



BRNO UNIVERSITY OF TECHNOLOGY
VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ



FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

DETACHED FAMILY RESIDENCE

RODINNÝ DŮM

BACHELOR'S THESIS
BAKALÁŘSKÁ PRÁCE

AUTHOR
AUTOR PRÁCE

MARTIN MIKUŠ

SUPERVISOR
VEDOUCÍ PRÁCE

Ing. **FRANTIŠEK VAJKAY, Ph.D.**

BRNO 2015



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	Martin Mikuš
Název	Detached Family Residence
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

prof. Ing. Miloslav Novotný, CSc.
Vedoucí ústavu



prof. Ing. Rostislav Drochytka, CSc., MBA
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, cíle práce, požadované výstupy)

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

Abstract

The subject of this work is the design of a detached family house in area Nove Domky near Jihlava in which natural construction materials were used. Instead of concrete or bricks, this building is designed with materials such as straw, rock, timber, clay, reed, hemp or sheep's wool. Furthermore, the work deals with methods of plumbing, electrical installations and heating. The possible utilization of natural energy resources or ecological processing of waste were also taken into account. The conclusion contains the financial comparison with a building where traditional and industrially produced materials are used.

Key words

detached family house, frame structure, straw, rock, timber, clay, hemp, sheep's wool, reed, Nove Domky, Jihlava

Abstrakt

Práca sa zaoberá návrhom rodinného domu pre 2 dospelé osoby s 2 deťmi v oblasti Nové Domky pri Jihlave, na ktorý boli použité prírodné stavebné materiály. Miesto betónu či tehly boli využité materiály ako slama, kameň, drevo, hlina, konope, rákos či ovčia vlna. Ďalej práca rozoberá spôsoby vedenie vody a električky či možnosti vykurovania objektu. Riešené sú i možnosti využitia prírodných zdrojov energie alebo druhy ekologického spracovania odpadu. V závere práce sa nachádza i finančné porovnanie stavby z prírodných stavebných materiálov oproti stavbe z priemyselne vyrábaných stavebných materiálov.

Klíčové slová

rodinný dom, rámová konštrukcia, slama, kameň, drevo, hlina, konope, ovčia vlna, rákos, Nove Domky, Jihlava

Bibliografická citace VŠKP

Martin Mikuš *Detached Family Residence*. Brno, 2015. 34 s., 126 s. příl. Bakalářská práce. Vysoké učení technické v Brně, Fakulta stavební, Ústav pozemního stavitelství. Vedoucí práce Ing. František Vajkay, Ph.D.

Declaration:

I hereby certify that I am sole author of this thesis and that no part of this thesis has been published or submitted for publication and that I have listed all information resources.

Prohlášení:

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

V Brně dne 28.5.2015



podpis autora
Martin Mikuš

Pod'akovanie:

Týmto by som rád pod'akoval vedúcemu bakalárskej práce Ing. Františkovi Vajkayovi, Ph.D. za ochotu a cenné rady ktoré mi poskytol pri riešení bakalárskej práce. Ďalej patrí moja vďaka rodine s priateľkou, ktorí ma vždy ochotne podporovali. V neposlednom rade by som chcel pod'akovať všetkým mojím spolužiakom z anglickej skupiny, ktorí majú veľkú zásluhu na tom, že túto prácu vôbec môžem písať.

Thanks:

I would like to thank my supervisor of bachelor thesis Ing. František Vajkay, Ph.D. for the willingness and valuable advice during the elaboration of the bachelor project. Furthermore my thanks goes on my family with girlfriend, who was always supporting me. Last but not least, I would like to thank my fellow students, without whom creation of this thesis wouldn't be possible.

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 28.5.2015



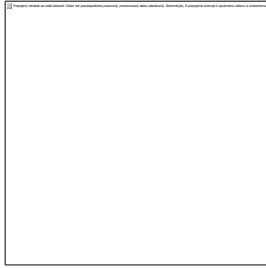
.....
podpis autora
Martin Mikuš

CONTENT

1. Introduction
2. A Accompanying report
3. B Summary Technical report
4. C Technical Report
5. Conclusion
6. List of used sources
7. List of used symbols
8. List of attachments

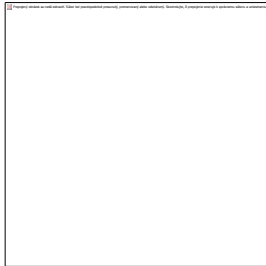
INTRODUCTION

The bachelor's thesis is aimed on the solution of construction of "Detached Family Residence" in form of project documentation. The house is intended for one family with two children. It is located on a flatly terrain parcel 795/18, cadastral area Velký Beranov located in Velky Beranov, in Vysočina district. The house is without basement and has two storeys, where the second floor is located only above the first one. The structural system used for load bearing external walls is timber frame filled with straw bales. Whole concept of the project was to design only those building materials, which would be really friendly to environment. As roof cover is reed projected under slope of 45° . The family residence is placed on large parcel with beautiful view to the surrounding nature.



BRNO UNIVERSITY OF TECHNOLOGY

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ



FACULTY OF CIVIL ENGINEERING

INSTITUTE OF BUILDING STRUCTURES

FAKULTA STAVEBNÍ

ÚSTAV POZEMNÍHO STAVITELSTVÍ

A - ACCOMPANYING REPORT

BACHELOR'S THESIS

BAKALÁŘSKÁ PRÁCE

AUTHOR
AUTOR PRÁCE

MARTIN MIKUŠ

SUPERVISOR
VEDOUCÍ PRÁCE

Ing. FRANTIŠEK VAJKAY, Ph.D.

BRNO 2015

CONTENT

A.1 Identification data

A.1.1 Information about the object

A.1.2 Information about investor

A.1.3 Information about supplier

A.2 The list of input documentation

A.3 Information about the plot

A.4 Information about the object

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

A.1 Identification data

A.1.1 Information about the object

- a) Name: Detached Family Residence
- b) Location: Nové Domky, cadastral area Velký Beranov, plot # 795/18
- c) Subject of the documentation : The subject is construction of new detached family house

A.1.2 Information about investor

- a) Name: Daniel Šmejkal
- b) Address: Tábor 15, 616 00 Brno, Czech Republic
- Phone: +420 123 456 789

A.1.3 Information about supplier

- a) Name of company: FAST VUT Brno, Veveří 95, 602 00 Brno
- b) Name of designer: Martin Mikuš, Lipová 86/33, 905 01 Senica

A.2 The list of input documentation

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

A.3 Information about the plot

- a) The plot # 795/18 in cadastral area Velký Beranov is in located 5 km from Jihlava, Area of plot is 998,36 m²
- b) There is no existing utilization of the plot. Surrounding plots are partially built-up, from one side there is only field with agricultural utilization.
- 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 paging the plot is leaving into the side of field.
- e) For locality of this object is valid municipal plan of town Rosice u Brna. This documentation is in compliance with the municipal plan
- j) There is no effect on surrounding plots

A.4 Information about the object

- a) It is new two-storey building without basement and no garage
- b) The building is meant to be area for living according to decree # 501/2006 Sb.
- c) The building is considered as permanent structure.
- 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 meets all the requirements of concerned authorities and follows the existing decrees and standards.
- g) There are no needs for any special exemptions.
- h) Built area: 998,36 m²
Paved areas: 69,96 m²
Floor area: 119,88 m²
The object is designed as one housing unit for family of four.
- j) Estimated date of start of construction is august 2018
- k) Estimated price of object is 2 500 000 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



BRNO UNIVERSITY OF TECHNOLOGY
VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ



FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

B - SUMMARY TECHNICAL REPORT

BACHELOR'S THESIS
BAKALÁŘSKÁ PRÁCE

AUTHOR
AUTOR PRÁCE

MARTIN MIKUŠ

SUPERVISOR
VEDOUCÍ PRÁCE

Ing. FRANTIŠEK VAJKAY, Ph.D.

BRNO 2015

CONTENT

- B.1 Description of the site territory
- B.2 Overall description of the object
 - B.2.1 Purpose of the object
 - B.2.2 Urban and architectural solution
 - B.2.3 Disposition solution and technology prescription
 - B.2.4 Usage by disabled people
 - B.2.5 Safety during serviceability of the building
 - B.2.6 Basic technical description of the structures
 - B.2.7 Basic characteristics of the building services
 - B.2.8 Fire safety solution
 - B.2.9 Principals in energy saving
 - B.2.10 Hygienic, working and communal environment requirements
 - B.2.11 Protection of the building against negative effects
- B.3 Connection to technical infrastructure
- B.4 Transportation solution
- B.5 Solution of vegetation and landscaping
- B.6 Description of building impact on the environment
- B.7 Protection of population
- B.8 Organizational principles during construction

B.1 Description of the site territory

- a) The parcel with specific number 795/18 in cadaster Velky Beranov, which is used for the construction of this object, is slightly sloped to almost flat with a maximal vertical gain approximately one meter. The shape of the plot is polygonal. While looking on north, there is possible to see upcoming new family residences on left and agriculturally used field.
- 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) The building will not have a negative impact on surrounding land. Rain water will be retained into sewerage.
- f) Before the beginning of construction it is necessary to cut the grass short. There are requirements for felling several trees which are situated on the construction site, but it is also possible to leave the trees growing.
- 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) There is public sewage pipeline, public water supply pipeline and mid voltage cables under the road. All infrastructures connections are possible to connect to the existing public infrastructures.
- i) The object is not limited with any special investments or special timetables. Before construction is necessary to carry out demarcation of existing networks in the area of construction.

B.2 Overall description of the object

B.2.1 Purpose of the object

Built-up area: 257, 25 m²

Paved areas: 69, 96 m²

Floor area: 119, 88 m²

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

B.2.2 Urban and architectural solution

a) 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 Jihlava.

b) Whole architectural concept of this project was to fit it into village style, using natural materials. As facade material was clay chosen, because of its natural look. Reed roof cover makes feeling to be somewhere near the forest.

B.2.3 Disposition solution and technology prescription

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

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 using stone mixed with Canabiote (mixture of hemp parts mixed together with calcium, which reach better thermal and strength properties as concrete). However it is not necessary to design any strips in soil, there are foundation strips of 600 mm width and 1150 mm depth. There is no reinforcement used. These types of foundations are also used to prepare foundation for stairs.

Vertical structures

All vertical structures are designed as timber frame. There are two lines of frame, one is internal timber frame, this one is holding ceiling above the ground floor, and external timber frame, which holds roof structure. Frames are made of timber columns 100 mm x 100 mm, which were designed from static calculations. Frames are filled with straw bales of sizes 400x500x600 mm, what has made the calculations and designing of a project a little bit more difficult. As a covering of the straw is clay plaster designed. Because of none heat capacity of the straw bales, it had to be taken into account and there was clay plaster of thickness 50 mm design. It makes the overall thickness of the wall on 600 mm. The partitions are made of timber frame structure, not designed as load bearing. Timber columns of thickness 60 mm and width 60 mm, in 600 mm layering system from each other and filled with Ekopanel block. As cover is fine grained clay plaster of thickness 10 mm designed. In case of partitions, where is plumbing needed, will be that partition made from two layers of Ekopanel (2x60 mm).

Horizontal structures

The slab above the first ground floor is constructed from timber joists (width 200 mm and height 250 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 soffit is made from timber tartan profile planks (thickness 15 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 rafters and nailing a decorative spruce tartan profile planks on the inner side of roof structure. However, there is an exception in the bathroom on the second floor. The soffit there is executed by humid resistant gypsum.

Roof structure

The house has a sloped roof in angle 45°. The roof cover is a reed. Roof construction is a wooden truss, saddle roof type combined with half-hipped roof. There is also pitched roof over the terrace. The main structural members are columns, rafters and tie beams, connected together with nails and threaded rods.

Windows and doors

There are designed triple glazed windows Makrowin 88 for better thermal protection. The entrance doors are also designed in accordance to energy savings and were chosen also the same type, Makrowin 88.

B.2.7 Basic characteristics of building services

There are two bathrooms, two toilet rooms and one kitchen in the building. One of the bathrooms and toilet 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. There are two regular wash basins, two small washbasin, one kitchen sink, two bathtub, two toilets, one washing machine and one dish washer in the object.

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

Construction is proposed in accordance with ČSN 73 0540-2 (Thermal Protection of buildings –part 2). Windows in the building are designed wooden with Triple glazing. The thermal transmittance of the window is $U = 0.6 \text{ W /m}^2 \text{ K}$. required by the standard heat transfer coefficient for the window and door of the heated space to the outdoor environment is $U_N = 1.7 \text{ W / m}^2 \text{ K}$. The roof structure will be insulated with hemp insulation of thickness 260 mm. Thermal insulation shall be protected against water vapor barrier TYVEK SOLID. The heat transfer coefficient proposed ceiling is $U = 0.13 \text{ W / m}^2 \text{ K}$. required by the standard heat transfer coefficient for the ceiling under unheated space is $U_N = 0.15 \text{ W /m}^2 \text{ K}$ for passive house.

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 fire place insert with water heat exchanger placed in the living 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

The vegetation and the landscape architecture are up to the investor as he personally asked for it. There are several trees which have 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 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 together with kitchen trash. 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. Municipal waste will be sorted by type (paper, plastics, and glass and beverage cartons) and stored in containers according to type of waste.

B.7 Protection of population

All the necessary requirements are fulfilled.

B.8 Organizational principles during the construction

It is important to build the water and an electricity connection 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.



BRNO UNIVERSITY OF TECHNOLOGY
VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ



FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

D – ARCHITECTURAL SOLUTION

TECHNICAL REPORT

BACHELOR'S THESIS
BAKALÁŘSKÁ PRÁCE

AUTHOR
AUTOR PRÁCE

MARTIN MIKUŠ

SUPERVISOR
VEDOUCÍ PRÁCE

Ing. FRANTIŠEK VAJKAY, Ph.D.

BRNO 2015

CONTENT

- D.1 General information about the object
- D. 2 Area setup and excavation works
- D.3 Foundations
- D.4 Vertical structures
- D.5 Horizontal structures
- D.6 Roof structure
- D.7 Terrace
- D.8 Floor finishes
- D.9 Staircase
- D.10 Openings
- D.11 Chimney

D.1 General information about the object

D.1.1 Information and parameters of the object

- Title: Detached family residence
- Location: Nové Domky (plot # 795/18)
- Investor: Daniel Šmejkal
- General contractor: FCE VUT Brno
- Planner: Martin Mikuš
- Built area: 257,25 m²
- Floor area: 119,88 m²
- Built in space of house: 640 m³
- Paved areas: 69,96 m²
- No. of floors: 2

D.1.2 Architectonic and dispositional 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 Jihlava.

Whole architectural concept of this project was to fit it into village style, using natural materials. As facade material was clay chosen, because of its natural look. Reed roof cover makes feeling to be somewhere nears the forest.

D.1.3 Basic characteristics of the object

The bachelor's thesis is aimed on the solution of construction of "Detached Family Residence" in form of project documentation. The house is intended for one family with two children. It is located on a flatly terrain parcel 795/18, cadastral area Velký Beranov located in Velky Beranov, in Vysočina district. The house is without basement and has two storeys, where the second floor is located only above the first one. The structural system used for load bearing external walls is timber frame filled with straw bales.

Whole concept of the project was to design only those building materials that would be

really friendly to environment. As roof cover is reed projected under slope of 45°. The family residence is placed on large parcel with beautiful view to the surrounding nature.

D.2 Area setup and excavation works

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. Earthworks start with removing of topsoil over the area of future building. The thickness of layer is expected around 200 mm. The soil will be stored on the construction site and the investor (builder) will use it for garden creation after finishing of construction. Excavations works are based on digging of trenches for foundation strips. The depth is given by design into non-freezing zone approximately 1000 mm. In the case of groundwater seepage into the trench excavation is necessary to protect the wall by sheeting and drain out the water from it. Installation of connection networks will be carried out and laying of pipelines and cables before construction of foundation.

D.3 Foundations

Foundations are designed according to current standards. Designed foundations are strip foundations made of using stone mixed with Canabiote (mixture of hemp parts mixed together with calcium, which reach better thermal and strength properties as concrete). However it is not necessary to design any strips in soil, there are foundation strips of 600 mm width and 1150 mm depth. There is no reinforcement used. These types of foundations are also used to prepare foundation for stairs.

D.4 Vertical structures

All vertical structures are designed as timber frame. There are two lines of frame, one is internal timber frame, this one is holding ceiling above the ground floor, and external timber frame, which holds roof structure. Frames are made of timber columns 100 mm x 100 mm, which were designed from static calculations. Frames are filled with straw bales of sizes 400x500x600 mm, what has made the calculations and designing of a project a little bit more difficult. As a covering of the straw is clay

plaster designed. Because of none heat capacity of the straw bales, it had to be taken into account and there was clay plaster of thickness 50 mm design. It makes the overall thickness of the wall on 600 mm. The partitions are made of timber frame structure, not designed as load bearing. Timber columns of thickness 60 mm and width 60 mm, in 600 mm layering system from each other and filled with Ekopanel block. As cover is fine grained clay plaster of thickness 10 mm designed. In case of partitions, where is plumbing needed, will be that partition made from two layers of Ekopanel (2x60 mm).

D.5 Horizontal structures

The slab above the first ground floor is constructed from timber joists (width 200 mm and height 250 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 soffit is made from timber tartan profile planks (thickness 15 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 rafters and nailing a decorative spruce tartan profile planks on the inner side of roof structure. However, there is an exception in the bathroom on the second floor. The soffit there is executed by humid resistant gypsum.

D.6 Roof structure

The house has a sloped roof in angle 45°. The roof cover is a reed. Roof construction is a wooden truss, saddle roof type combined with half-hipped roof. Because reed is not completely waterproof, it had to be taken in account to design layer of reed in bigger thickness. Minimal thickness is 300 mm but in my project given 350 mm on safety side. Under reed layer are two layers of lathing, one in longitudinal direction, second layer in perpendicular direction. Under these layers is waterproofing ISOVER Solid designed. Thermal insulation made of hemp, is filled between rafters 90x180mm. To resist a problems with vaporization it is designed Isover VARIO KM Duplex UV. As finishing layer is timber tile of thickness 15 mm designed.

D.7 Terrace

Terrace is the connection of the building with the garden. It is placed in the eastern side of the building. The terrace is finished with polywood decking. The material of the decking profile Grenadeck is dyed in bulk, i.e. the material displays and preserves the same solid color tone in case of surface scratches or damage. Grenadeck also subjects to natural shading (known as wooden patina) - due to the presence of sawdust, the color fades over time. Fading takes several weeks to months and then retains throughout the product's lifetime. This effect is the same for all wood products. Natural exposure may roughen the surface of the floor profile Grenadeck.

D.8 Floor finishes

D.8.1 Finishes on 1st floor

Floor composition of the first ground floor consists sheep wool between timber planks above the foundation strips. This insulation requires dilatation of humidity, because its property, gyrosopic, could absorb the humidity and don't act as insulation anymore. Above this layer are 50 mm robust planks projected. This layer acts as zero layer for frame system of external wall. As insulation is designed floor insulation desks from hemp of thickness 50 mm. above it is double layer of OSB desks designed. First, 18 mm robust act as distributive layer for the insulation, second, 12 mm act like treading layer to spread forces vertically. Near the walls is 10 mm strip of insulation material given as separation of shaking between vertical and horizontal structure (otherwise could be vibrations transmitted into whole frame structure). As top layer is wooden parquet designed but it can be changed due to wishes of investor.

D.8.2 Finishes on 2nd floor

Floor composition and finish on second floor is the same as on first ground floor except top layer. This is in 2nd floor projected as even more vibration reducing variant, carpet with thickness of 20 mm. On both floors is considered also floor finished in bathrooms, where are ceramic tiles designed.

D.9 Staircase

Stairs are designed as wooden custom made with 17 steps. The shape of the flight is in the letter U with no landing. The height of steps is 172 mm and the width is 255 mm. The height of the railing and balustrade is 900 mm. The pitch of the stair is 34°. 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.

D.10 Openings

Window openings are provided with triple glazed windows Makrowin 88. This is a plastic window with excellent insulation properties designed for low-energy and passive houses with 88mm construction depth. The window has improved thermal and acoustic insulation properties. The heat transfer coefficient of whole window is 0,6 W/m².K. The designed entrance door is Makrowin 88 from timber. The door has high stability and optimal thermal insulation. There is triple insulated glazing. The heat transfer coefficient is 0,6 W/m².K. There are also entrance door to the ground floor terrace. The door is also Makrowin 88 and used the same system as on windows. All interior doors are wooden ERKADO Broadway with the wooden frame.

D.11 Chimney

There is one chimney constructed. It is in the living room for connecting a fire place. The system used for chimneys is Schiedel Absolut with double duct. The dimensions of the chimney are 800x400 mm with d=200 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 tinsmith around the chimney is carried out. The height of chimneys is 9,8 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. Second aim of this project was also to show, that to design any project is not everytime connected with concrete, but exist also some substitutions for it. There have been some changes in the disposition which brought me to use the space of internal part of house more efficionaly and correctly. The goal of this project was fulfilled as the out of this project is a realization documentation of a family residence.

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.slamenka.cz/>

straw material

<http://www.hoxter.eu/>

inserts fire place

<http://www.korenova-cisticka.cz/>

ecological solution

<http://www.tzb-info.cz/>

norms

<http://www.isover.cz/>

waterproof and vapour barrier

<http://www.drevostavitel.cz/>

roof structure

<http://www.101vykresov.sk/>

roof structure

<http://www.makrowin.sk/>

windows and doors

http://www.ozartur.sk/	wall composition
http://www.mojdom.sk/	nature building materials
http://www.rakosovestrechy.cz/	roof structure
http://geoportal.cuzk.cz/	maps
http://www.cuzk.cz/	cadastre
http://www.prirodnstavba.cz/	Ekopanel
http://www.ekopanel.sk/	Ekopanel
http://www.bucina-ddd.sk/	OSB desk
http://www.drevomat.sk/	timber elements

Software used

Microsoft Office 2010

AutoCAD 2014

ArchiCAD 18

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

Attachments

Folder B – Architectural study

- B.1 Floor plan – Ground Floor
- B.2 Floor plan – First Floor
- B.3 Sections
- B.4 Elevations
- B.5 3D Visualization

Folder C – Site plans

- C.1 Situation of further relations
- C.2 Overall siteplan
- C.3 Site Coordination plan

Folder D

D.1.1.b Architectural-structural solution

- D.1.1.01 Ground floor plan
- D.1.1.02 First floor plan
- D.1.1.03 Roof plan
- D.1.1.04 Section A-A'
- D.1.1.05 Section B-B'
- D.1.1.06 Elevations
- D.1.1.07 Detail of wall to foundation connection
- D.1.1.08 Detail of internal wall to floor structure connection
- D.1.1.09 Detail of window with roof to wall connection
- D.1.1.10 Door schedule
- D.1.1.11 Window schedule

D.1.2.b Structural solution

- D.1.2.01 Foundation plan
- D.1.2.02 Ceiling plan of ground floor
- D.1.2.03 Ceiling plan of first floor
- D.1.2.04 Roof structure plan
- D.1.2.05 Wall frame structure plan and elevations

D.1.3 Fire Safety

- D.1.3.01 Fire safety report
- D.1.3.02 Plan of fire safety distances

Folder E – Building physics

- E.1 Calculation of stairs
- E.2 Thermal evaluation of building envelope