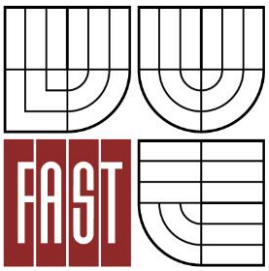
VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
BRNO UNIVERSITY OF TECHNOLOGY



FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

DIPLOMOVÁ PRÁCE
DIPLOMA THESIS

AUTOR PRÁCE — BC. PAVEL SUBALLY
AUTHOR

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

BRNO 2016

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
FAKULTA STAVEBNÍ

Studijní program	N3607 Civil Engineering
Typ studijního programu	Navazující magisterský studijní program s výukou v anglickém jazyce s prezenční formou studia
Studijní obor	3608T001 Pozemní stavby
Pracoviště	Ústav pozemního stavitelství

ZADÁNÍ DIPLOMOVÉ PRÁCE

Diplomant	Bc. Pavel Subally
Název	Univerzitní knihovna
Vedoucí diplomové práce	Ing. František Vajkay, Ph.D.
Datum zadání diplomové práce	31. 3. 2015
Datum odevzdání diplomové práce	15. 1. 2016

V Brně dne 31. 3. 2015

.....	.....
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, Stavební zákon č. 183/2006 Sb., Zákon č. 350/2012 Sb., Vyhláška č. 499/2006 Sb., Vyhláška č. 62/2013 Sb., Vyhláška 268/2009 Sb., Vyhláška 398/2009 Sb., platné ČSN, směrnice děkana č. 19/2011 a dodatky

Zásady pro vypracování

Zadání VŠKP: Projektová dokumentace stavební části k provedení novostavby univerzitní knihovny.
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 (textová část projektové dokumentace dle vyhlášky č. 499/2006 Sb. ve znění vyhlášky 62/2013 Sb.) a položku j) Závěr (zhodnocení obsahu VŠKP, soulad se zadáním, změny oproti původní studii).
Příloha textové části VŠKP v případě, že diplomovou 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 včetně zadané specializované části. O zpracování specializované části bude rozhodnuto vedoucím DP v průběhu práce studenta na zadaném tématu.

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).

3.

.....

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

Abstrakt

Táto diplomová práca sa zaoberá návrhom univerzitnej knižnici v meste Brno. Objekt je navrhnutý ako viac podlažná budova vrátané podzemných podlaží. Návrh je vytvorený na základe požiadaviek investora a zaoberá sa architektonickým, stavebným ale aj technickým riešením objektu. Cieľom je vytvoriť nie len moderné kultúrno-vzdelávacie centrum ale aj miesto oddychu a zábavy pre študentov Vysokého Učení Technického. Pri návrhu sa berie do úvahy aj požiadavka na sprístupnenie hromadných priestorov ako je prednášková sala alebo miestnosti pre výučbu verejnosti.

Klíčová slova
knižnica, skelet, betónový skelet, zavezená fasáda, Brno, VUT, plochá strecha, biela vaňa, predpätý betón, predpäté stropy, predpäté prievlaky

Abstract

The content of this diploma project is to design an university library in the city of Brno, Czech Republic. The object is designed as multistory building with underground stories included. The design is created based on requests brought by the investor and includes architectural, constructional and technological proposes for the building. The aim is to create not only a modern cultural and educational center but also a place of entertainment and relax for students of Vysoké Učení Technické. During the design it is taken in an account the request of having the auditorium and lecture rooms available for public, also

Keywords
Library, frame, concrete frame, curtain wall, Brno, VUT, flat roof, white bath, prestressed concrete, prestressed slabs, prestressed girders

Bibliografická citace VŠKP

Bc. Pavel Subally *Univerzitní knihovna.* Brno, 2016. 33 s., 185 s. příl. Diplomová práce. Vysoké učení technické v Brně, Fakulta stavební, Ústav pozemního stavitelství. Vedoucí práce Ing. František Vajkay, Ph.D.

Prohlášení:

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

V Brně dne 7.1.2016

……

podpis autora
Bc. Pavel Subally

PROHLÁŠENÍ O SHODĚ LISTINNÉ A ELEKTRONICKÉ FORMY VŠKP

Prohlášení:

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

V Brně dne 7.1.2016

……

podpis autora
Bc. 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

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
FAKULTA STAVEBNÍ

POPISNÝ SOUBOR ZÁVĚREČNÉ PRÁCE

Vedoucí práce	Ing. František Vajkay, Ph.D.
Autor práce	Bc. Pavel Subally
Škola	Vysoké učení technické v Brně
Fakulta	Stavební
Ústav	Ústav pozemního stavitelství
Studijní obor	3608T001 Pozemní stavby
Studijní program	N3607 Civil Engineering
Název práce	Univerzitní knihovna
Název práce v anglickém jazyce	University Library
Typ práce	Diplomová práce
Přidělovaný titul	Ing.
Jazyk práce	Čeština
Datový formát elektronické verze	
Anotace práce -	Táto diplomová práca sa zaoberá návrhom univerzitnej knižnici v meste Brno. Objekt je navrhnutý ako viac podlažná budova vrátané podzemných podlaží. Návrh je vytvorený na základe požiadaviek investora a zaoberá sa architektonickým, stavebným ale aj technickým riešením objektu. Cieľom je vytvoriť nie len moderné kultúrno-vzdelávacie centrum ale aj miesto oddychu a zábavy pre študentov Vysokého Učení Technického. Pri návrhu sa berie do úvahy aj požiadavka na sprístupnenie hromadných priestorov ako je prednášková sala alebo miestnosti pre výučbu verejnosti.
Anotace práce v anglickém jazyce	The content of this diploma project is to design an university library in the city of Brno, Czech Republic. The object is designed as multistory building with underground stories included. The design is created based on requests brought by the investor and includes architectural, constructional and technological proposes for the building. The aim is to create not only a modern cultural and educational center but also a place of entertainment and relax for students of Vysoké Učení Technické. During the design it is taken in an account the

	request of having the auditorium and lecture rooms available for public, also
Klíčová slova	knižnica, skelet, betónový skelet, zavezená fasáda, Brno, VUT, plochá strecha, biela vaňa, predpätý betón, predpäté stropy, predpäté prievlaky
Klíčová slova v anglickém jazyce	Library, frame, concrete frame, curtain wall, Brno, VUT, flat roof, white bath, prestressed concrete, prestressed slabs, prestressed girders

Content:

Introduction

This study solves a preliminary design of a faculty library located in Brno, Czech Republic. The object is situated only 10 minutes of waling from school. However, the project is named library it also contains auditorium, lecture rooms, computer and group study rooms, leisure area for students and a bookstore. The reason for construction of such an object is to give a new and modern place to study and a place to spend their free time between the lectures. Also, the construction of a new library will allow an additional expansion of the school because the library will be moved out and it’s area reconstructed fas new lecture rooms.

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

DIPLOMOVÁ PRÁCE
DIPLOMA THESIS

AUTOR PRÁCE — BC. PAVEL SUBALLY
AUTHOR

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

BRNO 2016

Content:

A.1 Identification

A.1.1 Information about the project

Name: University library

Location: Brno-Veveří, cadaster Brno, parcel number 251/3

A.1.2 Information about the investor

Name: FAST VUT

Address: Veveří 331/95, Brno 601 90

Phone #: +420 541 141 111

A.1.3 Information about the designer

Name: Bc. 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 service sconnections in the area.

A.3 Plot information

The object is located on two different ground plot. Both plots are in the Brno-Veveri cadastral district. The first ground plot with a specific number 251/7 has area 5724 meters squared is mostly covered with concrete or asphalt forming (together with some surrounding parcels) a parking lot for the near by grocery store. Only a small portion of the ground plot is going to be used for the construction of the object. The second ground plot has a specific number 251/3 and area 2233 meters squared. It is mostly covered by panels and at this moment it is divided by a fence to disable the customers of the grocery store to park there. Both plots has mildly rought almost flat. There is a retailing

wall from south-east, east and north east to ensure the flatness of the plot. There is also a mild greenery growing on the plot which will be together with the panels and asphalt removed before construction. Both plots has the same owner. Kounicova street will be used as an entrance road for the construction. It is two lane main road with sidewalks and bike trails on both sides. There are all necessary services and pipes built on the Kounicova street also. There are no legal obstacles on the parcel. The slope of the hill is oriented south east. The overall elevation of the plot regarding the sea level is 276m.a.s.l. The surrounding structures are constructed in various architectures from post war area to functionalistic architecture. The future complex of academical buildings creates a nice and itegrated group of buildings and therefore doesn't disturb the environment.

A.4 Object information

The purpose of this completely new building is to provide an additional storage for books and student works as well as nice and pleasant institution of knowledge not only for students. The live expectation of the building is at least 80 years. There are no legal obstacles or protections on the plot or area. The access for disabled people is necessary and therefor provided. There are 3 floors and 1 underground floors designed. The object is suitable as for public purposes, purposes of school and educating and also for self-studying of students.

Total built - in area	612,56 m^2
Built - in volume	11140,67 m^3
Total useable area	m^2
Usable area of the 1st underground floor	m^2
Usable area of the 1st ground floor	m^2
Usable area of the 2nd ground floor	
Usable area of the 3th ground floor	
# of public accessible areas	8
# people	400

A.5 The division of the object in parts

The construction is divided into 7 objects according to the coordination situation. There are: LIBRARY, SURROUNDING PAVEMENTS RETAINING WALLS, PARK,

UNDERGROUND GARAGE, SEWAGE CONNETION, HEATING WATER CONNETION, 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

DIPLOMOVÁ PRÁCE
DIPLOMA THESIS

AUTOR PRÁCE — BC. PAVEL SUBALLY
AUTHOR

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

BRNO 2016

Content:

B.1 Description of the plot

The object is located on two different ground plot. Both plots are in the Brno-Veveri cadastral district. The first ground plot with a specific number 251/7 has area 5724 meters squared is mostly covered with concrete or asphalt forming (together with some surrounding parcels) a parking lot for the nearby grocery store. Only a small portion of the ground plot is going to be used for the construction of the object. The second ground plot has a specific number 251/3 and area 2233 meters squared. It is mostly covered by panels and at this moment it is divided by a fence to disable the customers of the grocery store to park there. Both plots are mildly rought almost flat. There is a retaining wall from south-east, east and north east to ensure the flatness of the plot. There is also a mild greenery growing on the plot which will be together with the panels and asphalt removed before construction. Both plots has the same owner. Kounicova street will be used as an entrance road for the construction. It is two lane main road with sidewalks and bike trails on both sides. There are all necessary services and pipes built on the Kounicova street also. There are no legal obstacles on the parcel. The slope of the hill is oriented south east.

B.2 General description of the object

B.2.1 Purpose of the object

The purpose of this object is to create a modern institution of education and development for young engineers and scientists as well as an institution of entertainment, relax and social development. Also the object serves as public facility for various lectures or speeches.

B.2.2 Urban and architectural solution

The object is very well located in the vicinity of the faculty. The walking distance to the building from the faculty is about 15 minutes which is enough for student to walk there and beck between the classes. The other mean of transportation in the vicinity are the trolley

bus(3 minutes), tram (1 minute) or a car. There is an underground garage designed for parking cars. The capacity of garage should be not less than 150 cars. The object on the corner of Pekarska and Kounicova street. This location enables full exposure to the sun which is very useful in winter. There are numerous facilities in vicinity of the object which student can use while going to library and back. Some of them are restaurants, grocery stores or pubs. The object itself is designed with squared floorplan. The initial design was taken from the rubic cube but only the floor plan and color variety transformed from it. The object is split into 4 floors. First floor, the very bottom floor is used as a greeting floor dedicated to people who come to visit the library or people who simply want to enjoy some coffee. There is a coffee shop, faculty bookstore, coat hangers, lockers and administrative offices located in this floor. The second floor, also referred as library floor is dedicated to student's education. There are study tables, book shelves and computer tables designed on this floor. The disposition of the floor is very open so in case there is a need of transformation of the building in the future for a different purpose it is very easy to erect any kind of structures to divide the disposition in needed way. On the last (third) floor are located group study rooms, lecture room and computer area for the students. The lecture room is suitable for 36 to 40 people and the 6 group study rooms are suitable for about 50 people. Every room is equipped with a conference table, chairs and a tv with a cable. The overall disposition of furniture has to be approved by an interior architect before final approval. The study area is in the north corner of the building separated by a low partition. There are three different staircases. One is dedicated to the office area for an easy access to the archive. Secondary staircase is used for the staff and as evacuation route. The area with this staircase also includes the evacuation elevator. The main staircase is located in the middle segment of the structure. It is 1300mm wide and suitable for both way traffic. The stair is 3 flight stair with couple of elevators in the middle. The evacuation elevator is suitable for 13 people at maximum where the main elevators are capable of transporting 8 people at once.

B.2.3 Overall operational solution

Every floor of the object is designed for a different purpose. The main idea was to divide the traffic of staff from the public traffic. Therefore the staff has their separate secondary entrance. In the entrance room is secondary staircase starting in the first ground floor and ending in the third. The room also includes an evacuation elevator operating all four floors. From this staff connecting area is possible to get easily to

every floor. Administration area contains two offices, meeting room, kitchen, restroom and an archive staircase. The public sector in the first ground floor includes coat hangers, lockers, coffee shop and a book store. The main entrance to object is located from Pekarska street. Right after entering there is a foyer with a dirt rug designed. The big connecting area also referred to as a lobby is equipped with reception and doors to every room mentioned above. Easy access to coat room and lockers provides a confortable way of leaving unneeded belongings on a safe place. The faculty book store is located in the north part of the object and is also equipped with a reception. The book store has it's own entrance possible to use as an escape way also. Coffee shop is located right next to the entrance and is also designed with it's separate entrance for convenient and confortable entering. the coffee shop is designed for 30 people appproximatelly (depending on interior design). Lobby is large and spacious for two main reasons. It's meant to be used as a waiting area with confortable seats and as a potential gallery area for various exhibitions. At the end of the lobby is wet area. This area includes men and women toilets. Every restroom is designed with accessible toilets. The main staircase is located in the middle of the building therefore the access to any place in the building is really easy. On the second floor is a huge library area with table designed around the perimeter and shelves designed around the core. If needed the library area can be easily reconstructed to offices for instance. There are 3 exits from the staircase area to the library. The second floor also includes the wet area mentioned before. Third floor is dedicated to group studying, lecturing and computer skill development. There are 6 group study rooms located in the south of the floor plan. Partition used for the rooms are fully glazed so the room don't feel so small. The computer lecture room is suitable for about 36 people. The floor includes the wet area as well. Parking is solved as a separate building object.

B.2.4 Usage by disabled people

The building is fully operational by disabled people. Every access to the building is lowered and stepless. The access for disabled people is from Veveri street where there is no need to overcome a height difference between the plot and adjacent street. Every entrance door and surrounding pavements are disabled people accessible. The further design of the passage from Veveri street to the object will be introduced in later

development of the area. The interior of the building is completely disabled accessible. There are no thresholds in the door ways and no additional steps which would be in the way of a disabled person. All doors are at least 900mm with 1500mm turning circle around. All restrooms are designed with one restroom for disabled people. The vertical movement is secured with two elevators in the middle block of the building.

B.2.5 Safety during usage

There are no special requirements for safety during usage.

B.2.6 Basic characteristics of the object

Foundations

There are 2.5x2.5m foundation pads below the columns and 600mm wide foundation strips under the walls. Pads are made of reinforced concrete and the strips are made of plain concrete. Due to the height of the object a further review of structural and geotechnical engineer is needed. The water tightness of the envelop is secured with asphalt felt hydro insulation. The material is applied on the whole perimeter of the underground structure. Studded film is applied on the top to protect the insulation from mechanical damage.

Hydro insulation

Material used for water proofing of the underground structure is asphalt felt. The basememtn walls are first treated with asphalt coating for increasing the adhesion and then the felts are applied. Fire welding is used for connecting the felts to the structure. The felt is then protected by a layer of 20mm thick studded film. As a last layer a non wool textile is applied on the surface securing the soil from the film. The roof hydro insulation is applied in two layers. First layer is anchored with dowels through the polystyrene and the second layer is fire melted to the previous one. This way a really water tight envelope can be created.

Vertical load bearing elements

The building is designed as reinforced concrete frame with 3 fields. The columns are squared with 500mm side. The axial distance for the columns is 8000mm. The columns need to be designed and reviewed by a professional. The continuous length of the

columns is 30000mm. There are peripheral load bearing walls in the basement of thickness 250mm supporting the slabs and girders. The structural height is 4200mm in the above ground floor and 3300mm in underground floors. The main stair is 3 flights stair designed from reinforced concrete. The secondary stair is also 3 flights and designed from reinforced concrete. The width of the main stair is 1300mm and the secondary 1000mm. The archive stair has width of 900mm and is also designed as reinforced concrete. Concrete used for the columns and walls is C30/35. The design of vertical load bearing elements has to be further reviewed by a structural engineer.

Horizontal load bearing elements

The horizontal load bearing elements are designed as prestreessed concrete slabs of thickness of 300mm. The slabs are both ways reinforced and supported are supported by 400 by 500mm girders in the interior of the object. On the perimeter of the objects are girders 800x500 made of reinforced concrete. The clear span of the girders is 7500mm and clear span of the slabs both ways are 7600mm. The design of the horizontal elements needs to be further designed and reviewed by professional.

Roof

The roof is supported by prestressed concrete slab. The attic walls are made of reinforced concrete and its height is 1000mm. The connection to prestressed slab is done by special type of isokord. The roof is designed as flat roof with unified slope of 2.5%. There are four inlets on the roof, one roof access and safety anchors on the top of the roof. The final layer of the roof is wash out gravel which also ensures a protection and weight for the waterproof layer. The waterproof layer is designed from two layers of asphalt felts. There is a layer of 160mm of polystyrene in the lowest place of the roof. This layer is sufficient for the thermal envelope evaluation.

Thermal insulation

The insulation in roof is designed from expanded polystyrene. The unified thickness of polystyrene is designed with extra polystyrene in shape of sloping wedges. There is additional 1000mm deep strip of polystyrene around the base of the building. The

thermal insulation of the façade is 1.0W.K.m2 therefor ensuring sufficient thermal protection for this type of structure and no extra insulation is needed.

Windows and doors

There are no windows in the façade because it is designed as curtain wall with no open able windows. There are four doors in the façade. One is sliding door of width 1600mm used as main entrance to the building; the secondary entrance is 900mm door. The other two doors are 900mm wide and are used for the shops.

B.2.7 Basic characteristic of the building services

There one wet area in every floor. The areas are stacked above each other and have the same disposition. This way it is easy to connect all the pipes to one downpipe. The downpipe ends in the first underground floor where it goes to the public sewage system. The main floor has one other toilet and janitor closet for the coffee shop and the bookstore. Another toilet is in the office area reserved for the administration staff. The Administration area also includes a small kitchen area with a sink, a dishwasher, A stove, and a fridge. The main water pipe goes in the same service shaft as the sewage pipe. The distribution to individual equipment is done below the slab (above the soffit). The ventilation and fire water downpipe are also located in the same shaft. The shaft is fire protected and creates an individual fire compartment. All service rooms are located in the first underground floor. The building services has to be further designed by the specialists

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 mechanical ventilation. The mechanical room for ventilation is located in the first underground floor. The main ventilation pipe is located in the service shaft. The object is heated by the ventilation air as well. For 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. The further consultation of building services with individual experts is necessary.

B.2.11 Protection of the building against negative effects

The object is well protected against radon. No other protections are needed. Also, the roof is weighted by washout gravel for protecting against wind.

B.3 Connection to the infrastructure

There are three connections constructed in the object. First one, the water connection (BO.06) is 14.7 m long with water shaft 3.8 meter from the edge of the parcel; second one, sewage connection (BO.05) is 15.1 m with one 30° bend located in the revision shaft. The sewage connection is connected with the public network under 60°. The third connection is the electricity connection (BO.07) and its length is 17.5 m. The box with the main closing valve is placed 2.5 m from the building next to the designed pavement. The electricity and water main are below the sidewalk closer to the plot and sewage is in the middle of the road.

B.4 Transportation solution

The plot is very easily accessible from every side. The biggest road Kounicova street is wide two lane road with bike trails and sidewalks on both sides and with parking places on the closer side. The smaller road Pekarenska road is wide one way road going from Veveri to Pekarenska. The street includes sidewalk and parking places on both sides of the road. However the secondary entrance/exit is need to be established from Kounicova street. The main entrance is from Veveri street through already existing entrance to the

area. The truck flow suggested is as follows; Entrance on Veveri street and exit on Kounicova street.

B.5 Vegetation and terrain solution

There is no major vegetation at this plot. The panels places there at this moment need to be removed and stored in the construction side. They will be recycled with other construction waste and used as backfills and subgrade for pavements. The landscape visualization is only for better representation of future environment. A hand of landscape architect is necessary.

B.6 Description of the environmental effect of the building

The object does not have any major negative effect on the environment. It is non-production facility and there for the only waste produced there is sewage waste and general trash. The sewage waste is led away by the sewage piping and the general trash is collected in the trash containers next to the buildin (see C.3 Coordination situation). There will be three trashcans located one for general trash, one for paper and one for plastic. There will be numerous trash cans around the building for confortable trash collecting. The rain water will be collected in the underground reservoir and used for later watering the plants or any other technological procedures.

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 begin. 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. Due to flat surface of the location it is recommended to start the

construction at the beginning of spring when the rains are not expected. In case of flooding the construction pit it is needed to use water pumps for dewatering of the pit. 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. The construction waste will be separated so the further recycling can be possible. Separation should be divided into timber, plastic and sewage. Timber waste timber waste should be collected and either reused or turned at the recycling plant. 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

DIPLOMOVÁ PRÁCE
DIPLOMA THESIS

AUTOR PRÁCE — BC. PAVEL SUBALLY
AUTHOR

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

BRNO 2016

Content:

C.1 General information about the object

Investor:	FAST VUT, Veveri 331/95, 20600
Location:	Brno-Veveří, cadaster Brno, parcel number 251/3
Build-in area:	612,56 m^2
Useable area:	m^2
Build-up volume:	10480.13 m^3
Total height:	13.6 m
No. of floors:	3 floors (1 underground)

C.2 Earthworks

At the very beginning it is necessary to raise up a temporary fence around the construction site to protect it from unwanted visitors and public. Secondly, the fence needs to be disassembled and piled on the free space on the site. The panels need to be removed and also places on the site and stored for further recycling. The building is then setted out by geodesist who marks out the perimeter of the structure. Then the excavator take place and excavate the fountarion pit. The walls of foundation pit have to be under slope of 60 degrees so the retaining walls don't have to be used. The foundation pit is 800mm bigget to every side as the structure for easier access to the exterior of the basement wall and therefore the easier execution of hydroinsulation work. After excavating the foundation pit the geodesist setts out the location of foundation pads. The foundation pads are excavated. The depth of the pit is 3700mm below the project zero. The depth of the foundation pads is the same. There is no additional retaining necessary unless the soil shows to be too cohesive. The excavated soil will be removed from the site to a local damp. The whole process is very important and there for it has to be monitored by a geodesist thought out the whole process. The 0,000 of the object is in the level of 234.000ma.s.l.

C.3 Foundations

There are two types of foundations designed. First type is the foundation strips placed below the basement walls. The width of strips is 600mm and the depth is 1200mm.

When the soil shows to have insufficient load bearing capacity then bentonite suspension will be injected into the soil increasing the bearing capacity. The strips are casted from plain concrete of grade 30/35. The foundation pads are in the same depth as the strips and are casted reinforced concrete pads. The same rules apply for the foundation pads as described for the foundation strips. The soil has to be strengthen with bentonite suspension if a low load bearing capacity is discovered. The foundation slab is placed onto the existing soil and has thickness of 300mm. Only a distribution reinforcement is needed in the composition of the slab. Supervision of geotechnical engineer is necessary.

C.4 Vertical load bearing structure

There are two types of vertical load bearing structures. The columns have dimensions of 500 by 500mm and are made of reinforced concrete. The concrete used for the columns is grade C30/35 and the reinforcement is given by the structural design. The columns are continuous from the underground floor all the way to the roof top. The concrete cover should be no less than 30mm due to fire safety. The columns are placed on the foundation pads. The basement wall is 250mm thick load bearing wall made of reinforced concrete. The reinforcement of the wall should be specified by the structural engineer. However due to the fire safety design the minimal cover has to be 30mm. The bracing walls are 250mm thick also

C.5 Horizontal load bearing structure

As horizontal load bearing structures were designed presstressed concrete slabs. This technology was used due to the relatively long span. The slabs are both ways reinforced and the specification of cables is given in the structural design. The thickness of the slab is 300mm. The slabs area continuous in both directions. The supporting element for the slabs is girders. Two types of girders were used. The peripheral girders are made of reinforced concrete where the internal girders are made of prestressed concrete. The peripheral girders have dimensions of 800x500mm and the design of the reinforcement is given by the structural engineer. The dimensions of prestressed girders are 500x400mm and the dimensions of cables are given in the structural design. All

horizontal structures have to have concrete cover at least 15mm. There are numerous floor openings. There are three staircase openings, one elevator opening and one service shaft.

C.6 Roof structure

The roof is designed as flat, with no public service on it. The supporting structure for the roof is both ways presstressed concrete slab designed in the structural drawings. The roof has a unified slope of 2.5% and 4 inlets. The diameter of inlets is 100mm. there are also two safety inlets included in the attic. The safety inlets are placed 20mm above the highest edge of the slope. The vapor barrier is placed first and onto it the polystyrene insulation boards. The lowest thickness of the insulation is 160mm. This thickness is found around the inlets. After placing two layers of 80mm thick polystyrene boards come the sloping wedges. They are freely laid and mechanically anchored according to manufacturer's design. For anchoring of the polystyrene are used telescopic dowels and screws. The screws have to penetrate all layers to the concrete slab This way the top insulation layer will be about 400mm around the attic. The first layer of water proofing comes onto the polystyrene. This layer anchored by its adhesive glue on the bottom. No additional anchoring is necessary for the waterproofing. The second layer or waterproofing is fire welded to the first layer creating a very solid water tight envelope. The very top layer is the 100mm layer of washed out gravel. The granularity recommended is 18/36mm. Both layers of waterproofing have to be extended at least 150mm above the highest edge of the slope. The second layer has to be extended all the way to the top of the attic and secured by a dowel. The attic has a slope of 5% towards inside of the building. OSB board is screwed to the concrete attic and two zinc coated clips are attached to it. The final tinsmith work is placed onto it and secured by clips.

C.7 Partitions

The partitions used in the project are made of ceramic brick blocks. The thicknesses of partitions vary according to their usage. The basic thickness is 150mm and is used mostly in the wet area or office areas. Brick blocks of thickness are used as separation walls of toilets in the wet area or the staff area and storages in the first ground floor. The

partitions of 300mm are used for supporting stairs or to divide single area as fire compartments. There are also glazed partitions used in group study rooms. all the partitions go to the bottom of the above ceiling.

C.8 Floor above the foundation

It is made of plain concrete with distribution reinforcement. Layer of 5.2mm hydro insulation is fire welded to the slab. however, before that the surface of the slab needs to be treated with asphalt coating to increase the adhesion. 50mm thermal insulation will be used in the composition of the floor. As a top layer is designed cement screed. No additional layer is needed.

C.9 Staircase

The structural height is 4200mm in the above ground floor and 3300mm in underground floors. The main stair is 3 flights stair designed from reinforced concrete. The height of of step is 165mm and the width is 300mm. The secondary stair is also 3 flights and designed from reinforced concrete. The width of the main stair is 1300mm and the secondary 1000mm. Same height/width ration is used as for the main stair The archive stair has width of 900mm and is also designed as reinforced concrete. The ratio is 168/300 and there were 20 steps needed for the designed clear height. Concrete used for the columns and walls is C30/35. The design of vertical load bearing elements has to be further reviewed by a structural engineer.

C.10 Openings

Since the design includes a curtain wall no additional windows are needed. The curtain wall has U=1.0W/K.m2 and provides sufficient thermal protection for the envelope. Doors in the façade are made by the same technology as the curtain wall therefore they have the same properties. The curtain wall is anchored by dowels into the slab structure of every floor. Specifications given by the curtain wall designer.

Conclusion

The project has focused on practical and technologically modern design of faculty library. The disposition of the object is designed in a way it is pleasant for students as well as for the staff. All requirements of the investors were taken into an account during the design there for large open areas were designed so they can easily be transformed into smaller rooms (offices for example). The object contains 4 floors where one is located below the ground. The built in area of the structure is 612m2 and total usage area is about 2400m2. The object is a part of first stage of larger development of academic facilities in the area.

List of used sources

Legislation

Vyhláška 499/2006 Sb., o dokumentaci staveb
Zákon č. 183/2006 Sb., o územním plánování
Vyhláška 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.schuco.cz
www.tzb-info.cz
www.otis.cz
www.baumit.at
www.rigips.sk
www.decktrade.cz
www.dorken.cz
www.geocell.cz
www.kvkparabit.com
www.kjg.sk
www.youtube.com
www.isotherm.cz

Used software

AutoCAD 2015
Autodesk Revit 2015
Autodesk 3D Max studio
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) B SUMMARY TECHNICAL REPORT
4) C TECHNOLOGICAL REPORT

FOLDER B – STUDY

1. LEVEL 1
2. LEVEL 2
3. LEVEL 3
4. LEVEL 4
5. LEVEL 5
6. LEVEL 6
7. LEVEL -1
8. LEVEL -2
9. Section AA’
10. Section BB’
11. Section CC’
12. Section DD’
13. Elevation North-west , Elevation North-east
14. Elevation South-west, Elevation South-east
15. Park view 1, Park view 2
16. Entrance view, Object view
17. Coffee shop 1st floor, Library

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 – FLOORPLAN OF 3TH GROUND FLOOR
4) D.1.1.04 – FLOORPLAN OF -1ST GROUND FLOOR
5) D.1.1.05 – DRAWING OF SECTION AA’
6) D.1.1.06 – DRAWING OF SECTION BB’
7) D.1.1.07 – DRAWING OF SECTION CC’
8) D.1.1.08 – DRAWING OF SECTION DD’
9) D.1.1.09 – VIEWS
10) D.1.1.10 – DRAWING OF ROOF
11) D.1.1.19 – DETAIL A
12) D.1.1.20 – DETAIL B
13) D.1.1.21– DETAIL C
14) D.1.1.22 – DETAIL D
15) D.1.1.23 – DETAIL E
16) D.1.1.24 – DETAIL F
17) D.1.1.14 – COMPOSITION OF STRUCTURES
18) D.1.1.16 – LIST OF DOORS
19) D.1.1.18 – LIST OF TINSMITH WORKS

FOLDER D.1.2 – CONSTRUCTION SOLUTION

1) D.1.2.01 – FOUNDATIONS
2) D.1.2.02 – DRAWING OF SL1
3) D.1.2.03 – DRAWING OF SL2&3

FOLDER D.1.3 – FIRE SAFETY

1) D.1.3 – FIRE SAFETY REPORT
2) D.1.3.01 – SITUATION OF FIRE HAZARD
3) D.1.3.02 – LEVEL 1 PLAN
4) D.1.3.03 – LEVEL 2 PLAN

FOLDER E – THERMAL EVALUETION, GEOTECHNOCAL REPORT AND CALCULATION

1) THERMAL ENVELOPE CALCULATION
2) CALCULATION OF STAIRS

Attachments

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

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

CALCULATION OF STAIRS

DIPLOMOVÁ PRÁCE
DIPLOMA THESIS

AUTOR PRÁCE — BC. PAVEL SUBALLY
AUTHOR

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

BRNO 2016

Content

INPUT DATA FOR ARCHIVE STAIR

Construction height of the floor:	3300 mm
Width range of the tread:	<210,300>
Height range of the riser:	<150,180>
Lehman's formula's result range:	<600,650>
Width of the stair flight:	900 mm

CALCULATION FOR ARCHIVE STAIR

-determination of the number of steps

$$n_p = \frac{H_c}{h_i} = \frac{3300}{170} = 19.41\ steps$$

Where: n_p – preliminary number of steps

H_c – construction height

h_i – height of the ideal step

-choosing of the number of steps. n_d= 20 steps

$$h_s = \frac{H_c}{n_d} = \frac{3300}{20} = 165\ mm$$

Where: h_s – height of a riser

n_d – number of designed steps

-calculation of the width of tread

$$l_1 = 610 - 2 * n_d = 610 - 2 * 165 = 280\ mm$$

$$l_2 = 650 - 2 * n_d = 650 - 2 * 165 = 320\ mm$$

Where: l_1 – lower condition boundary

l_2 – upper condition boundary

-choosing of the width of the tread. l=300 mm

-calculation of the slope

$$\alpha = \tan^{-1}\frac{165}{300} = 28.8°$$

-calculation of the passage height

$$H = 750 + 1500 * \cos\alpha = 750 + 1500 * \cos 28.8 = 2064\ mm$$

-the minimum required height is 2100 mm so the staircase fulfills the requirements

INPUT DATA FOR MAIN STAIR

Construction height of the floor:	4200 mm
Width range of the tread:	<210,300>
Height range of the riser:	<150,180>
Lehman's formula's result range:	<600,650>
Width of the stair flight:	1300 mm

CALCULATION MAIN STAIR

-determination of the number of steps

$$n_p = \frac{H_c}{h_i} = \frac{4200}{170} = 24.7\ steps$$

Where: n_p – preliminary number of steps

H_c – construction height

h_i – height of the ideal step

-choosing of the number of steps. n_d= 25 steps

$$h_s = \frac{H_c}{n_d} = \frac{4200}{25} = 168\ mm$$

Where: h_s – height of a riser

n_d – number of designed steps

-calculation of the width of tread

$$l_1 = 610 - 2 * n_d = 610 - 2 * 168 = 274\ mm$$

$$l_2 = 650 - 2 * n_d = 650 - 2 * 168 = 314\ mm$$

Where: l_1 – lower condition boundary

l_2 – upper condition boundary

-choosing of the width of the tread. l=300 mm

-calculation of the slope

$$\alpha = \tan^{-1}\frac{168}{300} = 29.2°$$

-calculation of the passage height

$$H = 750 + 1500 * \cos\alpha = 750 + 1500 * \cos 29.2 = 2058\ mm$$

-the minimum required height is 2100 mm so the staircase fulfills the requirements

INPUT DATA FOR SECONDARY STAIR

Construction height of the floor:	4200 mm
Width range of the tread:	<210,300>
Height range of the riser:	<150,180>
Lehman's formula's result range:	<600,650>
Width of the stair flight:	900 mm

CALCULATION SECONDARY STAIR

-determination of the number of steps

$$n_p = \frac{H_c}{h_i} = \frac{4200}{170} = 24.7\ steps$$

Where: n_p – preliminary number of steps

H_c – construction height

h_i – height of the ideal step

-choosing of the number of steps. n_d= 25 steps

$$h_s = \frac{H_c}{n_d} = \frac{4200}{25} = 168\ mm$$

Where: h_s – height of a riser

n_d – number of designed steps

-calculation of the width of tread

$$l_1 = 610 - 2 * n_d = 610 - 2 * 168 = 274\ mm$$

$$l_2 = 650 - 2 * n_d = 650 - 2 * 168 = 314\ mm$$

Where: l_1 – lower condition boundary

l_2 – upper condition boundary

-choosing of the width of the tread. l=300 mm

-calculation of the slope

$$\alpha = \tan^{-1}\frac{168}{300} = 29.2°$$

-calculation of the passage height

$$H = 750 + 1500 * \cos\alpha = 750 + 1500 * \cos 29.2 = 2058\ mm$$

-the minimum required height is 2100 mm so the staircase fulfills the requirements

CONCLUSION

The structure of all stair flights is made of reinforced concrete and have three flights. The width of the main stair is 1300mm and the height of step is 168mm. The width of step is 300mm. There are 25 steps over 4200mm. The secondary stair is very similar to the main stair with exception of its flight width. The width is 900mm. The archive (service) stair is 900mm wide and the heath/width of steps is 165/300mm. There are 20 steps over 3300mm. The passage height was set to 2100mm for all stairs. The staircase is designed according to standards. The stair flight is designed to take as less space as possible while creating a comfortable way of overcoming of the height between floors. The structural design of all stairs is acc to structural engineer.

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

FIRE SAFETY REPORT

DIPLOMOVÁ PRÁCE
DIPLOMA THESIS

AUTOR PRÁCE — BC. PAVEL SUBALLY
AUTHOR

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

BRNO 2016

D1.3 FIRE SAFETY REPORT

Object type: Library

# of plot:	251/3
Cadastral area:	Brno-Veveri
Investor:	FAST VUT Brno
Designer:	Bc, Pavel Subally

Brno, December 2015

CONTENT

Obsah

1. GENERAL DATA ABOUT THE STRUCTURE

Urban and architectural description:

The structure is designed as fully detached object in Brno, Veveri. It is newly built with three ground floors and tone underground floors. The object is going to serve mainly as university library with combination of public lecture rooms and auditorium. There are no adjacent buildings around. The object is designed as a cube with skeleton load-bearing system. The system is RC concrete with prestressed slabs. The exterior facade is designed as curtain wall mostly covered by glass panels.

Layout of the object:

The floor plan is squared with one main entrance and two side entrances. The range of this report only includes the first and the second floor. The first floor contains main lobby, administration offices, coffee shop, book store, coat room, locker room and wet area. The second floor includes study area, wet area, chill-out area and two computer sections. The disposition is fully open due to investor's requirements.

Structural solution of the object:

The object is designed as reinforced concrete skeleton structure with prestressed horizontal structures. The dimension of columns is 500x500mm, the dimension of girders is 400x800mm. The thickness of the slab is 300mm. The internal girders are prestressed with the dimension of 500x300mm.All structures have the concrete cover of thickness 40mm. The grade of concrete used is C30/35. The public elevator shafts are designed as steel frame with glass panels and the service elevator is made of brick wall of thickness 150mm. The façade is designed mostly from composite panel where 1/3 of panel is filled with insulation panel and 2/3 of it is glazed. The roof is non-walkable, made of asphalt felts covered with 100mm of wash out gravel. The insulation in the roof is polystyrene.

2. FIRE-TECHNICAL REPORT

2.1 Sources

Technical sources

- Drawings issued for building permit

Law and other Regulations

- No. 246/2001 Coll. , about determination of conditions of fire safety
- No. 38/2008 Coll., about technical regulations of fire protection

Standards CSN

- CSN 730802, FP for non-manufacturing objects

2.2 Fire-technical characteristics

The object will be solved as general building of non-manufacturing character according to CSN 730802. The object was classified as library and it will be evaluated according to this classification.

Object: 3GF and 1 UF (only 1st, 2nd observed)

Vertical load bearing structures:	DP1	RC column (500x500mm)
		RC elevator wall (200mm)
Horizontal load bearing structures:	DP1	RC girder (800x400mm)
		PSC slab (300mm)

Construction system: non-combustible
Fire height: h= 13.6m
Clear height: hs=2.7m

2.3 Determination of fire compartments

The object is going to be divided in fire compartments as follows:

N1.1- Cloak room and lockers
N1.2- Lobby
N1.3- Coffee shop
N1.4- Book store
N1.5- “A” type escape way
N1.6- Administration areas
N2.1- Library
N2.2- “A” type escape way
N2.3- “A” type escape way

2.4 Evaluation of fire compartments

N1.1- Cloak room and lockers
Fire height: 0m
Height of level: 3.7mm
Clear height: 2.8mm
Structural system: non-combustible (DP1)

Room #	Purpose	S (m2)	pn (kg/m2)	an (-)	ps (kg/m2)	as (-)	S0 9m2)	a	b	c	pv	Degree
113	Cloak room	46.86	75	1.1	0	0.9	11.2	1.0	0.3	1.0	14.9	II
114	Lockers	41.41	15	0.7	0	0.9	33.6					

N1.2- Lobby
Fire height: 0m
Height of level: 3.7mm
Clear height: 3.5mm
Structural system: non-combustible (DP1)

Room #	Purpose	S (m2)	pn (kg/m2)	an (-)	ps (kg/m2)	as (-)	S0 9m2)	a	b	c	pv	Degree
101	Foyer	16.75	5	0.8	0	0.9	22.4	0.8	0.8	1.0	4.6	II
112	Lobby	95.17	5	0.8	2	0.9	0.0					
110	Gentlemen's room	18.20	5	0.7	2	0.9	0.0					
111	Lady's room	18.20	5	0.7	2	0.9	0.0					

N1.3- Coffee shop
Fire height: 0m
Height of level: 3.7mm
Clear height: 2.8mm
Structural system: non-combustible (DP1)

Room #	Purpose	S (m2)	pn (kg/m2)	an (-)	ps (kg/m2)	as (-)	S0 9m2)	a	b	c	pv	Degree
102	Coffee shop	65.56	30	1.2	2	0.9	44.8	0.7	0.3	1.0	5.1	II
104	Coffee shop storage	7.06	5	0.7	2	0.9	0.0					
105	Corridor 1	3.00	5	0.8	2	0.9	0.0					
106	Janitors	2.10	5	0.7	2	0.9	0.0					
107	Emloyee toilet	2.03	5	0.7	2	0.9	0.0					

N1.4- Book store

Fire height: 0m
Height of level: 3.7mm
Clear height: 2.8mm
Structural system: non-combustible (DP1)

Room #	Purpose	S (m2)	pn (kg/m2)	an (-)	ps (kg/m2)	as (-)	S0 9m2)	a	b	c	pv	Degree
103	Bookstore storage	9.46	150	0.7	2	0.9	0.0	0.7	0.3	1.0	27.9	III
108	Bookstore	107.32	120	0.7	0	0.9	58.8					

N1.5- “A” type escape way

-protected escape way with DFS not lower than neighboring fire compartment
-minimal DFS II
-DFS II

Room #	Purpose	S (m2)	pn (kg/m2)	an (-)	ps (kg/m2)	as (-)	S0 9m2)	a	b	c	pv	Degree
109	Entrance room	19.97	5	0.8	2	0.9	22.4	0.8	0.2	1.0	1.8	II
118	Corridor 2	14.65	5	0.8	7	0.9	0.0					

N1.6- Administration areas

Fire height: 0m
Height of level: 3.7mm
Clear height: 2.8mm
Structural system: non-combustible (DP1)

Room #	Purpose	S (m2)	pn (kg/m2)	an (-)	ps (kg/m2)	as (-)	S0 9m2)	a	b	c	pv	Degree
115	Office stair	10.73	5	0.8	2	0.9	0.0	1.0	0.2	1.0	7.7	II
116	Meeting room	18.73	20	0.9	7	0.9	8.4					
117	Office 1	24.05	40	1.0	7	0.9	11.2					
119	Office toilet	2.23	5	0.7	2	0.9	0.0					
120	Office 2	22.13	40	1.0	7	0.9	25.2					
121	Office kitchen	10.47	25	0.9	2	0.9	11.2					

N2.1- Library

Fire height: 4m
Height of level: 3.7mm
Clear height: 2.8mm
Structural system: non-combustible (DP1)

Room #	Purpose	S (m2)	pn (kg/m2)	an (-)	ps (kg/m2)	as (-)	S0 9m2)	a	b	c	pv	Degree
202	Library area	465.6	120	0.8	7	0.9	246.4	0.8	0.4	1.0	38.2	III

N2.2- “A” type escape way

-protected escape way with DFS not lower than neighboring fire compartment
-minimal DFS II
-DFS II

Room #	Purpose	S (m2)	pn (kg/m2)	an (-)	ps (kg/m2)	as (-)	S0 9m2)	a	b	c	pv	Degree
201	Staircase + corridor	62.7	5	0.8	2	0.9	0	0.	0.	1.	0.3	II

203	Lady's room	18.2	5	0.7	2	0.9	0	8	1	0		
204	Gentlemen's room	18.2	5	0.7	2	0.9	0					

N2.3- "A" type escape way
-protected escape way with DFS not lower than neighboring fire compartment
-minimal DFS II
-DFS II

Room #	Purpose	S (m2)	pn (kg/m2)	an (-)	ps (kg/m2)	as (-)	S0 9m2)	a	b	c	pv	Degree
205	Service staircase	19.97	5	0.8	2	0.9	16.8	0.8	0.2	1.0	1.2	II
206	Service elevator	2.79	5	0.8	2	0.9	0					

2.5 Verification of fire resistance

Verification according to table 12 in CSN 730802

Fire compratment N1.1

Item	Structure	Requirement	Reality	Note
1.1	Fire ceiling	REI 30	REI 60 DP1	Comply
	300mm RC slab, 25mm cover			
1.2	Fire wall	EI 30	EI 120 DP1	Comply
	Ceramic brick wall 180mm			
1.3	Fire wall	EI 30	EI 30	Comply
	Fire resistant glass wall			
2	Fire door	EI 15 DP3	EI 30 DP3	Comply
	Glass wall door			
3	External facade	EI 15	EI 30	Comply
	Curtain wall panels			
5	L-B structures	REI 30	REI 60 DP1	Comply
	Concrete columns 500mm & girders			

Fire compartment N1.2

Item	Structure	Requirement	Reality	Note
1.1	Fire ceiling	REI 30	REI 60 DP1	Comply
	300mm RC slab, 25mm cover			
1.2	Fire wall	EI 30	EI 120 DP1	Comply
	Ceramic brick wall 180mm			
1.3	Fire wall	EI 30	EI 30	Comply
	Fire resistant glass wall			
2	Fire door	EI 15 DP3	EI 30 DP3	Comply
	Glass wall door			
3	External facade	EI 15	EI 30	Comply
	Curtain wall panels			
5	L-B structures	REI 30	REI 60 DP1	Comply
	Concrete columns 500mm & girders			

Fire compartment N1.3

Item	Structure	Requirement	Reality	Note

1.1	Fire ceiling	REI 30	REI 60 DP1	Comply
	300mm RC slab, 25mm cover			
1.2	Fire wall	EI 30	EI 120 DP1	Comply
	Ceramic brick wall 180mm			
1.3	Fire wall	EI 30	EI 30	Comply
	Fire resistant glass wall			
2	Fire door	EI 15 DP3	EI 30 DP3	Comply
	Glass wall door			
3	External facade	EI 15	EI 30	Comply
	Curtain wall panels			
5	L-B structures	REI 30	REI 60 DP1	Comply
	Concrete columns 500mm & girders			

Fire compartment N1.4

Item	Structure	Requirement	Reality	Note
1.1	Fire ceiling	REI 30	REI 60 DP1	Comply
	300mm RC slab, 25mm cover			
1.2	Fire wall	EI 30	EI 120 DP1	Comply
	Ceramic brick wall 180mm			
1.3	Fire wall	EI 30	EI 30	Comply
	Fire resistant glass wall			
2.1	Fire door	EI 15 DP3	EI 30 DP3	Comply
	Glass wall door			
2.2	Fire door	EI 15 DP4	EI 30 DP3	Comply
	Wooden door			
3	External facade	EI 15	EI 30	Comply
	Curtain wall panels			
5	L-B structures	REI 30	REI 60 DP1	Comply
	Concrete columns 500mm & girders			

Fire compartment N1.5

Item	Structure	Requirement	Reality	Note
1.1	Fire ceiling	REI 30	REI 60 DP1	Comply
	300mm RC slab, 25mm cover			
1.2	Fire wall	EI 30	EI 120 DP1	Comply
	Ceramic brick wall 180mm			
2	Fire door	EI 15 DP3	EI 30 DP3	Comply
5	L-B structures	REI 30	REI 60 DP1	Comply
	Concrete columns 500mm & girders			

Fire compartment N1.6

Item	Structure	Requirement	Reality	Note
1.1	Fire ceiling	REI 30	REI 60 DP1	Comply
	300mm RC slab, 25mm cover			

1.2	Fire wall	EI 30	EI 120 DP1	Comply
	Ceramic brick wall 180mm			
2	Fire door	EI 15 DP3	EI 30 DP3	Comply
	Wooden door			
3	External facade	EI 15	EI 30	Comply
	Curtain wall panels			
5	L-B structures	REI 30	REI 60 DP1	Comply
	Concrete columns 500mm & girders			

Fire compratment N2.1

Item	Structure	Requirement	Reality	Note
1.1	Fire ceiling	REI 30	REI 60 DP1	Comply
	300mm RC slab, 25mm cover			
1.2	Fire wall	EI 30	EI 120 DP1	Comply
	Ceramic brick wall 180mm			
1.3	Fire wall	EI 30	EI 30	Comply
	Fire resistant glass wall			
2	Fire door	EI 15 DP3	EI 30 DP3	Comply
	Glass wall door			
3	External facade	EI 15	EI 30	Comply
	Curtain wall panels			
5	L-B structures	REI 30	REI 60 DP1	Comply
	Concrete columns 500mm & girders			

Fire compratment N2.2

Item	Structure	Requirement	Reality	Note
1.1	Fire ceiling	REI 30	REI 60 DP1	Comply
	300mm RC slab, 25mm cover			
1.2	Fire wall	EI 30	EI 120 DP1	Comply
	Ceramic brick wall 180mm			
1.3	Fire wall	EI 30	EI 30	Comply
	Fire resistant glass wall			
2	Fire door	EI 15 DP3	EI 30 DP3	Comply
	Glass wall door			
5	L-B structures	REI 30	REI 60 DP1	Comply
	Concrete columns 500mm & girders			

Fire compratment N2.3

Item	Structure	Requirement	Reality	Note
1.1	Fire ceiling	REI 30	REI 60 DP1	Comply
	300mm RC slab, 25mm cover			
1.2	Fire wall	EI 30	EI 120 DP1	Comply
	Ceramic brick wall 180mm			
3	External facade	EI 15	EI 30	Comply

	Curtain wall panels			
5	L-B structures	REI 30	REI 60 DP1	Comply
	Concrete columns 500mm & girders			

2.6 Escape ways

According to CSN 730802

1) Occupancy of rooms
2) Possibility of use of one escape way – there are two excape ways in the object where every one is able to evacuate 200 people (acc. To table 17 in CSN 730802)
3) Both protected escape ways are type A up to 22.5m (acc. To table 16 in CSN 730802)
4) Length of emergency escape ways lmax=120m – in this object the longest escape way is 52m which satisfy to this requirement
5) Width of excape ways is assessed at the bottom of the stair case and exit from library space (acc. To table 20 & 21 in CSN 730802)

Escape way from the library area				
Room #	Purpose	S (m2)	people/m2	Occupancy
202	Library area	465.57	2.5	187
u=E.s/K				
u=187*0.8/80, u=1.87 strips which is equal to **990**mm				

Escape way at the bottom of the staircase				
Room #	Purpose	S (m2)	people/m2	Occupancy
202	Library area	465.57	2.5	186.228
203	Lady's room	18.2	1	18.2
204	Gentlemen's room	18.2	1	18.2
u=E.s/K				
u=187*0.8/80, u=1.87 strips which is equal to **990**mm				

6) Ventilation of protected escape ways –
7) Equipment of the escape ways – will be equipped with emergency lights with the function time of 60 min (acc. To CSN EN 1838), light fittings will be installed together with the marking of the direction of escape with built-in batteries, reaction of floors to fire up to C – satisfies, individual structures of escape way should be DP1 – satisfies
8) Doors on escape ways (acc. To article 9.13 in CSN 730802) – doors assembled in the protected escape ways must open in direction of escape and must not have a threshold. There cannot be any other type of door except sliding and with hinges inside of the room assembled on the escape ways, door wing doesnt make the escape way more narrow therefor there are no 180 degrees openable doors, doors to the protected escape way will be equipped with a panic bar, automatic doors need to be openable manually also, there are two types of door used – wooden and glass both EI 30
9) Signs and tables – escape ways have to be marked out according to CSN ISO 3864 everywhere, where an exit to open space is not straightly visible from corridors.

If everything is fulfilled then the assessed object will satisfy the fire safety.

2.7 Stand-off distances

The envelope of the object is made of curtain wall composed of aluminum profiles and mostly glazed panels. However, some of the panels are filled with mineral wool. The façade is non-combustible. There is no possibility of falling parts during the fire. Stand-off distances will be assessed for the influence of radiation:

- From partially opened fire areas of the envelope:
  - The envelope is graded as DP1, the reaction to fire is A1
- From open fire areas of roof:
  - The evaluation of roof is not in the range of this report

Stand-off distances will only be determined because of the influence of radiation from entirely open fire areas of windows and doors on the envelope of the building. Protected escape way is not a fire section which would report radiation and therefore it wasn't evaluated.

Review of heat radiation from fully opened areas:

N1.1- Cloak room and lockers, po=14,9 kg/m2
Po=100%, lu= 18m, hu= 4m ->
South d= 5.3m, West d= 5.4m

N1.2- Lobby, po=4,6 kg/m2
Po=100%, lu= 8m, hu= 4m ->
South d= 4m

N1.3- Coffee shop, po=5,1 kg/m2
Po=100%, lu= 16m, hu= 4m ->
South d= 3.7m, East d= 3.7m

N1.4- Book store, po=27,9 kg/m2
Po=100%, lu= 16m, hu= 4m ->
East d= 8m, North d= 6.2m

N1.5- "A" type escape way, po=1,8 kg/m2
Po=100%, lu= 8m, hu= 4m ->
North d= 4m

N1.6- Administration areas, po=7,7 kg/m2
Po=100%, lu= 22m, hu= 4m ->
North d= 4m, West d= 4.3m

N2.1- Library, po=38,2 kg/m2
Po=100%, lu= 88m, hu= 4m ->
North d= 6.8m, West d= 9.4m, East d= 9.4m, South d=9.4m

N2.3- "A" type escape way, po=1,2 kg/m2
Po=100%, lu= 8m, hu= 4m ->
North d= 4m

The fire zones reach the land of owner or public pavements and roads. No nearby buildings are influenced by excessive heat in case of fire. The reviewed object is not located in the reach of any nearby fire zone. The maximum distance of heat reach is drawn in the particular drawings.

2.8 Technical and technological devices

2.8.1 Service openings

Service openings and installation (including electricity cables openings) in fire resistant structures need to be designed in a way they fulfill the requirement given by 6.2.1 in CSN 730810. Structures with these passages have to be brought to outer surfaces of pervading devices in exact fire resistance like fire barriers have. Fire barriers can be for instance exchanged or customized in tightened part towards outer surface of certain passages provided that fire resistance will not be diminished nor type of structure will be changed (DP1)

Without further precautions distribution piping and its accessories can pass according to 11.1.1 in CSN 730802 through fire barriers, which are intended for distribution of non-combustible substances by fulfilling following conditions:

- Up to diameter of 40000 mm2 regardless on combustibility of used material without further measures
- Piping with clean cross-section over 40000 mm2 must be made of material with reaction to fire A1 and A2 and its eventual isolation is at least up to 1000mm distance from both faces of fire barrier which is made from non-combustible building material (reaction class to fire A1 and A2)
- Piping with clean diameter larger than 40000 mm2 and its accessories from combustible building materials must not be freely conducted through fire compartment and must be:
    - Assembled in building structure of type DP1 or otherwise fire protected, f.e. by cover layer with fire resistance of at least 30 minutes
    - Places in installation shaft of channel
- Ventilation devices can pass fire barrier up to the area of one passage – 40000 mm2 a must not have area bigger than 1/100 area of fire barrier by mutual distance 500 mm of these passages.
- At passages of fire barriers referred in 6.2.2 in CSN 730810 except piping openings, solved must be also avoidance of fire spreading through piping matter and through inner space of piping and other permeating devices. This sealing is asserted by help of putty, cuffs and likewise. Their fire resistance is determined by required fire resistance of tire barrier, at most 90 minutes. Passages sealing is evaluated according to 7.5.8 in CSN EN 13501-2:2008 in these cases:
    1. Fire resistance EI:
        - Sewage piping of reaction class to fire B-F of clean diameter over 8000 mm2 and if it is vertical position of piping over 12500 mm2. If it is horizontal position of piping with deviation up to 15 degrees.
        - Piping with permanent water filling or another non-combustible fluid, reaction to fire B-F with clean diameter over 15000 mm2
        - Piping serving to distribute compressed and not compressed air or another non-combustible gasses including ventilation distribution, reaction class to fire B-F of clean diameter over 12000 mm2
        - Cable and other electrical distributions created by cluster of conductors as long as these distributions are going through one opening have isolations which spread fire and their total weight is bigger than 1.0 kg.m-1 (provision does not apply to conductors and cables according to CSN 730802 and CSN 730804 and cables which are not spreading fire according to standards of council CSN EN 50266
    2. Fire resistance E-C/U or E-U/C and likewise, in all cases mention in point 1.

    In case of permeating more pipelines through fire barrier according points 1. And 2. And have clean diameter bigger than 2000 mm2 with axial distances is less than 300mm all these pipelines must be equipped by cuffs according to 7.5.8 in CSN EN 13501-2:2008. When the latter are passages according 6/2/2 in CSN 730810 permeate has to be not only sealed by filling up of structure up to the top

of piping but also has to be equipped with cuff according to 7.5.8 in CSN EN 13501-2:2008 so that spreading of fire by pipeline or by piping material will not occur for better connection between outer surface of piping and fire barrier. Realized permeates and cable seals in this way have to be clearly marked by info label about fire safety parameters of permeate:

- Object marking, places in object
- Sequence number of cable seal
- Fire resistance marking of cable seal
- Date of execution, company, address, marking of producer and marking of system

2.8.2 Heating

There Is a boiler room in this object. However, it is not in the range of this evaluation therefore it is not going to be evaluated. The requirement for the ventilation pipes is that the cross section area has to be smaller than 40 000 mm2.

2.8.3 Ventilation devices

There will be ventilation used in this object. At the time of evaluation of this object the ventilation drawings are not yet created so it is not possible to evaluate this point.

2.9 Devices for firefighting intervention

2.9.1 Access communication and boarding areas

The object is located on the corner of two streets where one of them is a main street (one lane each way with cycles lane and parking spots on one side) and the other one is a side street (one lane each way with parking spots on one side). The roads are less than 20 meters away from the object. The communications are in compliance with 12.2 in CSN 730802 and are acceptable. There will be no parking allowed on the side road in places from the hydrant to the corner of the street. There is no further access communication since the object is located right on the edge of the street and the fire intervention is possible from the street.

2.9.2 Fire water supply

Exterior water source:

Requirement according to tab. 1 in CSN 730873.

A fire hydrant needs to be included in the design of the object. It is recommended to put the hydrant out let in distance of 30m from the employee's entrance. The parameters of hydrant are given in the table below.

Type of outlet	Distance (m)	DN (mm)	v (m.s-1)	Q (l.s-1)	Volume of tank (m3)
Hydrandt	150	300	100	0.8	6

Interior water supply:

According to part 4.4/6c in CSN 730873 it is not necessary to install interior fire water supply if the object possesses an automatic fire extinguishing system (AFES). The object has AFES designed on every evaluated floor. The design of AFES will be managed according to CAP CEA 4001, CSN EN 12259+ 1 and 2.

2.9.3 Design number of PHP and ZaDS

#	Name of compartment	s	a	c3	nr	Rounded	nhj	RESULT
N1.1-	Cloak room and lockers	88.27	1.03	0.5	2.61	3	18	3 pcs PHP 21A PG 6

N1.2-	Lobby	148.32	0.803	0.55	3.13	4	24	4	pcs PHP 21A PG 6
N1.3-	Coffee shop	79.75	0.743	0.5	2.11	3	18	3	pcs PHP 21A PG 6
N1.4-	Book store	116.78	0.736	0.5	2.54	3	18	3	pcs PHP 21A PG 6
N1.5-	"A" type escape way	34.62	0.846	0.55	1.55	2	12	2	pcs PHP 21A PG 6
N1.6-	Administration areas	88.34	0.959	0.5	2.52	3	18	3	pcs PHP 21A PG 6
N2.1-	Library	465.6	0.786	0.6	5.74	6	36	6	pcs PHP 21A PG 6
N2.2-	"A" type escape way	99.1	0.793	0.55	2.55	3	18	3	pcs PHP 21A PG 6
N2.3-	"A" type escape way	22.76	0.823	0.55	1.24	2	12	2	pcs PHP 21A PG 6

2.9.4 Electric energy supply

In the evaluated building, there are not any electric distributions assuring the function or control of device served for firefighting intervention according to 12.9.1. in CSN 730802. All electrical devices which do not serve for fire safety of an object can have according to 12.9.3 in CSN 730802 any conductors and cables but they will satisfy operation conditions,. In fire compartments are not located freely guided conductors and cables therefore they do not have to be included in fire loading of given fire compartments. Electrical devices will comply with valid regulation and will be installed and operated according competent standards and prescriptions. Prescribed distances between eventual heating appliances and combustible appliances must be reacted according to decree no. 23/2008 coll. In terms of decree 268/2011 coll. In space of CHUC emergency lightning will be installed with functionality time 1 hour and can be used battery lightning connected alternatively with function of marking escape ways.

2.9.5 Devices ensuring the fire protection

There will be emergency signs with lights included installed in the escape ways. This lights will have functionality time of 60 minutes.

3. SECURITY TABLES

By these particular tables will be marked

- Escape ways
- Mobile firefighting devices
- Inner fire water source
- Outer fire water source
- Main switch of electricity
- Gas main lock
- Water main lock
- Eventual sealing of passages, cuffs

4. CONCLUSION

Project for building permit "Library" satisfies requirements for fire safety of buildings according to CSN 730802 by respecting above mentioned requirements and noted changes in contrast to original project.

APPENDIX:
D.1.1.1 – FIRE HAZZARD SITUATION
D.1.1.2 – LEVEL 1 PLAN
D.1.1.3 - LEVEL 2 PLAN

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA STAVEBNÍ
ÚSTAV POZEMNÍHO STAVITELSTVÍ

FACULTY OF CIVIL ENGINEERING
INSTITUTE OF BUILDING STRUCTURES

THERMAL EVALUATION OF BUILDING ENVELOPE

DIPLOMOVÁ PRÁCE
DIPLOMA THESIS

AUTOR PRÁCE — BC. PAVEL SUBALLY
AUTHOR

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

BRNO 2016

Protocol for the thermal evaluation of the building envelope

Identification

Type of the object	University Library
Address	Brno - Veveri
Cadaster region	Cadaster Brno, parcel number 251/3
Owner	Fast VUT

Characteristics of the object

Volume of the object V – outer volume of the heated space, Does not include loggias , attics and foundations	 10647 m^3
Total area A – sum of the areas limiting the volume of the object	2330.7 m^2
Volume factor of the object A/V	0.2
Interior temperature during winter θ_{im}	22 °C
Exterior temperature during winter θ_e	-15 °C

Characteristics of important cooled structures

Cooled structure	Area A_i (m^2)	Heat transfer coef. U_i ($W . m^{-2}.K^{-1}$)	Required heat transfer coef. $U_{N,20}$ ($W . m^{-2}.K^{-1}$)	Thermal reduction factor b_i (-)	Heat loos by heat transfer $H_{Ti} = A_i.U_i.b_i$ ($W.K^{-1}$)
Floor above soil	560	0.57	0,30	0,47	78.96
External facade	1209.71	1	0,24	1	1209.7
Roof	582.3	0.16	0,24	1	93.17
Basement wall	362.52	0.49	0.3	0.47	83.48
Thermal bridges	 ΣA_i 2714.53	 ΔU_{tbm} 0.02			1465.31 54.29
Total					Σ 1519.6

The structures fulfill the requirements stated in the code ČSN 73 0540-2.

Evaluation of the envelope's heat transfer

Average heat transfer coef. $U_{em} = H_T/A$	$W.K^{-1}$	0.55
Required heat transfer coef. $U_{em,N}$	$W.m^{-2}.K^{-1}$	0.88

Classification classes of heat transfer through the building envelope

Classification classes	Average heat transfer coef. U_{em} [$W/(m^2.K)$]	Verbal statement	Clasification letter
A	$U_{em} \leq 0,5.\ U_{em,N}$	Very efficient	⇐ 0,5
B	$0,5.U_{em,N} < U_{em} \leq 0,75.\ U_{em,N}$	Efficient	⇐ 0,55
C	$0,75.U_{em,N} < U_{em} \leq U_{em,N}$	Approvable	⇐ 1,0
D	$U_{em,N} < U_{em} \leq 1,5.U_{em,N}$	Not approvable	⇐ 1,5
E	$1,5.U_{em,N} < U_{em} \leq 2,0.U_{em,N}$	Not efficient	⇐ 2,0
F	$2,0.U_{em,N} < U_{em} \leq 2,5.U_{em,N}$	Inefficient	⇐ 2,5
G	$U_{em} > 2,5.U_{em,N}$	Unusually inefficient	

Thermal losses and the average heat transfer coefficient								
	Reference building				Evaluated building			
Structure	Area A [m2]	Heat transfer coefficient U [W/(m2.K)]	Reduction factor b [--]	Specific loss of heat transfer HT	Structure	Area A [m2]	Heat transfer coefficient U [W/(m2.K)]	Reduction factor b [--]
Basement wall	362.52	2.30	0.40	333.52	362.52	0.49	0.47	83.49
External facade	1209.71	1.2	1.00	1450.8	1209.71	1	1.00	1209.71
Roof	582.3	0.24	1.00	139.75	582.3	0.16	1.00	93.17
Floor on the soil	560	2.30	0.40	515.2	560	0.57	0.47	150.02
Total	2714.53	4.44	4.40	2439.27	2714.53	1.82	4.47	1536.39
Thermal bridges		0.02		54.29		0.05		135.72
Total specific loss of the heat transfer			Ht=	2493.53			Ht=	1672.08
Average specific loss of the heat transfer Umr,rq			Uem,rq=	0.9			Uem=	0.61
Classification		Uem/Uem,rq=		0.53	**CLASS**			**B**

Classification: **B**
Date of the issue of the classification: 10 / 01 / 2016
Maker of the classification: Pavel Subally
Address: Ružová 45, Bratislava, 262 28
IČO:

Elaborated: Pavel Subally Signature:.....

This protocol and the thermal classification was elaborated according the European standard no. 2002/91/ES and prEN 15217. Also, it was elaborated in accordance with ČSN 73 0540 and the project documentation which was given by the investor.

LABEL OF BUILDING ENVELOPE

Type: Family house Address: Zlín – Chlum		Evaluation	
Total area: 325.7 m^2		present	recommended
CI Very efficient A 0,5 B 0,75 C 1,0 D 1,5 E 2,0 F 2,5 G Mimořádně nehospodárná		⇦	
KLASIFICATION			
Average loss by heat transfer $U_{em,N}$ ve W/(m^2.K) $U_{em} = H_T/A$		0.33	
Required average loss by heat transfer of building envelope according the standard ČSN 73 0540-2 $U_{em,N}$ ve W/(m^2.K)		0.41	

Classification factor CI and its corresponding values

CI	0,5	0,75	1,0	1,5	2,0	2,5
U_{em}	0,135	0,203	0,27	0,405	0,54	0,375

Expiration date	Datum 26.5.2014
Elaborated by:	Jméno a příjmení PAVEL SUBALLY