářské práce	30. 11. 2013
Datum odevzdání bakalářské práce	30. 5. 2014

V Brně dne 30. 11. 2013

.....	.....
prof. Ing. Miloslav Novotný, CSc.	prof. Ing. Rostislav Drochytka, CSc., MBA
Vedoucí ústavu	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 …….
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.

Předepsané přílohy

.....

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

Abstract

Táto bakalárska práca sa zaoberá riešením dvojpodlažného rodinného domu na parcele 438/11 v Zlíne, mestskej časti Chlum. Parcela je v katastrálnom území mesta Zlín. Návrh rodinného domu sa zaoberá architektonickým, stavebným a technickým riešením objektu vzhľadom na požiadavky investora. Objekt je navrhnutý z dreveného rámového systému s plochou zelenou strechou. Cieľom návrhu je vytvoriť stavbu s čo najnižším zaťažením životného prostredia počas výstavby a s minimálnym zaťažením životného prostredia počas užívania.

Kľúčové slova

drevený rám, drevostavba, ekologický, ekológia, extenzívna strecha, Chlum, plochá strecha, zelená strecha, Zlín

Abstract

This bachelor thesis concerns a design of two floors family residence located in Zlín, Chlum on a parcel number 428/11 in the cadaster region of Zlín. The design if the residence includes the architectural, structural and technical solution according the investor’s requirements. The object is designed as timber frame structure with flat extensive green roof. The goal of the design was to create a residence with very low ecological impact during the construction process and with minimal ecological impact during its lifetime usage.

Key words

Chlum, ecological, ecology, extensive roof, flat roof, green roof, timber frame, timber structure, Zlín

Bibliografická citace VŠKP

Pavel Subally *Rodinný dům.* Brno, 2014. 36 s., 92 s. příl. Bakalářská 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 the used information sources.

Prohlášení:

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

V Brně dne 28.5.2014

……

podpis autora
Pavel Subally

Thanks:

I would like to thank my teacher ing. František Vajkay for the motivation, support, advice, supervision and proper leading he gave me during the elaboration of this project.

Poďakovanie:

Chcel by som poďakovať môjmu učiteľovi ing. Františkovi Vajkayovi za motiváciu, podporu, rady, dohľad a správne usmernenie počas spracovania tohto projektu.

V Brně dne 28.5.2014

……

podpis autora
Pavel Subally

Content:

Introduction

This bachelor's thesis includes a project documentation and architectural design of low energy family residence in Zlín – Chlum. The object is constructed as semi-detached, two floors high timber structure where the second floor is only located above the main part of the house. The additional part is lower comparing to the main part of the object to copy the terrain surface with roof above it. The main goal of the thesis was to design a family house which is environmentally friendly not only during the usage but also during its construction. A special attention was given to most of the material as their production had to be environmentally friendly and also to load bearing system and materials used for it. According to the object's envelope it is considered as class AAA (low-energy house) building. The family residence is designed of four people – one family. The structural system used for load bearing external walls is timber frame filled with blown cellulose with flat extensive green roof on concrete slab foundations.

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

A – ACCOMPANYING REPORT

BAKALÁŘSKÁ PRÁCE
BACHELOR'S THESIS

AUTOR PRÁCE — PAVEL SUBALLY
AUTHOR

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

BRNO 2014

Content:

A.1 Identification

A.1.1 Information about the project

Name: Family residence

Location: Zlín – Chlum, cadaster Zlín, parcel number 438/11

A.1.2 Information about the builder

Name: Rostislav Běťák

Address: Zábrančí II 265, 76302, Zlín 4

Phone #: +420 335 682 169

A.1.3 Information about the designer

Name: Pavel Subally

Address: Ružová 45, Bratislava, 262 28

Phone #: +420 905 668 957

E-mail: pavelsubally@gmial.com

A.2 The list of the input data

The input documents which were used for preparation of the design are the decision of the building office, cadaster map of the area, photos of the landscape and map of the connections in the area.

A.3 Information about the parcel

The parcel with the specific number 438/11 in the cadaster of Zlin , which is used for the construction of this object, is slightly sloped to almost flat with a maximal vertical gain approximately one meter. The slope is oriented to the south. The entrance road to the parcel is about five meters wide with asphalt cover. There is public sewage pipeline, public water supply pipeline and high voltage cables underneath the road. The shape of the parcel is polygonal. The polygon has five sides with four acute angles and one open angle. There are two neighboring structures. When looking north, on the left side there

is a newly built family house with garage and a knot wire fence on the interface of the parcels. On the right, there is a passive underground family house with a garage also. There is no fence dividing these two parcels. The parcel is covered by short growing grass and it also includes two young trees with log diameter less than ten millimeters. There are no obstacles on the parcel which would be needed to be taken in an account during the design. The investor is also the owner of the parcel.

A.4 Information about the objet

The object is going to be build as completely new and its purpose is to create a living place for a four-member family. The life expiration is expected after 50 years. The object is not protected in any way and there are no legal obstacles. The access for disabled people is not necessary. The object is designed as low – energy house therefore the thermal class is B. The residence is designed in shape of letter L where its longer part has two floors and the short one only one. The construction should take 18 months and the approximate cost is 3 900 000 czk (144 000€).

Total built - in area	195,36 m^2
Built-in area without the terrace and paved areas	112.51 m^2
Built - in volume	648.53 m^3
Total useable area	152.7 m^2
Usable area of the 1st ground floor	91.33 m^2
Usable area of the 2st ground floor	61.37 m^2
# of users	4
# of bedrooms	3

A.5 The division of the object in parts

The construction is divided into 7 objects according to the coordination situation. There are: FAMILY HOUSE, GARDEN STORGE, GARDEN ARBOUR, GARAGE, SEWER CONNECTION, WATER CONNECTION AND ELECTICITY CONNECTION listed in the situation. However, this project mainly concerns the family house.

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

B – SUMARRY TECHNICAL REPORT

BAKALÁŘSKÁ PRÁCE
BACHELOR'S THESIS

AUTOR PRÁCE — PAVEL SUBALLY
AUTHOR

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

BRNO 2014

Content:

B.1 Description of the parcel

The parcel with the specific number 438/11 in the cadaster of Zlin , which is used for the construction of this object, is slightly sloped to almost flat with a maximal vertical gain approximately one meter. The slope is oriented to the south. The entrance road to the parcel is about five meters wide with asphalt cover. There is public sewage pipeline, public water supply pipeline and high voltage cables underneath the road. The shape of the parcel is polygonal. The polygon has five sides with four acute angles and one open angle. There are two neighboring structures. When looking north, on the left side there is a newly built family house with garage and a knot wire fence on the interface of the parcels. On the right, there is a passive underground family house with a garage also. There is no fence dividing these two parcels. The parcel is covered by short growing grass and it also includes two young trees with log diameter less than ten millimeters. Before the beginning of construction it is necessary to cut the grass short. It is possible to leave the trees growing as they are at the edge of the parcel and will not create an obstacle during the construction. There are no protected areas, flood areas or undermined areas at the location.

B.2 General description of the object

B.2.1 Purpose of the object

The purpose of this object is to create a nice, healthy and ecologically friendly place to live for a young family. It is possible to use this object by at maximum four people. The ideal scenario is two adults and two children.

B.2.2 Urban and architectural solution

The parcel is located on the south slope of the hill which ensures the sunlight for most parts of the house during all year. For this reason the most used rooms of the house are located to south. The object itself is located in the upper part of the parcel on the right side (when looking north). The reason why the house is located so far away from the

entrance road is that one of the investor's requirements was to have a nice view to the city of Zlín. The object is designed in the shape of the letter L where the longer side includes two floors and the short one only one with a flat roof above. From architectural point of view the disposition is divided in two parts. The first part is, a children part (first floor) and the second is a parent's part (ground floor). There is a bathroom (includes a bath tub, a washbasin and a toilet), storage room hallway and two children bedrooms on the first floor. The ground floor is again divided in two parts. The division was made into a night part and a day part. The day part includes a small office, a guest's toilet (includes a toilet and a small sink), a technical room (includes a boiler, washing machine and a dryer), an entrance room, a kitchen and a living room with a dining area also. The night part includes the master bedroom with an extra bathroom (includes a shower, a toilet and a washbasin). The living room with dining area is assumed to be the most used room during the day. It is located to the south and kitchen is located to the south-east. The office and the master bedroom is located to the south-west. The technical rooms (the technical room, the toilet room and the bathroom) are located to the north because they do not require a lot of sunlight during the day. The living room with the dining area is placed 0.3 meters below the project's zero so the object copies the terrain. This way it is possible to create a nice elevation difference which makes the object special. For facade, it is going to be used spruce tartan profile planks three times coated (one basic coating and two transparent coatings) and for socle, it is used decorative ceramic strips produced by Wienerberger. The roofs are designed as mono pitched extensive green roof with plants (stone crop) which don't require any special care. Both roof planes are sloped towards south which can be useful in the future in case the investor decides to mount solar panels for water heating. The load bearing elements of the roof are constructed from timber truss girders connected with punch metal plates. The service connections are going to be built as new to the existing ones beneath the road.

B.2.3 Overall operational solution

The disposition of the house was design to serve well to the family. Second floor is entirely used by children. This way the house can be divided in to a young (loud) part and adult (calm) part. The master bedroom has its own bathroom to keep the privacy of

the heads of the family. The common areas (living room, kitchen, dining room) are connected together to create a good place to socialize and communicate.

B.2.4 Usage by disabled people

The object is not suitable for usage by disabled people and this fact was not taken in account during the design. There is no free entrance for people on wheel chairs

B.2.5 Safety during usage

There are no special requirements for safety during usage.

B.2.6 Basic characteristics of the object

Foundations

The construction object is built on the compacted layer of granulated foam glass. Thickness of this layer is 600 mm after compaction. The geotextile has to be used under the layer of foam glass to protect it against the impurities. The foundation pit has to be extended 500 mm to every side so it is possible to put the foam glass around the sides of the foundation slab to ensure the building's thermal envelope. The load bearing structure is made from a 250 mm thick plain concrete slab reinforced with KARI grid. The grade of concrete and the diameter of reinforcement have to be used according to the structural design.

Hydro insulation

With using of the foam glass below the foundation slab it is not necessary to use any additional thermal or hydro insulation. However, this object is constructed as timber framed building so there was used an extra layer of hydro insulation Bitagit 35 mineral to protect the timber frame from any possible water or moisture in the foundation slab. For the hydro insulation of flat roof were used two layer of insulation, for the first layer is used SBS modified bitumen belt GLASTEK 40 special and for the second is used SBS modified bitumen belt ELASTEK 50 garden.

Vertical load bearing elements

The peripheral load bearing walls are constructed from timber frames (dimensions of studs and runners are 50x150 mm, also known as 2 by 6 structural system) filled with

blown cellulose as thermal insulating material and covered by 60 mm thick EKOPANELs (straw compressed at high pressure to form a panel) from both sides. The thickness of the main load bearing wall is 270 mm. As an external facade, there are used 15 mm thick spruce tartan profile planks (planks with tongue and groove) coated first with basic primer than with two layers of transparent coating for external use. The planks are screwed onto vertical timber laths (40x50mm). The overall thickness of the peripheral is 320 mm but the overall thickness of the peripheral walls is 320 mm. The thickness of partitions is 120 mm, made of double layered EKOPANEL (alternatively, constructed from timber studs (100x50 mm) and runners (100x50 mm) covered with OSB (15 mm thick) and wall paper as the last layer, overall thickness is 130 mm)

Horizontal load bearing elements

The slab above the first ground floor is constructed from timber joists (width 50 mm and height 275 mm) placed on the runners in position of the frame studs. The direction of the studs is transversely to given floor plan. It is very important to secure the right position of the joist so the stability of the object is secured. The additional bracing has to be established by short joist put in between the main joist according to the drawing D.1.2.02. The decking is executed by 60 mm thick EKOPANELS. The soffit is made from timber tartan profile planks (thickness 10 mm) treated with two layers of coating (first layer is a basic primer and second is a transparent coating). There is no slab above the second ground floor. The soffit is created by exposing the truss girders and nailing a decorative spruce tartan profile planks on the top of the girders. However, there is an exception in the bathroom on the second floor. The soffit there is executed by humid resistant gypsum boards screwed on an aluminum mesh which are hanging from the trusses above.

Roof

There are two separated roofs constructed on this object. Both of them are mono pitched green extensive roof with a slope of 5% (2.86°). For the load bearing elements are used mono pitched timber trusses connected with punch metal plates. The trusses are visible from the bottom except the bathroom at the second floor. For the protecting top layer of

the roof is used 100 mm of soil substrate and low care required plants (stonecrop, sedum).

Thermal insulation

Recycled paper is used as an insulating material for the walls. It comes in shape of cellulose which is the filling material of the free space between the frame studs. The cellulose is blown in hole created during the execution of the EKOPANEL decking of the walls. It is not necessary to insulate the floor because the 60 mm layer of foam glass below the foundation slab creates the required layer of the thermal insulation. There is additional 60 mm of extruded polystyrene used around the perimeter of the foundation slab and the socle to eliminate the thermal bridge at the position of the connection of slab and the foundation runner of the timber frame. The thermal insulation of the roof is ensured by 200 mm thick layer of STYRODUR polystyrene mechanically anchored to the EKOPANEL.

Windows and doors

To ensure the thermal protection of the building it was needed to use triple glazed windows and walls. There are wooden windows and external doors used on this object. The window type is Natura 94 produced by VEKRA company. The door type is Pardubice III also produced by VECTRA company

B.2.7 Basic characteristic of the building services

There are two bathrooms, one toilet room and one kitchen in the building. One of the bathrooms is located on the second floor. The bathroom and the toilet room on the first ground floor are located next to each other with the second bathroom above them. This way the waste water pipes can connect to one stack and easily drain the water. The main waste water pipe, water pipes and gas pipes are going underneath the foundation slab and go up at the designed places (see drawing D1.2.01 for more details). There are two regular wash basins, one small washbasin, one kitchen sink, one shower, one bathtub, one shower, three toilets, one washing machine and one dish washer in the object.

B.2.8 Fire safety

For more information see the fire report in folder D.1.3.

B.2.9 Fundamentals of the usage of energies

There is a possibility of using solar panels for pre-heating or heating the domestic water in the future. This option was introduced to the investor but for the lack of money it was necessary to exclude this option for now. However, the investor is planning on such a step in the future so the design of the object was adjusted to this fact.

B.2.10 Hygienic, working and communication requirements

The ventilation is ensured by natural ventilation through the windows and doors. For heating and preparation of hot domestic water is used electrical boiler (type according to the building services design). Alternatively, it is possible to connect the solar panels to the heating system in the future.

B.2.11 Protection of the building against negative effects

The object is well protected against radon. No other protections are needed.

B.3 Connection to the infrastructure

There are three connections constructed in the object. First one, the water connection (BO.06) is 26 m long with water shaft one meter from the edge of the parcel; second one, sewage connection (BO.05) is 21.5 m with one 15° knee. The sewage connection is connected with the public network under 60°. The third connection is the electricity connection (BO.07) and its length is 20 m. The box with the main closing valve is placed right on the border of the parcel. All three of them are connected with the public network underneath the road.

B.4 Transportation solution

The parcel is directly connected to the road. The road is old but in very good condition. There are no sidewalk or bike routes. It is easily accessible from the city.

B.5 Vegetation and terrain solution

It is necessary to cut the grass before the beginning of the construction. A 300 mm layer of soil should be removed in the area of the object before the beginning of the construction. This soil should be stored on the construction site and be used during the landscaping works. The vegetation and the landscape architecture is up to the investor as he personally asked for it.

B.6 Description of the environmental effect of the building

The object does not have any negative effect on the environment. The only waste produced in the building is sewage waste and kitchen trash. The sewage waste is led away by the sewage piping and the kitchen trash is collected in the trash container next to the garage (see C.3 Coordination situation). On the other hand, the object has a very positive effect on the environment. 90% of materials used during construction are natural or affect the environment in a minimal range.

B.7 Protection of the inhabitants

All necessary requirements are fulfilled.

B.8 Organizational principles during construction

It is important to build the water and electricity connections before the construction begins. There are no significant withdrawals expecting. Water will be mainly used for drinking, washing or treating of the concrete and the electricity will be used for powering the tools. Drainage of the construction site is natural as the object is built on a slope. The parcel lies on the road side that way it is not important to construct any new roads. There won’t be a necessity of demolition or logging.(your way is also correct, I just suggest this one also) The construction waste will be separated so the further recycling can be possible. Separation should be divided into timber, plastic and sewage. Timber waste can be stored at the construction site for later usage by the investor. The

plastic waste should be collected in plastic bags and turned in to the recycling place. For the sewage waste, there should be a dry toilet (ToiToi type) brought to the construction. Any bigger soil movement is not expected except the excavation of the foundation pit. It is important for workers to wear proper clothes, shoes and wear helmets during the construction.

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

C – TECHNICAL REPORT

BAKALÁŘSKÁ PRÁCE
BACHELOR'S THESIS

AUTOR PRÁCE — PAVEL SUBALLY
AUTHOR

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

BRNO 2014

Content:

C.1 General information about the object

Investor:	Rostislav Běťák, Zábrančí II 265, 76302, Zlín 4
Location:	Zlín – Chlum, cadaster Zlín, parcel number 438/11
Build-in area:	195.36 m^2
Useable area:	152.7 m^2
Build-up volume:	648.53 m^2
Total height:	7.2 m
No. of floors:	2 floors

C.2 Earthworks

Before the construction can begin it is needed to mow the grass and flatten the land to create a good surface for manipulation with machines and tools around the construction site. Also, it is good to protect the trees with additional formwork to secure that there will not be any damage on them. It is required to remove the top 300 mm of arable soil before excavating of the pit. The soil is taken only from the area of the actual object and one meter around it. This arable soil is placed aside on the construction site. Preferably, it is place at the left upper corner (when looking north) of the parcel. This soil will be used for the backfills (if necessary) or landscaping works at the end of construction. It is important to set the project's zero with help of timber benches and ropes at this point so the depth of the pit can be measured. There should be set of two benches at every corner of the object. The perimeter of excavation should be offset 500 mm from the actual perimeter of the slab and marked out with lime powder for good visibility. Foundation pit should be excavated with respect to the project's zero because the surface is sloped. There are two different depths of the pit. The depth of the first foundation pit is 970 mm and the depth of the second is 1270 mm. The connection between them is done by chamfering the step at 60°. The perimeter side of the pit can be sloped under a 60° angle to secure the land falls and load bearing capacity at the edge of the pit. The project's zero is designed at the height 267,000 meter above the see level. The depth of the pit should be measured many times to ensure the correct depth. The excavated soil should be taken away to the nearby collecting place.

C.3 Foundations

At first, it is important to put geotextile with area weight more them 150 g/m^2 on the bottom of foundation pit. Make sure that there is a least one meter of extra geotextile on every side so it is possible to wrap the edges of the foam glass after compaction. After the placing of geotextile comes the foam glass. It is brought as granulate in big bags. The supplier is GEOCELL Company. Foam glass is embedded in three layers where each one is well compacted. This layer has to be 600 mm thick after the compaction. The overlapping geotextile is now put over the foam glass to create a continuous envelope around it so it does not get dirty and filled with impurities. Add separation PE foil Tatratex to separate the glass from the fresh concrete mix. Then, the formwork of the lower part of the slab is constructed first and reinforcement can be placed in the position. Both concrete grade and reinforcement diameter should be used according to the structural design evaluated by structural engineer. Afterwards, the concrete can be placed and vibrated. There is one day technological brake necessary before the construction of formwork for the upper part of the slab can begin. After constructing the formwork it is possible to place the concrete for the second slab also. Concrete has to be treated twice a day with water to avoid cracking. The treatment should last for at least 7 days. The formwork can be removed after 3 days but it is recommended to leave it at least for 7 days. As last, 750 mm wide bitumen belts (Bitagit 35) are placed below the future load bearing walls. The foam glass gives a very good protection for the foundation structure so the Bitagit 35 is used as safety hydro insulation. 250 mm from the strip has to overlap the slab so it can be attached to it from the side. For attaching the belts is used gas bomb and fire burner.

C.4 Vertical load bearing structure

As a main structural system is used timber platform frame. The single floors are constructed separately one after the other with a decking above the first floor. The main load bearing elements are spruce timber balks (dimension 150x50 mm). These balks are used as studs and runners also. The foundation balk is from oak and its position is secured by custom made metal L profiles. For any connection in the frame are used screws (l=100 mm). It is important to brace the structure with timber balks during

construction because it is needed to construct the second floor before placing EKOPANELs on the walls. When the frames of both floors are constructed then EKOPANELs can be placed from the exterior side and then from the interior side also. Keep in mind to make a hole in the EKOPANELs so the cellulose can be blown in the free space between studs. After constructing the external side it is important to put penetration coating Ceresit CN94 on the wall. Diffusion foil is used as the next layer. The foil is used as extra water protection of the panels in case of undesirable water penetration through the facade. It is stapled to the panels. The next layer are vertical balks (40x35 mm) nailed with 55 mm long nails. As the covering layer are used spruce tatran profile planks 15 mm thick treated with three layers of coating. First layer is a base primer and the other two are transparent coatings Pam lak for the external usage.

C.5 Horizontal load bearing structure

There is only one horizontal load bearing structure and it is the slab above the two floor part of the object. The clear span of the joists is 5380 mm and it is executed from spruce timber joists (dimensions 50x275 mm). The joists are precisely placed above the studs and secured with screws. This is very important for the structural rigidity of the structure. The slab joists are also braced with short joist placed perpendicularly on them (for more detail see the drawing D.1.2.02). The decking of the slab is done by EKOPANELs secured with 100 mm long screws. There is decorative spruce decking (thickness of 10 mm) between the joists and EKOPANELs nailed to the joists. There are three openings made in the slab. The biggest one 3.7x0.9 m is for the staircase, second one 0.3x0.5 m for the services and the last one 0.46x0.46 m for the chimney. There is an exchange executed for the chimney opening. The 50 mm fire safety distance is ensured around the chimney.

C.6 Roof structure

The roofs are constructed as mono pitched flat green extensive roofs. There are two separate roof plains. One is above the main (two floors height) part of the object and the other is above the living room. The roof compositions are precisely described in the drawing D.1.1.08. The main load bearing elements are timber trusses made from

50x100 mm balks and connected with punch metal plates. The spans of the trusses are 5.5 m and 5.38 m. The short one is above the main part of the object. The trusses are placed directly on the frame runner in place of the studs. Same as during construction of the slab, it is very important to secure the right position of the trusses. They are connected with L profiles and screws to the runners. The trusses above the living room are placed on the runners on one side and on the other they are placed on a glue-laminated beam. They are secured the same way as the trusses above the main part of the object. There is a decorative spruce tatran profile decking (10 mm thick) nailed to the trusses on the top of them. The planks are treated with two coatings. First one is a base primer and the second one is transparent finishing coatings (Pam lak for external usage). The load bearing decking is executed by EKOPANELs screwed on the trusses by 100 mm long screws and coated with penetration coat Ceresit CN94. Next layer is the layer of thermal insulation. As thermal insulation it is used 200 mm of Styrodur 2800c mechanically attached to the straw panel by plate fasteners Koelner KI/10N length 200 mm. The 30 mm hole has to be cut out before placing the fasteners. The hydro insulation contains 2 layers. For the first layer is used SBS modified bitumen belt GLASTEK 40 special and for the second is used SBS modified bitumen belt ELASTEK 50 garden with protection against roots. The first layer is mechanically anchored to the surface and the second is attached by fire to the previous one. The details of placement of the layers around chimneys and attic are described in detail in drawings D.1.1.15 and D.1.1.17. The last layer is created by 106 mm of soil substrate with stonecrop or sedums plants.

C.7 Partitions

Partitions are executed from two layers of EKOPANEL. The panels are secured in position by screws and profiles which are recommended by producer of the panels. The technological prescription can be found at the producer’s web page. The joints of the panels are covered by gypsum screed and rubbed with sandpaper after hardening. The finishing layer is either done by regular paint Spectra or a wall paper glued on the partition. The glue used is Pufas EURO 3000 special.

C.8 Floor above the foundation

The main floor in the object is constructed on laths (40x50 mm) secured by metal L profiles and screws to the concrete slab. The gap is used for heat and water pipes and electricity wiring. On the lathing there are two layers of OSB (thickness 10 mm each) to create a bearing surface for the other layers. The OSBs are secured by 25 mm long nails. Separation foil is placed on the OSBs to create a protection against leakage of the self-nivelated screed to the gap below the OSB layer. For the 38 mm layer of screed is used Hasit self-nivelated screed. The minimum thickness of the layer has to be 30 mm so the requirement is fulfilled. There are two types of floor finishes used in the first ground floor. First type is ceramic tiles (kitchen, toilet room, bathroom, technical room, entrance) and the second it wooden oak floor. The adhesive used for ceramic tiles is Ceresit ELASTIC and maximal thickness is 5 mm. Foam pad Stalion 3 mm is used under the wooden floor.

C.9 Staircase

Stairs are designed as wooden custom made with 17 steps. The shape of the flight is in the letter L with no landing. The height of steps is 176.46 mm and the width is 250 mm. The height of the railing and balustrade is 900 mm. The pitch of the stair is 35°. The construction of the stair should be consulted by the carpenter. Also, the opening needs to be measured to ensure the dimensions needed for the construction of the stair. The stairs are light weight so they do not require any special foundation. They are only secured at the bottom by steel L profiles and suitable screws and at the top they can be screwed to the joist J2 and J4.

C.10 Openings

For the filling of the openings were used triple glazed windows Vekra Natura 94 with U_r= 0.7 W/m^2.K. For the production of the windows and doors is used oak timber. The same producer is used for doors. The entrance door used is Vekra Pardubice III. The windows and doors are aligned with the outer edge of the timber frame and secured by special steel plates used for this purpose. There is a necessity of adding stretchable

vapor permeable tape on the exterior side of the window and stretchable vapor proof tape on the interior side of the window. The way of anchorage and more details about assembly of the doors and windows is well shown in the detail drawing D.1.1.12. However, as the assembly of the windows and doors is very important for the overall thermal losses so it is highly recommended to leave the assembling process for the producer. There is 30 mm overlap of the exterior layer of EKOPANEL over the frame of the windows and doors to secure the thermal protection of the joints.

C.11 Chimney

There are two chimneys constructed. One is in the living room for connecting a fire place and the other one is in the technical room for connecting the gas boiler. The construction of the second chimney was designed upon the investor's request. There is new public gas network planned to build in the area and the investor would like to connect to it in the future. Until this time, there is electrical boiler with a water tank designed in the object. The system used for chimneys is Schiedel Absolut with single duct. The dimensions of the chimney are 360x360 mm with d=160 mm chimney flue. The fire place is connected to the flue by a special T shaped piece prefabricated for this use. The slope of the flue inlet is 60° towards the fire place. For further information it is possible to visit the web pages of the producer. The chimney heads have to be covered by copper roof to eliminate the possibility of the rain water getting inside the chimney. The second chimney is clogged with cloth and cone styrodur stop to eliminate the draft in the chimney. Porotherm brick strips TERCA – Blue Velvet are used as decorative layer of chimney part above the roof plane. The tinsmith around the chimney is carried out also. The height of chimneys is 7.2 m.

Conclusion

The project has focused on efficient usage of floor area so it suits the best for the purposes of the family and fulfilling of all the investor’s requirements. The materials used in this object are new, modern and ecological. They create and try to keep a healthy and natural interior environment. There have been some changes in the disposition of the kitchen and toilet and entrance room comparing to the study. These changes had to be made in accordance to create more room in the kitchen and the entrance room. The goal of this project was fulfilled as the out of this project is a realization documentation of a family residence.

List of used sources

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

Used standards

ČSN 73 4301 – Obytné budovy
ČSN 73 0580 – Denní osvětlení budovy
ČSN 73 0532 – Akustika, ochrana proti hluku v budových
ČSN 73 0540 – Tepelná ochrana budov
ČSN 01 3420 – Výkresy pozemních staveb – kreslení výkresů
ČSN 73 0802 – Požární bezpečnost staveb – Požadavky na požární odolnost stavebních konstrukcí

Webpages

www.schiedel.cz
www.tzb-info.cz
www.vekra.cz
www.isocell.at
www.pam.sk
www.killich.cz
www.decktrade.cz
www.ekopanel.cz
www.geocell.cz
www.kvkparabit.com
www.kjg.sk
www.youtube.com
www.optigreen.cz

Used software

AutoCAD 2010
ArciCAD 17
Artlantis Studio 5
Microsoft Office 2010
Teplo 2010

List of abbreviations

ČSN – česká státní norma
mm – millimeter
m – metr
no. – number
th. – thickness
U_r – heat transmission coefficient

List of attachments

FOLRER A – INTRODUCION AND REPORTS

1) INTRODUCION
2) A ACCOMPANYING REPORT
3) SUMMARY TECHNICAL REPORT
4) TECHNICAL REPORT

FOLDER B – STUDY

1) STUDY OF FIRST GROUND FLOOR
2) STUDY OF SECOND GROUND FLOOR
3) STUDY OF THE SECTIONS
4) STUDY OF THE VIEWS
5) STUDY OF THE 3D VIEWS

FOLDER C – SITUATION DRAWINGS

1) C.1 – SITUATION OF THE NEIGHBOURHOOD
2) C.2 – CADASTRAL SITUATION
3) C.3 – COORDINATION SITUATION

FOLDER D.1.1 – ARCHITECTUAL SOLUTION

1) D.1.1.01 – FLOORPLAN OF 1ST GROUND FLOOR
2) D.1.1.02 – FLOORPLAN OF 2ND GROUND FLOOR
3) D.1.1.03 – DRAWING OF SECTION AA’
4) D.1.1.04 – DRAWING OF SECTION BB’
5) D.1.1.05 – DRAWING OF ROOF
6) D.1.1.06 – VIEWS
7) D.1.1.07 – COMPOSITION OF FLOORS
8) D.1.1.08 –COMPOSITION OF ROOF AND WALL
9) D.1.1.09 – LIST OF DOORS
10) D.1.1.10 – LIST OF WINDOWS
11) D.1.1.11 – LIST OF TINSMITH WORKS
12) D.1.1.12 – DETAIL A
13) D.1.1.13 – DETAIL B
14) D.1.1.14 – DETAIL C

15) D.1.1.15 – DETAIL D
16) D.1.1.16 – DETAIL E
17) D.1.1.17 – DETAIL F

FOLDER D.1.2 – CONSTRUCTION SOLUTION

1) D.1.2.01 – FOUNDATIONS
2) D.1.2.02 – DRAWING OF CEILLING
3) D.1.2.03 – DRAWING OF TRUSS SYSTEM

FOLDER D.1.3 – FIRE SAFETY

1) D.1.3 – FIRE SAFETY REPORT
2) D.1.3.02 – SITUATION OF FIRE HAZARD

FOLDER E – THERMAL EVALUETION, GEOTECHNOCAL REPORT AND CALCULATION

1) THERMAL ENVELOPE CALCULATION
2) GEOTECHNICAL REPORT
3) CALCULATION OF STAIRS

Attachments

See the individual folders of the bachelor’s thesis Folder A, Folder B, Folder C, Folder D and Folder E.