CZECH TECHNICAL UNIVERSITY IN PRAGUE
FACULTY OF CIVIL ENGINEERING

DEPARTMENT OF ARCHITECTURAL ENGINEERING

MASTER'S THESIS

DESIGN OF THE COMMUNITY CENTRE – VODŇANY

Bc. Tadeáš Petřík

2022/2023

Table of Content

Annexes:

Master's Thesis assignment

ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE
Fakulta stavební
Thákurova 7, 166 29 Praha 6

ZADÁNÍ DIPLOMOVÉ PRÁCE

I. OSOBNÍ A STUDIJNÍ ÚDAJE

Příjmení: Petřík   Jméno: Tadeáš   Osobní číslo: 469094

Zadávající katedra: Katedra konstrukcí pozemních staveb (K124)

Studijní program: (N3649) Budovy a prostředí

Studijní obor/specializace: (3608T006) Budovy a prostředí

II. ÚDAJE K DIPLOMOVÉ PRÁCI

Název diplomové práce: Návrh kulturního domu – Vodňany

Název diplomové práce anglicky: Design of the community centre – Vodňany

Pokyny pro vypracování:
Analytická část: provedete analýzu zadání a technických požadavků na budovu a její konstrukce; provedete návrh a stavebně-energetickou optimalizaci obálky budovy a doložíte splnění požadavků energeticky pasivního standardu; vypracujte variantní návrhy konstrukčního systému (uspořádání, materiály, technologie). Rozsah analytické části 10 až 20 stran.
Projekční část: Zpracujete projektovou dokumentaci pro stavební povolení v částech A Průvodní zpráva; C.3 Koordinační situace; D.1.1 Architektonicko-stavební řešení; D.1.2 Stavebně konstrukční řešení (předběžný návrh a vybrané výkresy skladby); D.1.3 Požárně bezpečnostní řešení (koncepce); D.1.4 Technika prostředí staveb (koncepční návrh energetických systémů budovy, návrh přípojek, základní trasování; koncepce, dimenze a trasování VZT). Část D.1.1 doplníte o podrobný návrh všech skladeb konstrukcí a vybraných stavebních detailů (min. 6).

Seznam doporučené literatury:
Vyhl. č. 499/2006 Sb. o dokumentaci staveb ve znění vyhl. č. 62/2013 Sb.
Vyhl. č. 268/2009 Sb. O technických požadavcích na stavby, navazující ČSN
K. Kolb. Dřevostavby. 3. vydání. Grada 2011.
J. Hazucha, J. Bárta. Konstrukční detaily pro pasivní domy. Grada 2014.
M. Pokorný, P. Hejtmánek. Požární bezpečnost staveb. ČVUT Praha 2021.

Jméno vedoucího diplomové práce: Ing. Kamil Staněk, Ph.D.

Datum zadání diplomové práce: 19.9.2022   Termín odevzdání DP v IS KOS: 9.1.2023
Údaj uveďte v souladu s datem v časovém plánu příslušného ak. roku

[redacted]
Podpis vedoucího práce

[redacted]
Podpis vedoucího katedry

III. PŘEVZETÍ ZADÁNÍ

Beru na vědomí, že jsem povinen vypracovat diplomovou práci samostatně, bez cizí pomoci, s výjimkou poskytnutých konzultací. Seznam použité literatury, jiných pramenů a jmen konzultantů je nutné uvést v diplomové práci a při citování postupovat v souladu s metodickou příručkou ČVUT „Jak psát vysokoškolské závěrečné práce" a metodickým pokynem ČVUT „O dodržování etických principů při přípravě vysokoškolských závěrečných prací".

20.09.2022
Datum převzetí zadání

[redacted]
Podpis studenta(ky)

Sworn statement

I declare that I have prepared the submitted Master's Thesis on the topic "Design of a community centre – Vodňany" independently and that I have listed all the sources and literature used.

In Barcelona on 07.01.2023 …………………………………

Bc. Tadeáš Petřík

Čestné prohlášení

Prohlašuji, že jsem předloženou diplomovou práci na téma „Návrh kulturního domu – Vodňany" vypracoval samostatně, a že jsem uvedl veškeré použité zdroje a literaturu.

V Barceloně dne 07.01.2023 …………………………………

Bc. Tadeáš Petřík

Acknowledgement

I would like to thank my Master's Thesis supervisor Ing. Kamil Staněk, Ph.D., for his professional guidance, valuable advices and time. Furthermore, my thanks go to my consultant at the foreign university UPC ETSECCPB, Professor Climent Molins Borrell, I would like to thank him for his advices and help during the preparation of my Master's Thesis. I would also like to thank Ing. Jiří Nováček, Ph.D., Ing. Daniela Šejnová Pitelková, doc. Ing. Vladimír Mózer, PhD. and doc. Ing. Michal Kabrhel, Ph.D. for their advices in their individual specializations. Last but not least, I would like to thank all my family and friends for their help and support throughout my studies.

Poděkování

Tímto bych chtěl poděkovat vedoucímu mé diplomové práce panu Ing. Kamilu Staňkovi, Ph.D., za jeho odborné vedení, cenné rady a věnovaný čas. Dále mé poděkování patří mému konzultantovi na zahraniční univerzitě UPC ETSECCPB, jímž je pan profesor Climent Molins Borrell, děkuji mu za jeho rady a pomoc při zpracovávání diplomové práce. Dále děkuji panu Ing. Jiří Nováčkovi, Ph.D., paní Ing. Daniele Šejnové Pitelkové, panu doc. Ing. Vladimíru Mózerovi, PhD. a panu doc. Ing. Michalovi Kabrhelovi, Ph.D. za rady v jejich jednotlivých specializacích. V neposlední řadě bych pak chtěl poděkovat celé mojí rodině a přátelům za jejich pomoc a podporu během celého studia.

Annotation

The goal of this master‘s thesis was to develop selected parts of the project documentation of a new building of a community centre for a building permit as close to the passive standard as possible. The work is focused on the design of the compositions of the building and envelope structures, including their thermal and moisture assessment and the design of selected construction details. The community centre is located in Vodňany, Czech Republic. The building has one underground floor and two floors above ground. The load-bearing structures of the underground floor will be made from monolithic reinforced concrete, while the above-ground floors will be made from wooden load-bearing structures. The documentation of this master‘s thesis consists of the Initial research and analysis, and subdivisions A, C.3, D.1.1, D.1.2, D.1.3, D.1.4 and the Thermal and moisture assessment.

Keywords

community centre, new building, wooden structure, wood, heat transfer coefficient, project documentation, building permit

Anotace

Cílem této diplomové práce bylo vypracování vybraných částí projektové dokumentace novostavby komunitního centra pro stavební povolení v maximální míře blížící se pasivnímu standartu. Práce je zaměřena na návrh skladeb kompletačních a obalových konstrukcí včetně jejich tepelně technického posouzení a na návrh vybraných stavebních detailů. Komunitní centrum se nachází ve Vodňaněch, Česká republika. Objekt má dvě nadzemní podlaží a jedno podzemní podlaží. Nosná konstrukce podzemního podlaží bude provedena jako monolitická železobetonová, nadzemní podlaží pak budou provedena z dřevěných nosných konstrukcí. Dokumentace této diplomové práce je tvořena počáteční rešerší a analýzou, a dále částmi A, C.3, D.1.1, D.1.2, D.1.3, D.1.4 a Tepelně technickým a vlhkostním posouzením konstrukcí.

Klíčová slova

komunitní centrum, novostavba, dřevostavba, dřevo, součinitel prostupu tepla, projektová dokumentace, stavební povolení

Introduction

The subject of this master‘s thesis was to develop selected parts of the design documentation for a new community centre building for a building permit to the maximum extent close to the passive standard. In order to meet this requirement, it was first necessary to carry out an initial research and analysis of the various issues. It was then possible to proceed to the design of the structural system and the individual structure compositions and construction details. It was also necessary to choose the right layout. Fire safety had to be taken into account in the design of the whole building. Last but not least, it was then possible to design the sewerage, water supply and HVAC systems. The documentation of this master‘s thesis consists of the Initial research and analysis, and subdivisions A, C.3, D.1.1, D.1.2, D.1.3, D.1.4 and the Thermal and moisture assessment.

CZECH TECHNICAL UNIVERSITY IN PRAGUE
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INITIAL RESEARCH AND ANALYSIS

Table of Content

1. Basic information and criteria

1.1. Description of the building

The subject of my thesis is a community centre in a Czech town called Vodňany. It is a building with two floors above ground and one underground floor. The building is square in shape.

The main part of the building is a large black box theatre right in the middle of the layout. Around it, on the first floor, there are public areas such as a foyer, cloakroom, café, playroom, clubrooms, staff facilities and sanitary facilities. On the second floor there is another foyer, an adult‘s library and children's library, an exhibition space, a cinema room, storage space, technical facilities for the black room theatre, and again staff and sanitary facilities. On the underground floor we can find a rehearsal room, an air-conditioner mechanical room, a boiler room and storerooms. Near the building there is a playground, few parking spaces, and a park that extends on the rest of the property.

Figure: 3D model

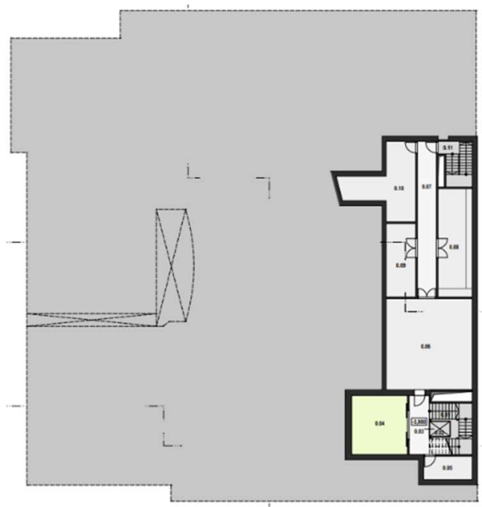


Figure: Underground floor

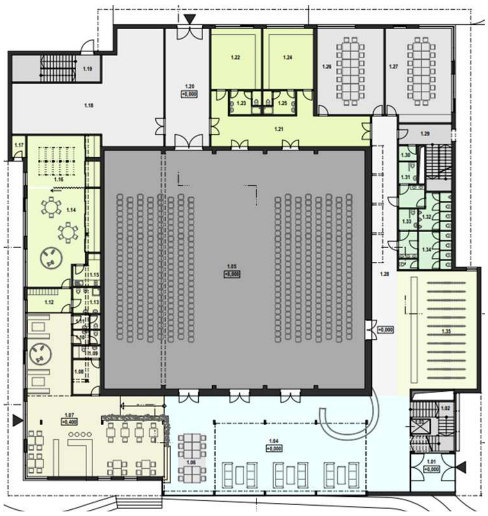


Figure: Firstr floor

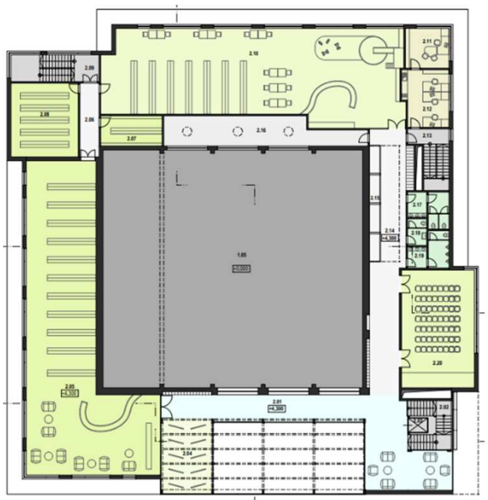


Figure: Second floor

[https://www.archcon.cz/projekt/kd-vodnany/]

Note: For full size drawings of the riginal architectural design, see annexes *AD-01 to AD-04*.

1.2. Location of the building

The building is located in the Czech Republic. It is a country in Central Europe. More specifically, the building is located in the small town of Vodnany, which is in the southwestern part of the country.

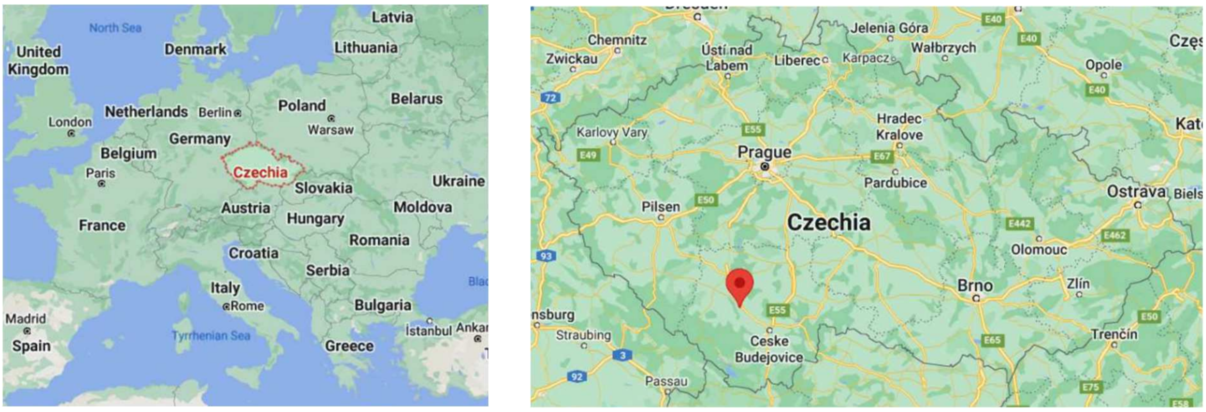


Figure: Location of the building

[https://www.google.com/maps]

The building is located on plots with parcel number st.1678, 132, st.358, st.1021, 3132, 1762, 689, 3123, 1855/9, st.784/1, 130/3, 130/4, 130/1, 1929. Cadastral community Vodňany [784281].

Figure: The plots on which the building is located

[https://nahlizenidokn.cuzk.cz]

1.3. Climatic data

The following graph shows the average temperatures and precipitation during the year in Vodňany. As we can see, the temperatures range from about -11 °C to 31 °C throughout the year.

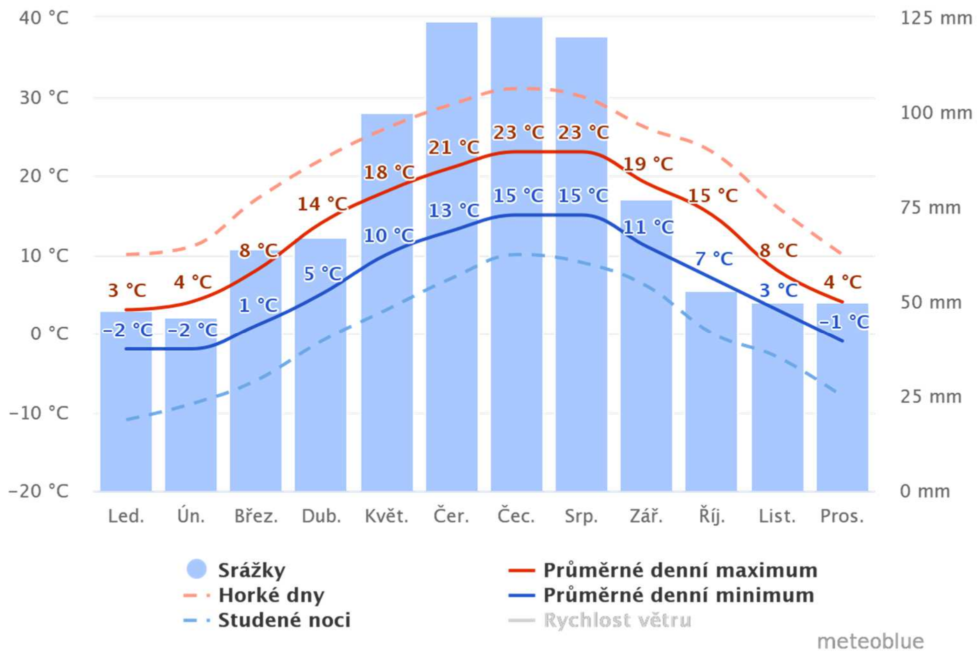


Figure: Average temperatures and precipitation

[https://www.meteoblue.com/cs/počasí/historyclimate/climatemodelled/vodňany_Česko_3062642]

In the next graph we can see the approximate number of days per month with a certain temperature.

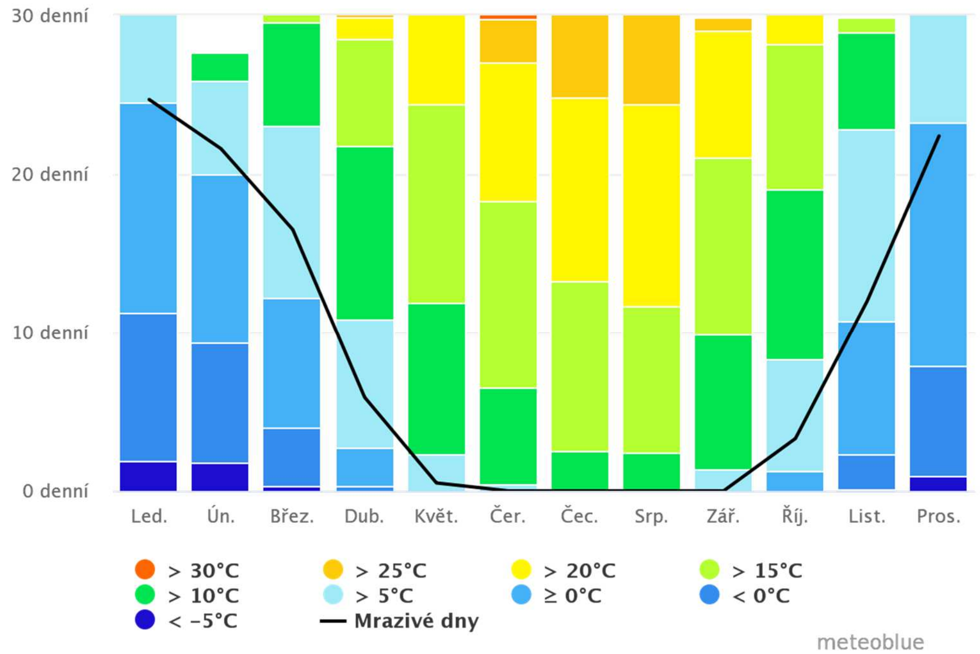


Figure: Number of days with the specified temperature

[https://www.meteoblue.com/cs/počasí/historyclimate/climatemodelled/vodňany_Česko_3062642]

1.4. Definition of a passive house

Since I will be designing a building in passive standard in my Master's Thesis, it would be appropriate to first clarify what the definition of a passive house actually is.

Passive houses are mainly characterised by their low energy consumption. This is achieved in several ways.

Proper design should start with the choice of the building layout, the choice of glazed areas in relation to the cardinal points and the correct positioning of the building on the plot.

This should be continued with a sophisticated design of the building envelope, which should prevent high thermal transmittance and also high summer overheating. A properly designed passive house should also reduce thermal bridges to a minimum, this is partly achieved by the correct choice of the main air sealing layer. The main air sealing layer must be correctly positioned, a suitable material must be chosen for it, and it must be correctly executed, especially its joints.

Finally, the heating, cooling, and air conditioning systems must also be properly designed. This is in order to achieve the best possible quality of the indoor environment, while at the same time reducing as much as possible the energy consumption to achieve these suitable indoor conditions.

1.5. Passive house criteria

A building must meet several criteria to meet the Passive House standards. These European-recognised parameters are set by the Passivhaus Institute in Darmstadt.

1.5.1. Annual specific heat demand for heating

The most important criteria is the specific annual heating demand, which must not exceed a maximum of 15 kWh/(m^{2}a). The specific annual heating demand indicates how much heat is needed to heat one square metre of net floor area (not including partitions). The value is calculated by PHPP according to the conditions set by the Passivhaus Institute.

1.5.2. Airtightness n50

Furthermore, the building must meet an airtightness n50, which can be a maximum of 0.6 h -1. The airtightness n50 is the determining parameter for the airtightness of the envelope. The value tells how much air is exchanged per hour through leaks at a pressure difference of 50 Pa. After the envelope is sealed, a quality check of the design, the so-called Blowerdoor test or airtightness test, is carried out and must be passed.

1.5.3. Annual primary energy demand

The last criterion is the specific annual primary energy demand (for heating, hot water, auxiliary energy, lighting and appliances), which must not exceed a maximum of 120 kWh/(m²a).

1.6. Heat transfer coeficient

An important value in the design of a passive house is the value of the heat transfer coefficient U [W/(m2-K)], which indicates the quality of the thermal insulation properties of the construction. The lower the value, the better the elements insulate.

The recommended values of the heat transfer coefficient U [W/(m2-K)] for passive houses are as follows:

Popis konstrukce	Součinitel prostupu tepla [W/(m²·K)]		
	Požadované hodnoty $U_{N,20}$	Doporučené hodnoty $U_{rec,20}$	Doporučené hodnoty pro pasivní budovy $U_{pas,20}$
Stěna vnější	0,30 1)	těžká: 0,25 lehká: 0,20	0,18 až 0,12
Střecha strmá se sklonem nad 45°	0,30	0,20	0,18 až 0,12
Střecha plochá a šikmá se sklonem do 45° včetně	0,24	0,16	0,15 až 0,10
Strop s podlahou nad venkovním prostorem	0,24	0,16	0,15 až 0,10
Strop pod nevytápěnou půdou (se střechou bez tepelné izolace)	0,30	0,20	0,15 až 0,10
Stěna k nevytápěné půdě (se střechou bez tepelné izolace)	0,30 1)	těžká: 0,25 lehká: 0,20	0,18 až 0,12
Podlaha a stěna vytápěného prostoru přilehlá k zemině 4), 6)	0,45	0,30	0,22 až 0,15
Strop a stěna vnitřní z vytápěného k nevytápěnému prostoru	0,60	0,40	0,30 až 0,20
Strop a stěna vnitřní z vytápěného k temperovanému prostoru	0,75	0,50	0,38 až 0,25
Strop a stěna vnější z temperovaného prostoru k venkovnímu prostředí	0,75	0,50	0,38 až 0,25
Podlaha a stěna temperovaného prostoru přilehlá k zemině 6)	0,85	0,60	0,45 až 0,30
Stěna mezi sousedními budovami 3)	1,05	0,70	0,5
Strop mezi prostory s rozdílem teplot do 10 °C včetně	1,05	0,70	
Stěna mezi prostory s rozdílem teplot do 10 °C včetně	1,30	0,90	

<table>
<tr><th rowspan="2" colspan="2">Popis konstrukce</th><th colspan="3">Součinitel prostupu tepla [W/(m²·K)]</th></tr>
<tr><th>Požadované hodnoty $U_{N,20}$</th><th>Doporučené hodnoty $U_{rec,20}$</th><th>Doporučené hodnoty pro pasivní budovy $U_{pas,20}$</th></tr>
<tr><td colspan="2">Strop vnitřní mezi prostory s rozdílem teplot do 5 °C včetně</td><td>2,2</td><td>1,45</td><td></td></tr>
<tr><td colspan="2">Stěna vnitřní mezi prostory s rozdílem teplot do 5 °C včetně</td><td>2,7</td><td>1,80</td><td></td></tr>
<tr><td colspan="2">Výplň otvoru ve vnější stěně a strmé střeše, z vytápěného prostoru do venkovního prostředí, kromě dveří</td><td>1,5 [2)]</td><td>1,2</td><td>0,8 až 0,6</td></tr>
<tr><td colspan="2">Šikmá výplň otvoru se sklonem do 45°, z vytápěného prostoru do venkovního prostředí</td><td>1,4 [7)]</td><td>1,1</td><td>0,9</td></tr>
<tr><td colspan="2">Dveřní výplň otvoru z vytápěného prostoru do venkovního prostředí (včetně rámu)</td><td>1,7</td><td>1,2</td><td>0,9</td></tr>
<tr><td colspan="2">Výplň otvoru vedoucí z vytápěného do temperovaného prostoru</td><td>3,5</td><td>2,3</td><td>1,7</td></tr>
<tr><td colspan="2">Výplň otvoru vedoucí z temperovaného prostoru do venkovního prostředí</td><td>3,5</td><td>2,3</td><td>1,7</td></tr>
<tr><td colspan="2">Šikmá výplň otvoru se sklonem do 45° vedoucí z temperovaného prostoru do venkovního prostředí</td><td>2,6</td><td>1,7</td><td>1,4</td></tr>
<tr><td rowspan="2">Lehký obvodový plášť (LOP), hodnocený jako smontovaná sestava včetně nosných prvků, s poměrnou plochou průsvitné výplně otvoru
$f_w = A_w / A$, v m²/m²,
kde
A je celková plocha lehkého obvodového pláště (LOP), v m²;
A_w plocha průsvitné výplně otvoru sloužící převážně k osvětlení interiéru včetně příslušných částí rámu v LOP, v m².</td><td>$f_w \le 0,5$</td><td>$0,3 + 1,4 \cdot f_w$</td><td rowspan="2">$0,2 + f_w$</td><td rowspan="2">$0,15 + 0,85 \cdot f_w$</td></tr>
<tr><td>$f_w > 0,5$</td><td>$0,7 + 0,6 \cdot f_w$</td></tr>
<tr><td colspan="2">Kovový rám výplně otvoru</td><td>-</td><td>1,8</td><td>1,0</td></tr>
<tr><td colspan="2">Nekovový rám výplně otvoru [5)]</td><td>-</td><td>1,3</td><td>0,9-0,7</td></tr>
<tr><td colspan="2">Rám lehkého obvodového pláště</td><td>-</td><td>1,8</td><td>1,2</td></tr>
</table>

Table: Recommended values of the heat transfer coefficient „U“

[https://stavba.tzb-info.cz/tabulky-a-vypocty/136-normove-hodnoty-soucinitele-prostupu-tepla-un-20-jednotlivych-konstrukci-dle-csn-73-0540-2-2011-tepelna-ochrana-budov-cast-2-pozadavky]

1.7. Main air sealing layer

As already mentioned, one of the important components in the design of a passive house is the correct design of the main air sealing layer. Consideration must be given to its location in the structure, its material, and its execution, especially the execution of its joints.

1.7.1. Annual primary energy demand

In particular, the main airtightness layer helps to meet the airtightness requirement n50, which must not exceed the already mentioned maximum of 0.6 h^{-1}.

Poor design of the main airtightness layer leads to a higher air permeability of the building envelope and thus to higher heat losses. Care must therefore be taken in its design and execution.

In the attached graph we can see the dependence of the heat loss of the building on the airtightness of the building.

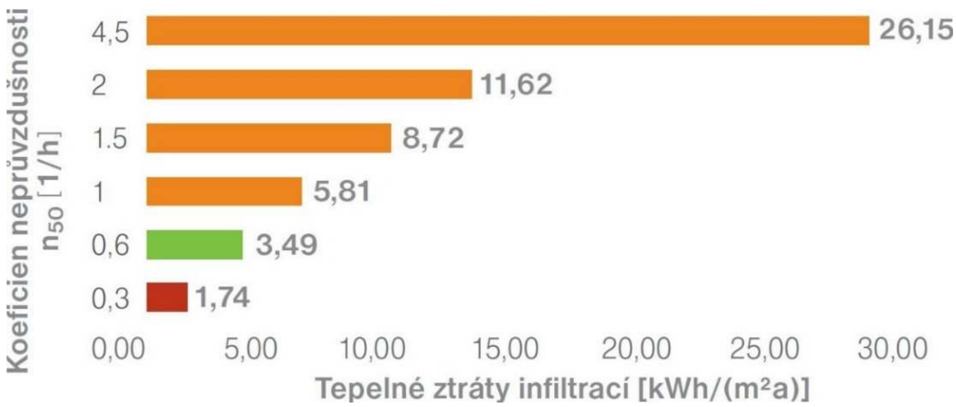


Figure: Dependence of the heat loss of the building on the airtightness of the building

[https://stavba.tzb-info.cz/pasivni-domy/13994-vzduchotesnost-pasivniho-domu]

1.7.2. Risk of moisture spreading

The main airtightness layer further reduces the risk of moisture spreading through the structure. Under normal conditions, warm air can flow from the interior to the exterior and thus act as a carrier of moisture. This problem occurs primarily at locations of poorly executed construction details, at the joints of individual structures, or at the connection of windows and doors to the building envelope. However, this accumulation of moisture and the subsequent degradation of the building is prevented by the correct design of the main airtightness layer.

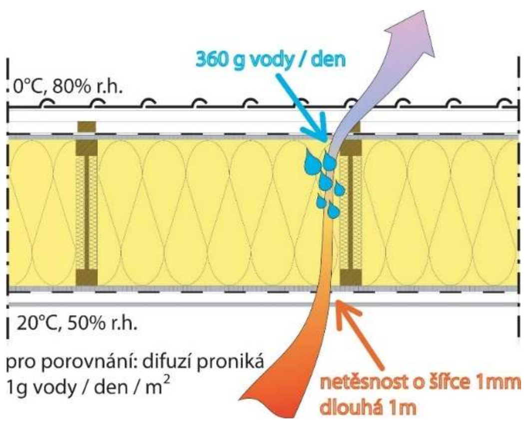


Figure: Moisture spreading through the structure

[https://stavba.tzb-info.cz/pasivni-domy/13994-vzduchotesnost-pasivniho-domu]

1.7.3. Things to focus on when designing the main airtightness layer

- choosing a suitable building design with a minimum of problematic details
- design of a continuous airtight envelope without interruption
- correct positioning of the main airtightness layer in the structure
- identification of problem areas, solution of the sealing method and connection of the main airtightness layer to other structures, together with detailed documentation and design of the materials used
- minimisation of the elements penetrating the airtightness layer
- selection of suitable airtightening material, and of high quality bonding and sealing materials compatible with the airtightening material and with guaranteed functionality such as adhesion and flexibility
- perfect sealing of the joints of connecting and penetrating elements such as windows, doors and pipes

1.7.4. The most common leakage points

These are mainly the connection points of the structures, where problematic sealing details arise.

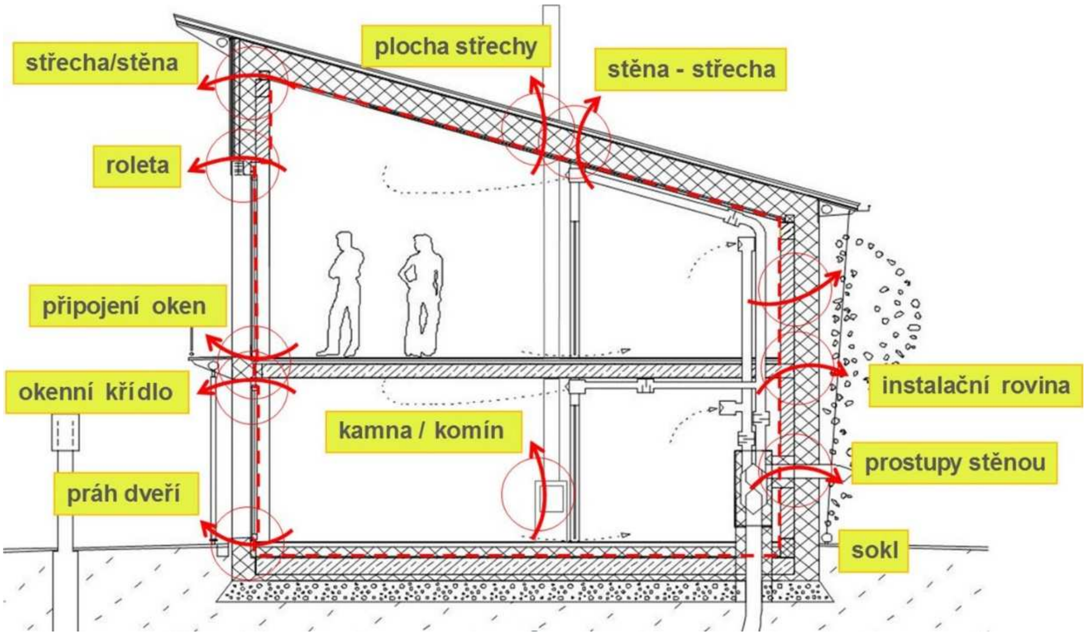


Figure: Most common leakage points

[https://stavba.tzb-info.cz/pasivni-domy/13994-vzduchotesnost-pasivniho-domu]

1.7.5. The main air sealing layer in wooden buildings and the materials used on it

Airtightness in wooden buildings is usually ensured by means of wood-based structural boards, such as OSB boards, or plastic films, i.e. vapour barriers. Both of these options have their advantages and disadvantages, so a combination of the two also seems to be a suitable option.

2. Building and energy analysis

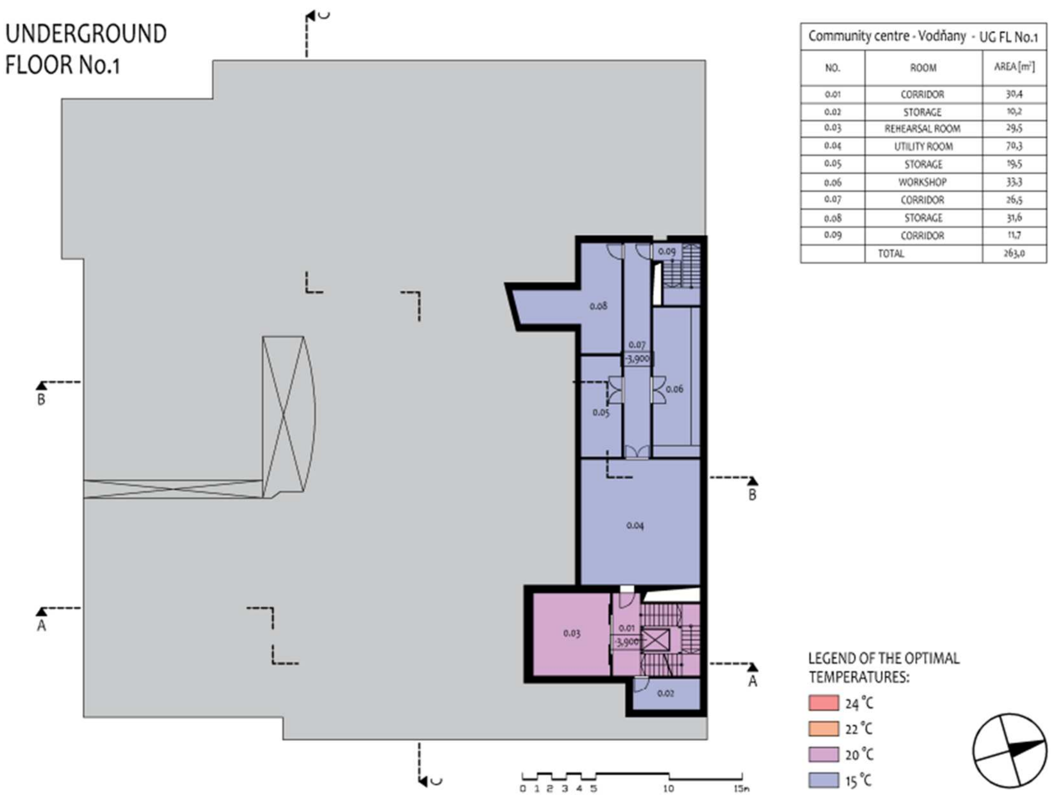
This analysis, which will be based on the above definitions and criteria, will serve to identify issues that will need to be further addressed in the upcoming design of the structural system and the individual compositions of all structures. In particular, the building and its layout will need to be analysed in terms of thermal performance, acoustics, and fire protection.

2.1. Layout of optimal temperatures in the building

Based on the standard ČSN EN 12831, I created a layout of the optimal temperatures in the individual parts of the building.

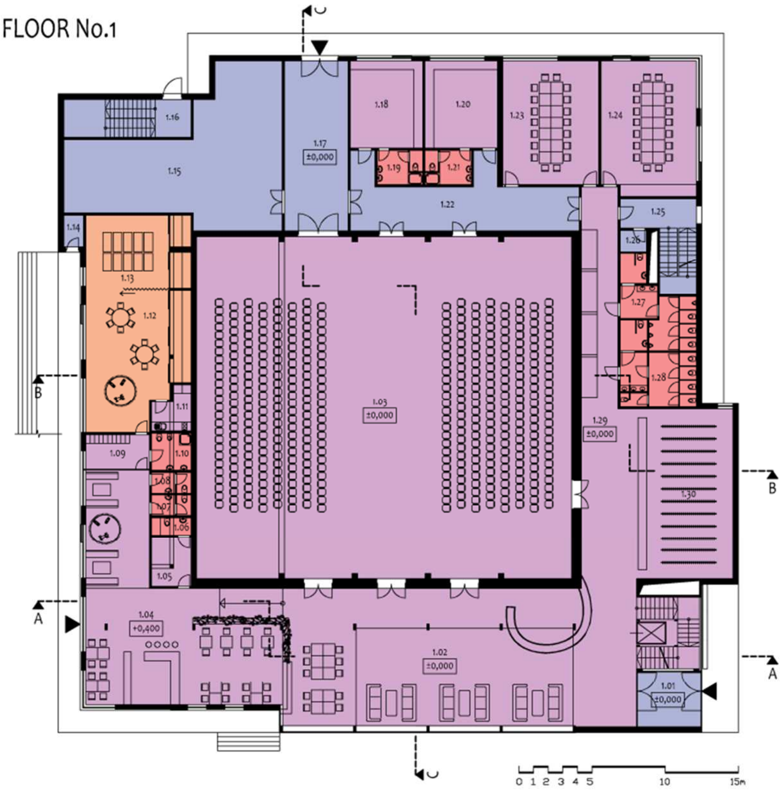
All sanitary facilities should have a temperature of 24 °C, rooms for pre-school children should have a temperature of 22 °C, other rooms such as the cafeteria, club rooms, black box theatre etc. are designed with a temperature of 20 °C, and in other areas such as staircases, corridors, warehouses, storages etc. the temperature should be kept at 15 °C.

This temperature layout should primarily serve to give a better idea of which parts of the building will place more demand on the thermal insulation of the surrounding walls, and will have greater demands on the HVAC systems. I will use this information in the detailed design of the building envelope and other building structures and in the conceptual design of the HVAC system.



Community centre - Vodňany - UG FL No.1		
NO.	ROOM	AREA [m²]
0.01	CORRIDOR	30,4
0.02	STORAGE	10,2
0.03	REHEARSAL ROOM	29,5
0.04	UTILITY ROOM	70,3
0.05	STORAGE	19,5
0.06	WORKSHOP	33,3
0.07	CORRIDOR	26,5
0.08	STORAGE	31,6
0.09	CORRIDOR	11,7
	TOTAL	263,0

FLOOR No.1

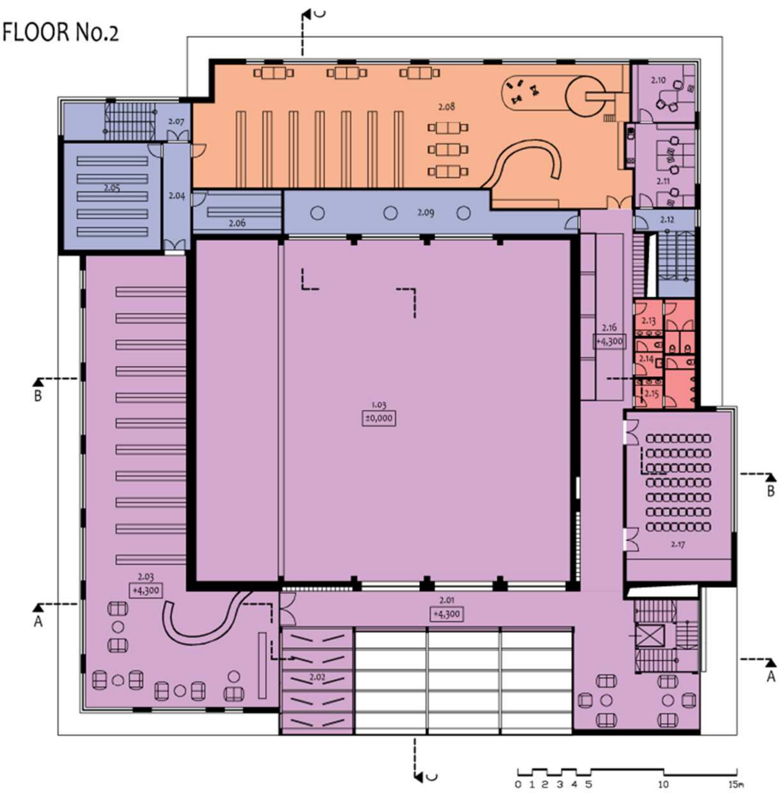


Community centre - Vodňany - FL No.1		
NO.	ROOM	AREA [m²]
1.01	VESTIBULE	16,3
1.02	FOYER + STAIRCASE	252,4
1.03	BLACK BOX THEATRE	601,1
1.04	CAFÉ	142,5
1.05	STORAGE + CLEANING ROOM	9,2
1.06	WC EMPLOYEES	3,2
1.07	WC WOMEN	3,7
1.08	WC MEN	3,7
1.09	CLOAKROOM	10,2
1.10	WC CHILDREN	6,8
1.11	KITCHEN	6,8
1.12	PLAYROOM	61,8
1.13	BEDROOM	36,0
1.14	TOY STORAGE	2,9
1.15	STORAGE	110,9
1.16	CORRIDOR	23,1
1.17	VESTIBULE	50,6
1.18	DRESSING ROOM MEN	29,7
1.19	WC MEN	7,0
1.20	DRESSING ROOM WOMEN	29,7
1.21	WC WOMEN	7,1
1.22	CORRIDOR	55,2
1.23	CLUBROOM	55,5
1.24	CLUBROOM	59,4
1.25	CORRIDOR	21,9
1.26	CLEANING ROOM	2,6
1.27	WC MEN	20,5
1.28	WC WOMEN	22,8
1.29	CORRIDOR	68,9
1.30	CLOAKROOM	92,1
	CELKEM	1814,1

LEGEND OF THE OPTIMAL TEMPERATURES

- 24 °C
- 22 °C
- 20 °C
- 15 °C

FLOOR No.2



Community centre - Vodňany - FL No.2		
NO.	ROOM	AREA [m²]
2.01	FOYER	109,7
2.02	EXHIBITION SPACE	37,3
2.03	LIBRARY	264,8
2.04	CORRIDOR	13,8
2.05	DEPOSITORY	48,5
2.06	DEPOSITORY	18,2
2.07	CORRIDOR	6,5
2.08	CHILDREN'S LIBRARY	262,1
2.09	TECHNICAL FACILITIES	52,0
2.10	OFFICE	17,0
2.11	OFFICE + KITCHEN	25,1
2.12	CORRIDOR	6,2
2.13	WC WOMEN	12,2
2.14	WC EMPLOYEES	5,0
2.15	WC MEN	11,5
2.16	CORRIDOR	89,9
2.17	CINEMA	83,7
	CELKEM	1063,5

1.03	BLACK BOX THEATRE	601,1

LEGEND OF THE OPTIMAL TEMPERATURES

- 24 °C
- 22 °C
- 20 °C
- 15 °C

Note: For full size drawings, see annexes *T-01 to T-03*.

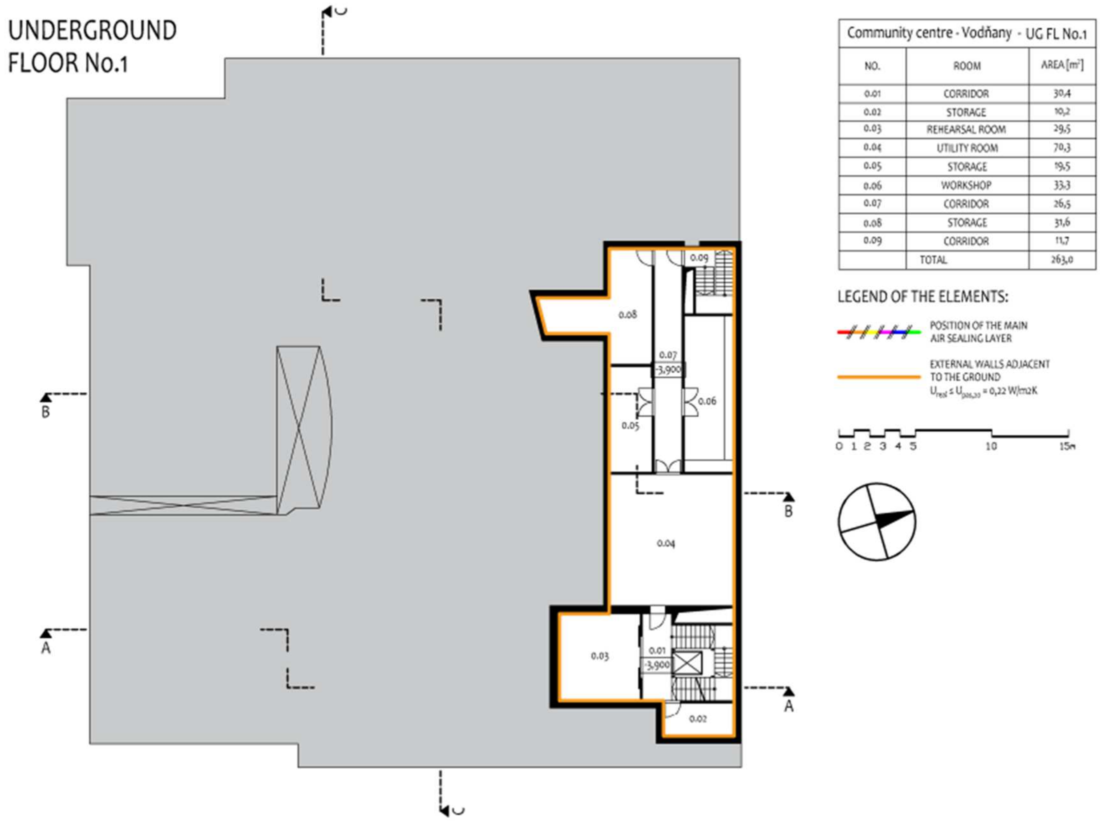
2.2. Recommended values of the heat transfer coefficient U [W/(m2K)]

The values are based on the standard ČSN 73 0540-2, I assigned the recommended values of the heat transfer coefficient to the individual constructions of the building.

For table with recommended values of heat transfer coefficient see paragraph *Heat transfer coeficient.*

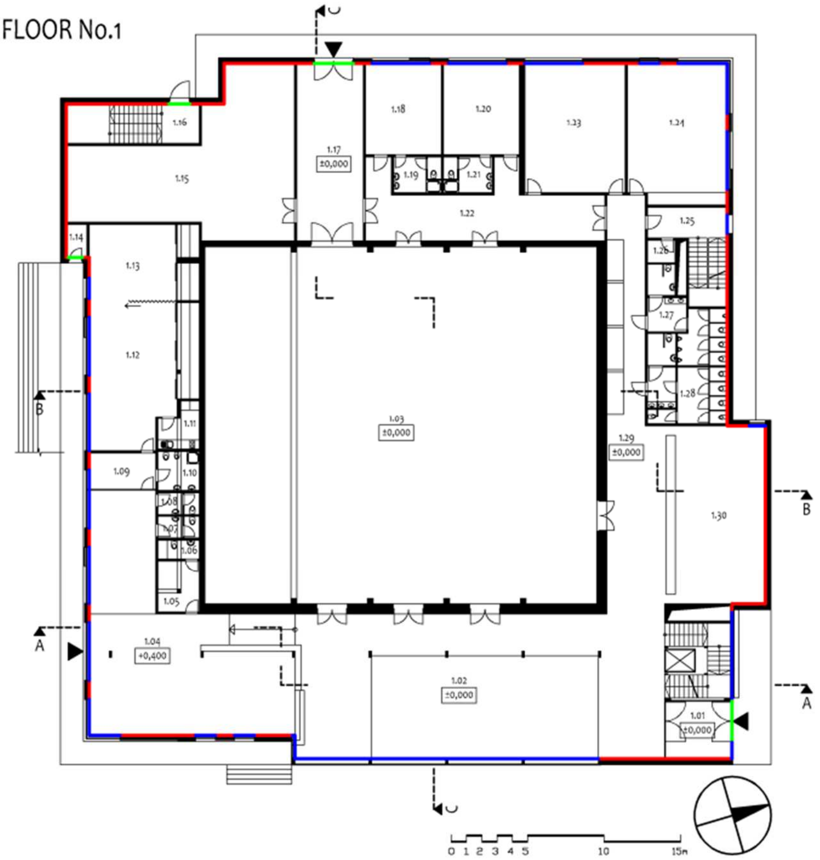
I also marked the position of the main air sealing layer in the building. It will be located as close as possible to the interior side of all envelope structures, that is, in front of the load-bearing part of the structures, so that moisture cannot accumulate in these load-bearing parts.

As with the previous paragraph on temperature layout, this division of individual structures according to their recommended heat transfer coefficient value should help me in the more detailed design of the building envelope, i.e. the exterior walls including windows and entrance doors, roofs and floors on the ground.



Community centre - Vodňany - UG FL No.1		
NO.	ROOM	AREA [m²]
0.01	CORRIDOR	30,4
0.02	STORAGE	10,2
0.03	REHEARSAL ROOM	29,5
0.04	UTILITY ROOM	70,3
0.05	STORAGE	19,5
0.06	WORKSHOP	33,3
0.07	CORRIDOR	26,5
0.08	STORAGE	31,6
0.09	CORRIDOR	11,7
	TOTAL	263,0

FLOOR No.1



Community centre - Vodňany - FL No.1		
NO.	ROOM	AREA [m²]
1.01	VESTIBULE	16,3
1.02	FOYER + STAIRCASE	252,4
1.03	BLACK BOX THEATRE	601,1
1.04	CAFÉ	142,5
1.05	STORAGE + CLEANING ROOM	9,2
1.06	WC EMPLOYEES	3,2
1.07	WC WOMEN	3,7
1.08	WC MEN	3,7
1.09	CLOAKROOM	10,2
1.10	WC CHILDREN	6,8
1.11	KITCHEN	6,8
1.12	PLAYROOM	61,8
1.13	BEDROOM	36,0
1.14	TOY STORAGE	2,9
1.15	STORAGE	110,9
1.16	CORRIDOR	23,1
1.17	VESTIBULE	50,6
1.18	DRESSING ROOM MEN	29,7
1.19	WC MEN	7,0
1.20	DRESSING ROOM WOMEN	29,7
1.21	WC WOMEN	7,1
1.22	CORRIDOR	55,2
1.23	CLUBROOM	55,5
1.24	CLUBROOM	59,4
1.25	CORRIDOR	21,9
1.26	CLEANING ROOM	2,6
1.27	WC MEN	20,5
1.28	WC WOMEN	22,8
1.29	CORRIDOR	68,9
1.30	CLOAKROOM	92,1
	CELKEM	1814,1

LEGEND OF THE ELEMENTS

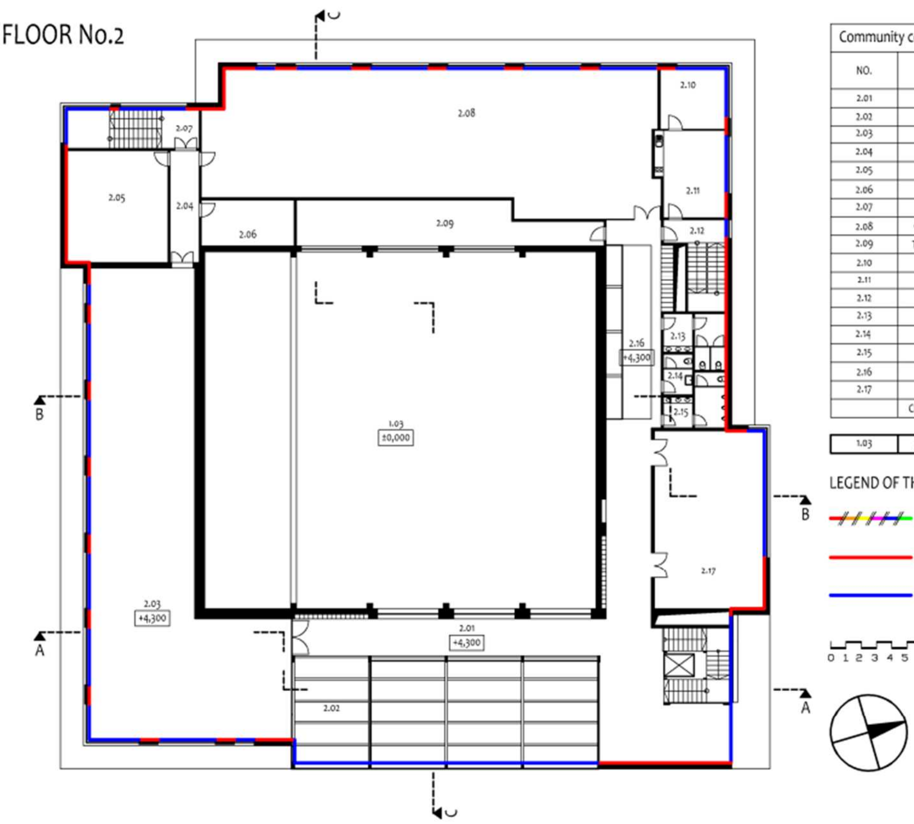
POSITION OF THE MAIN AIR SEALING LAYER

EXTERNAL WALLS $U_{real} \leq U_{pas,20}$ = 0,18 W/m2K

WINDOWS $U_{real} \leq U_{pas,20}$ = 0,8 W/m2K

DOORS $U_{real} \leq U_{pas,20}$ = 0,9 W/m2K

FLOOR No.2



Community centre - Vodňany - FL No.2		
NO.	ROOM	AREA [m²]
2.01	FOYER	109,7
2.02	EXHIBITION SPACE	37,3
2.03	LIBRARY	264,8
2.04	CORRIDOR	13,8
2.05	DEPOSITORY	48,5
2.06	DEPOSITORY	18,2
2.07	CORRIDOR	6,5
2.08	CHILDREN'S LIBRARY	262,1
2.09	TECHNICAL FACILITIES	52,0
2.10	OFFICE	17,0
2.11	OFFICE + KITCHEN	25,1
2.12	CORRIDOR	6,2
2.13	WC WOMEN	12,2
2.14	WC EMPLOYEES	5,0
2.15	WC MEN	11,5
2.16	CORRIDOR	89,9
2.17	CINEMA	83,7
	CELKEM	1063,5

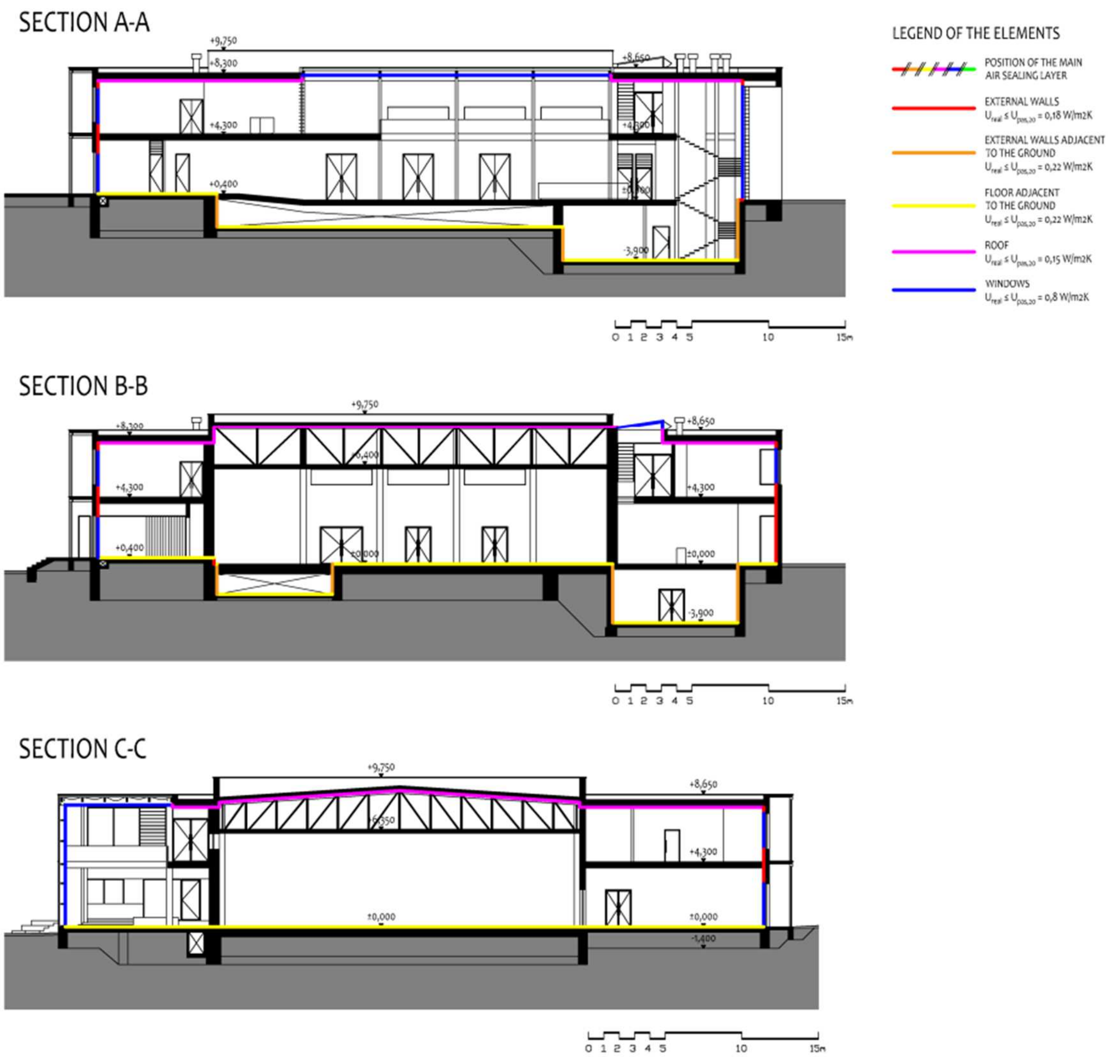
1.03	BLACK BOX THEATRE	601,1

LEGEND OF THE ELEMENTS

POSITION OF THE MAIN AIR SEALING LAYER

EXTERNAL WALLS $U_{real} \leq U_{pas,20}$ = 0,18 W/m2K

WINDOWS $U_{real} \leq U_{pas,20}$ = 0,8 W/m2K



Note: For full size drawings, see annexes *H-01 to H-04*.

2.3. Specific heat demand of the building E_A [kWh/m²a] and heat transfer through the building envelope U_{em} [W/m²k]

After determining the individual standard values of the heat transfer coefficient for each structure, I created a calculation of specific heat demand of the building in relation to the heated area.

I have created two variants of the calculation, they are based on the standard ČSN EN ISO 13790.

This calculations takes into account several parameters. These are the number of people in the building, the total volume and floor area of the building, the type of all envelope structures such as walls, roofs, ground floor, windows and entrance doors. It also considers the ventilation of the building, including the efficiency of heat recovery. Climatic data common for the Czech Republic were used for this calculation.

For all structures I consider their recommended standard values of heat transfer coefficient. My goal is to achieve a value of 15 kWh/(m^{2}a) for specific heat demand of the building in realtion to the heated area, as well as a value of 0,3 W/(m^{2}K) for the building envelope heat transfer coefficient (including exterior walls, roofs, floors in cotact with the ground, windows and entrance doors).

In the first variant I considered the minimum number of people in the building. I consider that the black box theatre is not in use, and that of the remaining number of seats in the building, 80% are occupied for 70% of the opening hours. This is a total of 156 seats (people).

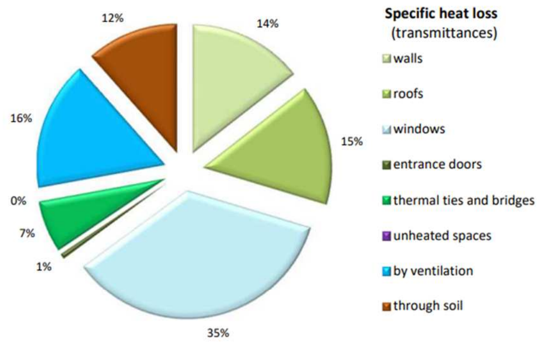
In the second variant I considered the number of people during the operation of the black box theatre. I considered 80% seat occupancy in the black box theatre, and 20% seat occupancy in the rest of the building. Again, I considered occupancy for 70% of the opening hours. This is a total of 372 seats (people).

Variant No.1:

BASIC DATA

Basic description of the zone:

Number of persons	n_{os}	156	os
Presence of persons (percentage of time)	p	70%	
Required indoor temperature	θ_i	20	°C
Volume of zone to be heated	V	18 387,8	m^3
Area of the envelope of the heated zone	A	5 949,1	m^2
Floor area of heated zone	A_f	3141,0	m^2
Volume factor of building form	A/V	0,32	-

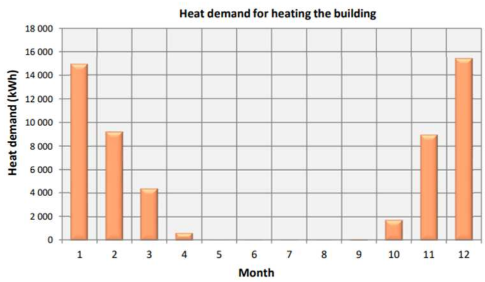


HEAT DEMAND

according to ČSN EN ISO 13790

Heat demand for heating the building Q_h (kWh):

month	period t days d	period t hours hod	outdoor temperature θ_e (°C)	indoor temperature θ_i (°C)	thermal loss Q_L (kWh)	total usable heat gains Q_g (kWh)	heat demand Q_h (kWh)
1	31	744	-1,0	20,0	27 025	12 073	14 952
2	28	672	1,0	20,0	22 323	13 087	9 236
3	31	744	4,0	20,0	21 150	16 753	4 397
4	30	720	9,0	20,0	14 634	13 998	636
5	31	744	14,6	20,0	8 318	8 300	18
6	30	720	17,0	20,0	5 149	5 147	1
7	31	744	18,2	20,0	3 761	3 760	0
8	31	744	18,8	20,0	2 951	2 951	0
9	30	720	13,8	20,0	8 628	8 544	84
10	31	744	9,4	20,0	14 224	12 478	1 745
11	30	720	4,0	20,0	20 117	11 150	8 967
12	31	744	-0,5	20,0	26 305	10 876	15 430
				TOTAL PER YEAR	174 585	119 118	55 466



Specific heat demand of the building:

Specific heat demand of the building in relation to the heated area	E_A	17,7	kWh/(m^2·a)
Specific heat demand of the building in relation to the heated volume	E_V	3,0	kWh/(m^3·a)

HEAT TRANSFER THROUGH THE BUILDING ENVELOPE

according to ČSN 730540-2

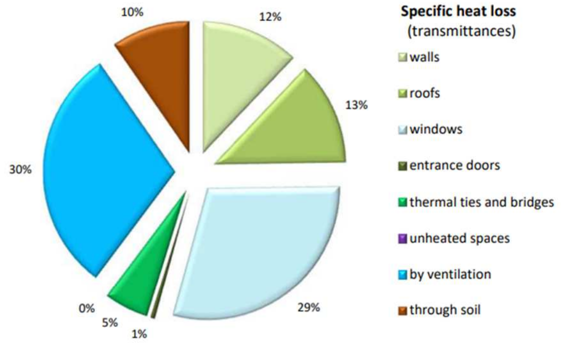
Calculated value	U_{em}	0,26	W/(m^2·K)

Variant No.2:

BASIC DATA

Basic description of the zone:

Number of persons	n_{os}	372	os
Presence of persons (percentage of time)	p	70%	
Required indoor temperature	θ_i	20	°C
Volume of zone to be heated	V	18 387,8	m^3
Area of the envelope of the heated zone	A	5 949,1	m^2
Floor area of heated zone	A_f	3141,0	m^2
Volume factor of building form	A/V	0,32	-

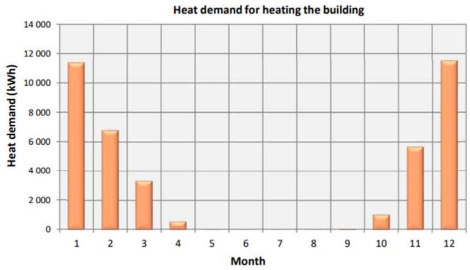


HEAT DEMAND

according to ČSN EN ISO 13790

Heat demand for heating the building Q_h (kWh):

month	period t days d	period t hours hod	outdoor temperature θ_e (°C)	indoor temperature θ_i (°C)	thermal loss Q_L (kWh)	total usable heat gains Q_g (kWh)	heat demand Q_h (kWh)
1	31	744	-1,0	20,0	32 647	21 256	11 392
2	28	672	1,0	20,0	26 918	20 105	6 813
3	31	744	4,0	20,0	25 434	22 098	3 336
4	30	720	9,0	20,0	17 484	16 899	585
5	31	744	14,6	20,0	9 764	9 738	25
6	30	720	17,0	20,0	5 926	5 924	2
7	31	744	18,2	20,0	4 242	4 242	1
8	31	744	18,8	20,0	3 272	3 272	0
9	30	720	13,8	20,0	10 234	10 159	75
10	31	744	9,4	20,0	17 062	16 014	1 048
11	30	720	4,0	20,0	24 263	18 570	5 692
12	31	744	-0,5	20,0	31 794	20 267	11 526
				TOTAL PER YEAR	209 040	168 545	40 496



Specific heat demand of the building:

Specific heat demand of the building in relation to the heated area	E_A	12,9	kWh/(m²·a)
Specific heat demand of the building in relation to the heated volume	E_V	2,2	kWh/(m³·a)

HEAT TRANSFER THROUGH THE BUILDING ENVELOPE

according to ČSN 730540-2

Calculated value U_{em} 0,26 W/(m²·K)

Note: For full calculations, see annexes *Specific heat demand of the building – variant No.1, Specific heat demand of the building – variant No.2*.

As we can see from the results, in the case of the second vairant, i.e. the full use of the building, there is no problem with exceeding the specified maximum values for heat demand of the building and for the heat transfer through the building envelope. However, in the case of the first variant (black box theatre out of service), we can see that we have exceeded the maximum value for heat demand of the building. Therefore, in the project I will try to adjust the building envelope and possibly the operation of the building so that the maximum allowed value for heat demand of the building is not exceeded.

2.4. Standard values of minimum airborne sound insulation R'_w and maximum impact sound $L'_{n,w}$

The following tables shows the values of minimum airborne sound insulation and maximum impact sound for individual constructions in the building, divided according to the use of the building.

The values are based on the standard ČSN 73 0532.

Since the building I am designing in my Master's Thesis is multipurpose, I will use the values from the table that are closest to the actual use of the building. I decided that I will base my values on the table for schools (ČSN 73 0532 – Table 4).

Table 4 - Sound insulation requirements between rooms in schools and educational institutions

Protected area (sound receiving room)					
No.	Noisy area (noise source room)	Sound insulation requirements			
		Ceilings		Walls	Doors
		R'_w, $D_{nT,w}$ [dB]	$L'_{n,w}$, $L'_{nT,w}$ [dB]	R'_w, $D_{nT,w}$ [dB]	R_w [dB]
Schools and educational institutions – classrooms, teaching spaces, teachers' offices					
1	Classrooms, teaching spaces, teachers' offices	≥ 53	≤ 55	≥ 47	≥ 37
2	Common areas, corridors, staircases	≥ 53	≤ 58	≥ 47	≥ 32 ≥ 27
3	Noisy areas (workshops, canteens, playrooms, technical centres) $L_{a,max}$ ≤ 85 dB	≥ 55	≤ 48	≥ 52	-
4	Very noisy areas (music rooms, workshops, gyms) $L_{a,max}$ ≤ 90 dB	≥ 60	≤ 48	≥ 57	-

Table: Sound insulation requirements between rooms in schools and educational institutions

Note: Part of the Table 4 of the standard ČSN 73 0532 (translated into English, all unused values have been deleted)

[ČSN 73 0532 Acoustics – Protection against noise in buildings and evaluation of acoustic properties of building constructions and elements – Requirements]

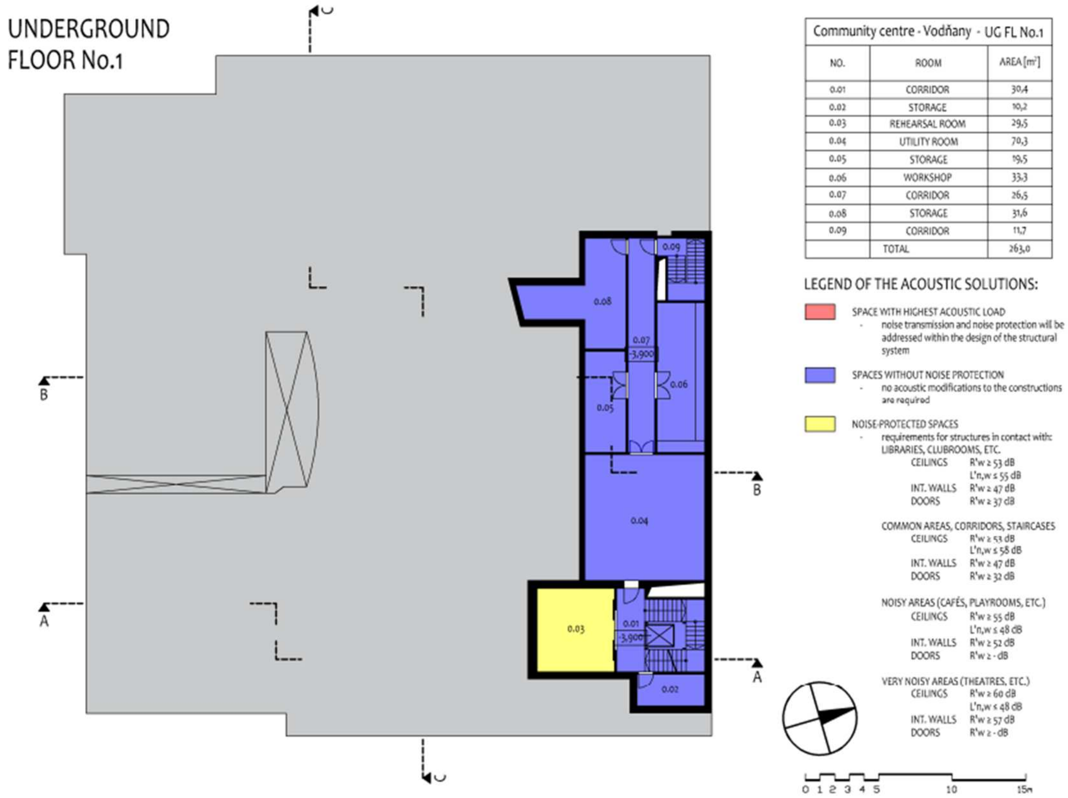
In the following drawings, I have divided the building into different parts depending on their noise level and their need for noise protection.

Some acoustic problems, which can be seen from the following drawings, will have to be addressed by modifying the structural system, in other cases it will be sufficient to comply with the standard values of minimum airborne sound insulation and maximum impact sound. Due to the multi-purpose nature of the building, I have chosen a table of values closest to the use of the individual rooms of the building I am designing. This is Table 4, which sets the acoustic requirements for schools.

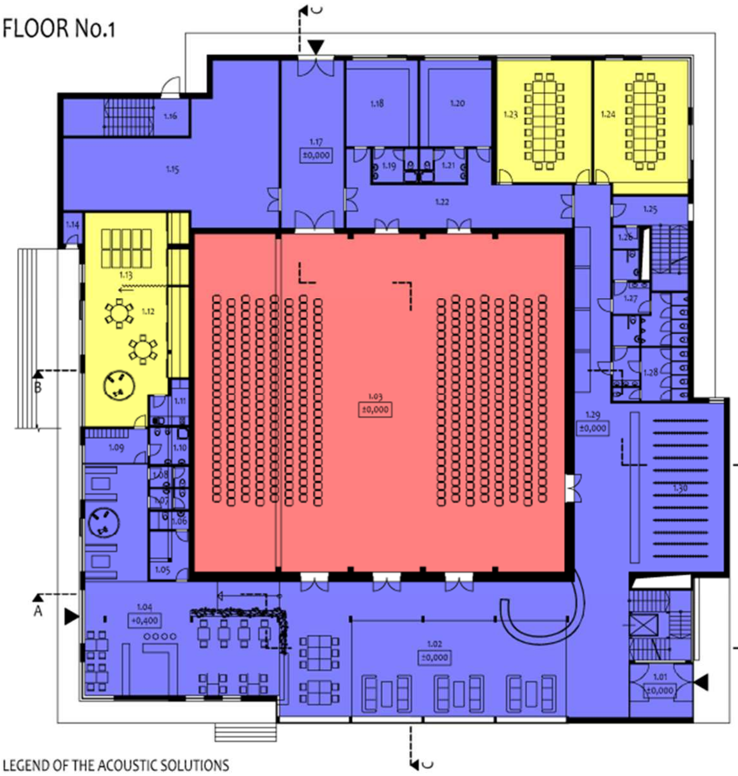
The layout is based on the Table 4 (based on the operation of the building, Table 4 was the closest option to the usage of designed building), see above *Standard values of minimum airborne sound insulation R’w and maximum impact sound L’n,w*.

The layout is as follows:

- space with highest acoustic load: noise transmission and noise protection will be addressed within the design of the structural system
- spaces without noise protection: no acoustic modifications to the constructions are required
- noise-protected spaces: acoustic requirements for structures are based on Table 4



FLOOR No.1



Community centre - Vodňany - FL No.1		
NO.	ROOM	AREA [m²]
1.01	VESTIBULE	16,3
1.02	FOYER + STAIRCASE	252,4
1.03	BLACK BOX THEATRE	601,1
1.04	CAFÉ	142,5
1.05	STORAGE + CLEANING ROOM	9,2
1.06	WC EMPLOYEES	3,2
1.07	WC WOMEN	3,7
1.08	WC MEN	3,7
1.09	CLOAKROOM	10,2
1.10	WC CHILDREN	6,8
1.11	KITCHEN	6,8
1.12	PLAYROOM	61,8
1.13	BEDROOM	36,0
1.14	TOY STORAGE	2,9
1.15	STORAGE	110,9
1.16	CORRIDOR	23,1
1.17	VESTIBULE	50,6
1.18	DRESSING ROOM MEN	29,7
1.19	WC MEN	7,0
1.20	DRESSING ROOM WOMEN	29,7
1.21	WC WOMEN	7,1
1.22	CORRIDOR	55,2
1.23	CLUBROOM	55,5
1.24	CLUBROOM	59,4
1.25	CORRIDOR	21,9
1.26	CLEANING ROOM	2,6
1.27	WC MEN	20,5
1.28	WC WOMEN	22,8
1.29	CORRIDOR	68,9
1.30	CLOAKROOM	92,1
	CELKEM	1814,1

LEGEND OF THE ACOUSTIC SOLUTIONS

SPACE WITH HIGHEST ACOUSTIC LOAD
- noise transmission and noise protection will be addressed within the design of the structural system

SPACES WITHOUT NOISE PROTECTION
- no acoustic modifications to the constructions are required

NOISE-PROTECTED SPACES
- requirements for structures in contact with:

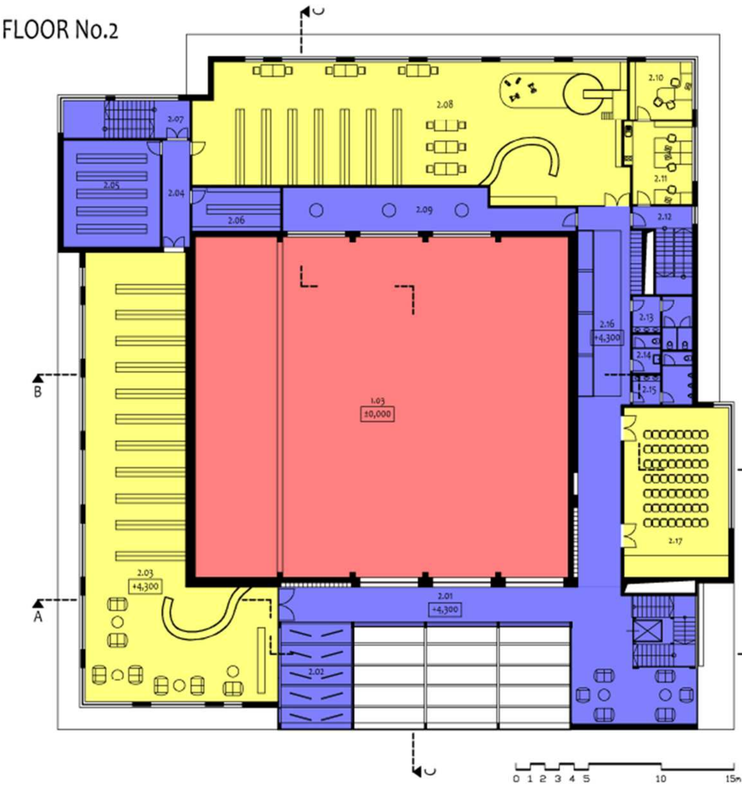
LIBRARIES, CLUBROOMS, ETC.
CEILINGS R'w ≥ 53 dB
L'n,w ≤ 55 dB
INT. WALLS R'w ≥ 47 dB
DOORS R'w ≥ 37 dB

COMMON AREAS, CORRIDORS, STAIRCASES
CEILINGS R'w ≥ 53 dB
L'n,w ≤ 58 dB
INT. WALLS R'w ≥ 47 dB
DOORS R'w ≥ 32 dB

NOISY AREAS (CAFÉS, PLAYROOMS, ETC.)
CEILINGS R'w ≥ 55 dB
L'n,w ≤ 48 dB
INT. WALLS R'w ≥ 52 dB
DOORS R'w ≥ - dB

VERY NOISY AREAS (THEATRES, ETC.)
CEILINGS R'w ≥ 60 dB
L'n,w ≤ 48 dB
INT. WALLS R'w ≥ 57 dB
DOORS R'w ≥ - dB

FLOOR No.2



Community centre - Vodňany - FL No.2		
NO.	ROOM	AREA [m²]
2.01	FOYER	109,7
2.02	EXHIBITION SPACE	37,3
2.03	LIBRARY	264,8
2.04	CORRIDOR	13,8
2.05	DEPOSITORY	48,5
2.06	DEPOSITORY	18,2
2.07	CORRIDOR	6,5
2.08	CHILDREN'S LIBRARY	262,1
2.09	TECHNICAL FACILITIES	52,0
2.10	OFFICE	17,0
2.11	OFFICE + KITCHEN	25,1
2.12	CORRIDOR	6,2
2.13	WC WOMEN	12,2
2.14	WC EMPLOYEES	5,0
2.15	WC MEN	11,5
2.16	CORRIDOR	89,9
2.17	CINEMA	83,7
	CELKEM	1063,5

1.03	BLACK BOX THEATRE	601,1

LEGEND OF THE ACOUSTIC SOLUTIONS

SPACE WITH HIGHEST ACOUSTIC LOAD
- noise transmission and noise protection will be addressed within the design of the structural system

SPACES WITHOUT NOISE PROTECTION
- no acoustic modifications to the constructions are required

NOISE-PROTECTED SPACES
- requirements for structures in contact with:

LIBRARIES, CLUBROOMS, ETC.
CEILINGS R'w ≥ 53 dB
L'n,w ≤ 55 dB
INT. WALLS R'w ≥ 47 dB
DOORS R'w ≥ 37 dB

COMMON AREAS, CORRIDORS, STAIRCASES
CEILINGS R'w ≥ 53 dB
L'n,w ≤ 58 dB
INT. WALLS R'w ≥ 47 dB
DOORS R'w ≥ 32 dB

NOISY AREAS (CAFÉS, PLAYROOMS, ETC.)
CEILINGS R'w ≥ 55 dB
L'n,w ≤ 48 dB
INT. WALLS R'w ≥ 52 dB
DOORS R'w ≥ - dB

VERY NOISY AREAS (THEATRES, ETC.)
CEILINGS R'w ≥ 60 dB
L'n,w ≤ 48 dB
INT. WALLS R'w ≥ 57 dB
DOORS R'w ≥ - dB

Note: For full size drawings, see annexes *S-01 to S-03*.

2.5. Fire protection solutions

The following very simplified design concept for fire protection measures in the building that I designed has been developed on the basis of standards ČSN 73 0802, ČSN 73 0831, ČSN 73 0818, ČSN 73 0821, ČSN 73 0810 and ČSN 73 0833.

This conceptual fire protection design should establish the additional criteria needed to the detailed design of the structural system and compositions of individual constructions, or to identify any necessary changes to the layout or operation of the building.

2.5.1. Escape routes and their accessibility

First I focused on the escape routes from the building, and their accessibility from the main assembly area (which in this case is the black box theatre). It was therefore necessary to determine several values according to the above mentioned standards.

I started with determining the fire height „h_p“, which is needed to continue working with the standards. According to this value, I further determine the height zone „VP“.

h_p = **4,3 m** ≤ 9,0 m => **VP1**

Extract – Division of assembly rooms according to fire height

Internal assembly areas are divided into three height zones in terms of their height position (referred to as VP), that is:

a) VP 1 includes areas on the first underground floor and on above-ground floors up to a fire height hp ≤ 9 m

b) VP 2 includes areas on …

Extract: Division of assembly rooms according to fire height

Note: Part of the Paragraph 4.3 of the standard ČSN 73 0831 ed. 2 (translated into English, all unused values have been deleted)

[ČSN 73 0831 ed. 2 Fire protection of buildings – Assembly rooms]

Next, it was necessary to determine the number of people in the main assembly area (black box theatre). Then, from the combination of the determined height zone, and the considered number of people, I determined the considered number of assembly rooms „SP“.

I was choosing from two options of operations, first option was theatres, cinemas, and community centres with attached seats, second option was the same areas but with unattached seats.

Considering the architectural study, as well as the operation of the main assembly room (black box theatre), I decided for the variant with attached seats.

The number of these seats had to be multiplied by a certain coefficient according to the standard.

Number of people: Attached seats => 416*1,1 = **458 people**

Table 1

No.	Type of space (room)	Floor area in m2 per person	Coefficient by which the number of persons according to the project is multiplied	Explanatory notes
3	EDUCATION, CULTURE, SCIENCE			
3.1	Auditoriums (in theatres, cinemas, community centres, ...)			...
3.1.1	- with attached seats		1,1	
3.1.2	- with unattached seats a) ... b) ...	... ...		...

Table: Number of people considered according to the operation of the room

Note: Part of the Table 1 of the standard ČSN 73 0818 (translated into English, all unused values have been deleted)

[ČSN 73 0818 Fire protection of buildings – Person/surface rate in buildings]

Now that we know both the height zone and the number of people, we can determine the number of assembly rooms „SP" to consider in the black box theatre.

Table A.1: VP1 => 1SP = 200 people

Calculation: 458/200 = 2,29 => **3 SP**

Table A.1 – Limit standard values for indoor assembly rooms

No.	Type	The lowest number of people in the area – SP (indicative floor area of the space)	
		Height zone	
		VP 1	VP 2
3	EDUCATION, CULTURE		
3.1	Auditoriums (in theatres, cinemas, community centres, ...)		
3.1.1	- with attached seats	200 (250)	... (...)
3.1.2	- with unattached seats	... (...)	... (...)

Table: Limit standard values for indoor assembly rooms

Note: Part of the Table A.1 of the standard ČSN 73 0831 ed. 2 (translated into English, all unused values have been deleted)

[ČSN 73 0831 ed. 2 Fire protection of buildings – Assembly rooms]

After this, I can finally determine the number of emergency exits needed from the main assembly area. By number of emergency exits, it is meant the number of exits to the different cardinal points.

Table 1: from 2 SP to 5 SP (including) => min. 3 emergency exits

Designed in the project: **3 emergency exists (1 door north, 3 doors east, 3 doors west)**

Table 1 - The smallest permitted number of emergency exits, the smallest and the largest relative capacity of one escape route

Size of the assembly area	The lowest permitted number of emergency exits	Countable capacity of exits Km in % of total number of persons from the assembly area	
		smallest	largest
up to 2 SP	...	...	...
over 2 SP to 5 SP	3	15	45
over 5 SP to 8 SP	...	...	...

Table: The smallest permitted number of emergency exits, the smallest and the largest relative capacity of one escape route
Note: Part of the Table 1 of the standard ČSN 73 0831 ed. 2 (translated into English, all unused values have been deleted)
[ČSN 73 0831 ed. 2 Fire protection of buildings – Assembly rooms]

After completing the design of the emergency exits, I concluded that the number of exits from the main assembly area (black box theatre) that is proposed in the architectural study is sufficient. The direction of the door openings is also correctly designed. However, a few changes had to be made to the direction of door openings further down the escape routes, see drawins (layouts) below, or see annexes *F-01 to F-04*.

I also added one additional exit to the exterior (from 2 to 3), to match the number of these exits to the number of emergency exits from the main assembly area leading to the escape routes.

2.5.2. Fire protection measures for the whole building

I will also identify several fire protection measures for the building that relate to the operation of the whole building (community centre), its layout, and general fire protection measures.

- Electronic fire alarms "EPS" will be installed in every room except the sanitary facilities.
- Panic bars will be installed on all doors leading from the main assembly area (black box theatre), library, children's library, lecture room, and on all doors in escape routes.
- A hydrant should be located within 20 metres of the building, easily accessible to firefighters in the event of a fire.

2.5.3. Fire resistance of structures

Another part of the fire protection of buildings is the design of the required fire resistance of individual structures. In the following section, I will determine the values needed to specify these resistances according to the standards.

First of all, I will have to determine from the above-mentioned standards and the design of my building the considered fire load and the possibility of using the coefficient „c“ (the coefficient reducing the fire load in case of additional fire protection elements such as electronic fire alarm system, etc.).

The values required to determine:

- considered fire load Table B.1 (standard ČSN 73 0802), standard ČSN 73 0833
- coefficient „c“ Table 2 and 6 (standard ČSN 73 0802)

The considered fire load „$p_{v,max}$“ and the coefficient "c" had to be selected for each individual room.

Table B.1 – Values of the considered fire load p_v

No.	Type of operation	p_v [kg/m^2]
1	Office spaces, writing rooms, study rooms, reading rooms including office spaces equipped with computers	42
2		...
3	Meeting, lecture and conference halls, call rooms, banking and other halls with counters	25
4	Lobbies, waiting rooms, smoking rooms	13
5	Entrances, lobbies, halls, corridors, etc. (if there is seating, tables, wardrobes, display cabinets, etc. in these areas, the procedure for No. 4 or 3 is followed)	7,5
6	...	...
7	...	...
8	Bedrooms in spa facilities, student dormitories, children's homes (in sleeping areas including sanitary facilities), as well as associated staff quarters	35

Table: Values of the considered fire load p_v

Note: Part of the Table B.1 of the standard ČSN 73 0802 ed. 2 (translated into English, all unused values have been deleted)

[ČSN 73 0802 ed. 2 Fire protection of buildings – Non-industrial buildings]

Extract – Values of the considered fire load p_v

For storage rooms and other spaces intended for the storage of various household goods, if they are a separate fire compartment, a considered fire load p_v = 45 kg/m^2 at a factor c = 1,0 may be assumed without further evidence.

Extract: Values of the considered fire load p_v

Note: Part of the Paragraph 5.1.4 of the standard ČSN 73 0833 (translated into English, all unused values have been deleted)

[ČSN 73 0833 Fire protection of buildings – Buildings for dwelling and lodging]

Table 2 – Values of the coefficient c_1

Total area of the assessed fire section S [m^2]	Value of the coefficient c_1			
	Height position of the fire section h_p [m]			
	up to 22,5		over 22,5 to 45	
	Number of floors in the fire section			
	z = 1	z > 1	z = 1	z > 1
up to 250	0,70	...	...	...
over 250 to 500	0,75	...	...	...
over 500 to 1000	...	0,85	...	...
over 1000	...	...	...	...

Table: Values of coefficient c_1

Note: Part of the Table 2 of the standard ČSN 73 0802 ed. 2 (translated into English, all unused values have been deleted)

[ČSN 73 0802 ed. 2 Fire protection of buildings – Non-industrial buildings]

Table 6 – Values of the coefficient c_4

Total area of the assessed fire section S [m²]	Value of the coefficient c_4			
	Height position of the fire section h_p [m]			
	up to 22,5		over 22,5 to 45	
	Number of floors in the fire section			
	z = 1	z > 1	z = 1	z > 1
up to 250	...	...	...	...
over 250 to 500	...	...	...	...
over 500 to 1000	...	0,70	...	...
over 1000	...	...	...	...

Table: Values of coefficent c_4

Note: Part of the Table 6 of the standard ČSN 73 0802 ed. 2 (translated into English, all unused values have been deleted)

[ČSN 73 0802 ed. 2 Fire protection of buildings – Non-industrial buildings]

Next, I had to determine the flammability of the structural systém of the designed building, and also its fire height, which I know thanks to the sections of the building from the architectural study.

The information and values required to determine:

- structural system	underground floor	non-flammable	(reinforced concrete)
	black box theatre	non-flammable	(reinforced concrete)
	rest of the building	flammable	(wood)
- fire height	h_p = 4,3 m		

Note: The determination of the flammability of the structural system depends on the mutual design of the structural system and the fire protection design, it is not possible to design one before the other.

See the design of the structural system in section *2.6 Structural system*, or annexes *D.1.2-1 to D.1.2-3*.

In the following table, I have divided all rooms of the building into individual fire sections „PÚ“ some of which are unprotected escape routes „NÚC“ (see drawings below, or annexes *F-01 to F-03*). Then, I selected the highest considered fire load „$p_{v,max}$“ for each fire section from all the rooms contained. After that, I multiplied this value by a coefficient „c“ to determine the final considered fire load value „$p_{v,final}$“.

All of the values determined above and the distribution of fire sections will then help me to determine the fire protection level „SPB“ (standard ČSN 73 0831 – Table 8).

The value of the fire protection level can also be seen in the following table. The table of standards from which I determined the fire protection level can be seen below the following table.

Fire sections PÚ and fire protection level SPB

PÚ/NÚC	NO.	ROOM	AREA [m²]	$p_{v,tab}$ [kg/m²]	$p_{v,max}$ [kg/m²]	* c [-]	$p_{v,final}$ [kg/m²]	SPB
PÚ	0.02	STORAGE	10,2	45,0	45,0	1,0	45,0	II.
PÚ	0.03	REHEARSAL ROOM	29,5	42,0	45,0	0,7	31,5	II.
	0.04	AIR CONDITIONING ROOM	70,3	WITHOUT (OR LOWER) FIRE RISK				
	0.05	BOILER ROOM	19,5	WITHOUT (OR LOWER) FIRE RISK				
	0.06	WORKSHOP	33,3	42,0				
	0.08	STORAGE	31,6	45,0				
NÚC	0.01	CORRIDOR	30,4	7,5	13,0	0,85	11,1	III.
	0.07	CORRIDOR	26,5	7,5				
	0.09	CORRIDOR	11,7	7,5				
	1.01	VESTIBULE	16,3	7,5				
	1.02	FOYER + STAIRCASE	252,4	13,0				
	1.17	VESTIBULE	50,6	7,5				
	1.22	CORRIDOR	55,2	7,5				
	1.25	CORRIDOR	21,9	7,5				
	1.29	CORRIDOR	68,9	7,5				
	2.01	FOYER	109,7	13,0				
	2.12	CORRIDOR	6,2	7,5				
	2.16	CORRIDOR	89,9	7,5				
PÚ	1.03	BLACK BOX THEATRE	601,1	25,0	25,0	0,7	17,5	II.
PÚ	1.04	CAFÉ	142,5	25,0				IV.
	1.05	STORAGE + CLEANING ROOM	9,2	45,0				
	1.06	WC EMPLOYEES	3,2	WITHOUT (OR LOWER) FIRE RISK				
	1.07	WC WOMEN	3,7	WITHOUT (OR LOWER) FIRE RISK				
	1.08	WC MEN	3,7	WITHOUT (OR LOWER) FIRE RISK				
	1.09	CLOAKROOM	10,2	13,0	45,0	0,75	33,8	
	1.10	WC CHILDREN	6,8	WITHOUT (OR LOWER) FIRE RISK	(35,0)	0,75	(26,3)	
	1.11	KITCHEN	6,8	WITHOUT (OR LOWER) FIRE RISK				
	1.12	PLAYROOM	61,8	35,0				
	1.13	BEDROOM	36,0	35,0				
	1.14	TOY STORAGE	2,9	45,0				
	1.15	STORAGE	110,9	45,0				
NÚC	1.16	CORRIDOR	23,1	7,5	7,5	0,75	5,6	II.
	2.04	CORRIDOR	13,8	7,5				
	2.07	CORRIDOR	6,5	7,5				
PÚ	1.18	DRESSING ROOM MEN	29,7	13,0	25,0	0,7	17,5	III.
	1.19	WC MEN	7,0	WITHOUT (OR LOWER) FIRE RISK				
	1.20	DRESSING ROOM WOMEN	29,7	13,0				
	1.21	WC WOMEN	7,1	WITHOUT (OR LOWER) FIRE RISK				
	1.23	CLUBROOM	55,5	25,0				
	1.24	CLUBROOM	59,4	25,0				

PÚ	1.26	CLEANING ROOM	2,6	WITHOUT (OR LOWER) FIRE RISK	13,0	0,7	9,1	II.
	1.27	WC MEN	20,5	WITHOUT (OR LOWER) FIRE RISK				
	1.28	WC WOMEN	22,8	WITHOUT (OR LOWER) FIRE RISK				
	1.30	CLOAKROOM	92,1	13,0				
PÚ	2.02	EXHIBITION SPACE	37,3	45,0	45,0	0,7	31,5	IV.
PÚ	2.03	LIBRARY	264,8	42,0	45,0	0,75	33,8	IV.
	2.05	DEPOSITORY	48,5	45,0	(42,0)	0,75	(31,5)	
PÚ	2.06	DEPOSITORY	18,2	45,0				IV.
	2.08	CHILDREN'S LIBRARY	262,1	42,0	45,0	0,75	33,8	
	2.09	TECHNICAL FACILITIES	52,0	WITHOUT (OR LOWER) FIRE RISK	(42,0)	0,75	(31,5)	
	2.10	OFFICE	17,0	42,0				
	2.11	OFFICE + KITCHEN	25,1	42,0				
PÚ	2.13	WC WOMEN	12,2	WITHOUT (OR LOWER) FIRE RISK	25,0	0,7	17,5	III.
	2.14	WC EMPLOYEES	5,0	WITHOUT (OR LOWER) FIRE RISK				
	2.15	WC MEN	11,5	WITHOUT (OR LOWER) FIRE RISK				
	2.17	LECTURE ROOM	83,7	25,0				

Table – Fire sections PÚ and fire protection level SPB

Table – Fire protection level of fire sections

Konstrukční systém	Výpočtové požární zatížení p_v [kg/m^2]	Nejnižší stupeň požární bezpečnosti požárního úseku						
		I.	II.	III.	IV.	V.	VI.	VII.
		maximální požární výška objektu h [m]						
nehořlavý	≤ 15	12	30	60				
	15,1–30	0	12	30	bez omezení			
	30,1–45	0	6	22,5	45			
	45,1–60	0	6	12	30	45		
	60,1–90	0	0	6	12	30	45	
	90,1–120	nelze	0	0	6	12	30	45
	> 120	nelze	nelze	0	0	6	12	30
hořlavý	≤ 10	4	9	12	12	12	nelze	nelze
	10,1–20	0	4	9	12	12	nelze	nelze
	20,1–30	0	4	9	12	12	nelze	nelze
	30,1–40	0	0	4	9	12	nelze	nelze
	40,1–60	nelze	0	4	4	9	nelze	nelze
	60,1–80	nelze	0	0	4	9	nelze	nelze
	> 80	nelze	nelze	0	0	4	nelze	nelze

Table: Fire protection level of fire sections

[https://www.tzb-info.cz/pozarni-bezpecnost-staveb/13654-pozarni-riziko-a-stupen-pozarni-bezpecnosti]

Now that I know the fire protection levels „SPB“ of the individual fire sections „PÚ“ („NÚC“), I can move on to determining the required fire resistance of the individual structures in the building. The required fire resistance values are based on standard ČSN 73 0802 ed.2 – Table 12. These fire resistance values of individual structures will be entered directly into the drawings that can be seen on the following pages, or in annexes *F-01 to F-03*.

The division into individual fire sections, fire protection measures, and required fire resistance of individual structures can be seen in the drawings on the following pages, or in annexes *F-01 to F-03*.

Fire resistance limit states used in the drawings *F-1 to F-03*:

R load-bearing capacity and stability

E integrity

I insulating ability

W limitation of heat radiation

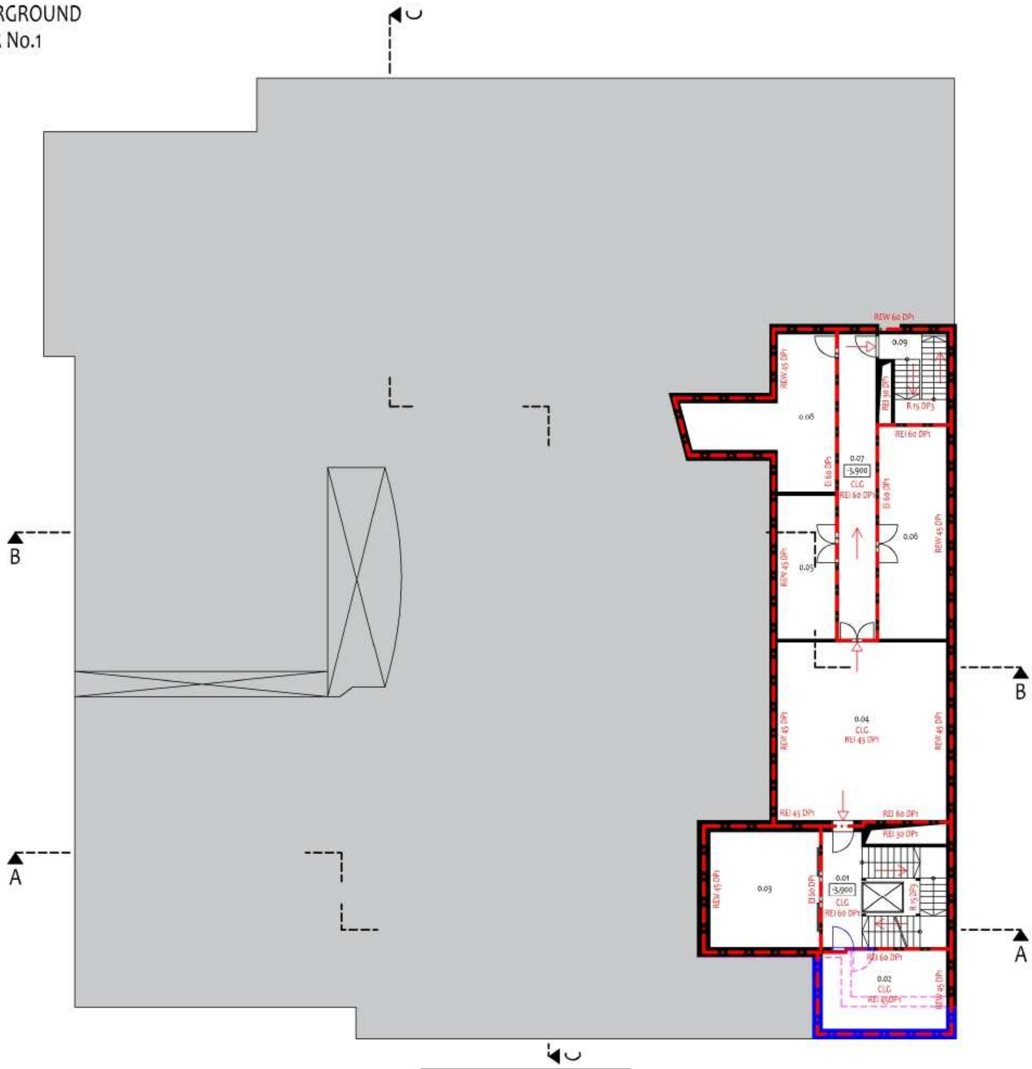
Fire protection measures for the whole building:

- Electronic fire alarms "EPS" will be installed in every room except the sanitary facilities.
- Panic bars will be installed on all doors leading from the main assembly area (black box theatre), library, children's library, lecture room, and on all doors in escape routes.

Note: All values (especially the fire protection levels and the fire resistance values of individual structures) in this section (*2.5 Fire protection solutions*) are only indicative, serving only for basic conceptual design. In no case should they be used for the final design of the fire protection of this building, which would have to be made by an expert who is specialized in the field of fire protection of buildings and would have to be supported by a detailed calculation.

However, this detailed design is not part of this Master’s Thesis.

UNDERGROUND
FLOOR No.1



LEGEND OF THE ELEMENTS:

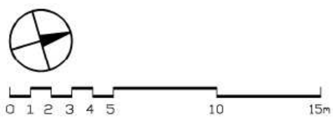
- FIRE SECTION "PÚ"
- 60DP1, 45, ... REQUIRED FIRE RESISTANCE
- CLG 30, ... REQUIRED FIRE RESISTANCE (CEILINGS)
- EMERGENCY EXIT SIGN
- DIRECTION OF THE ESCAPE ROUTE
- EMERGENCY EXIT TO THE EXTERIOR
- ZOKT SMOKE AND HEAT EXTRACTION DEVICE
- CHANGES IN LAYOUT OR STRUCTURES FOR FIRE PRTECTION REASONS:
  - NEW ELEMENTS
  - REMOVED ELEMENTS

FIRE RESISTANCE LIMIT STATES:

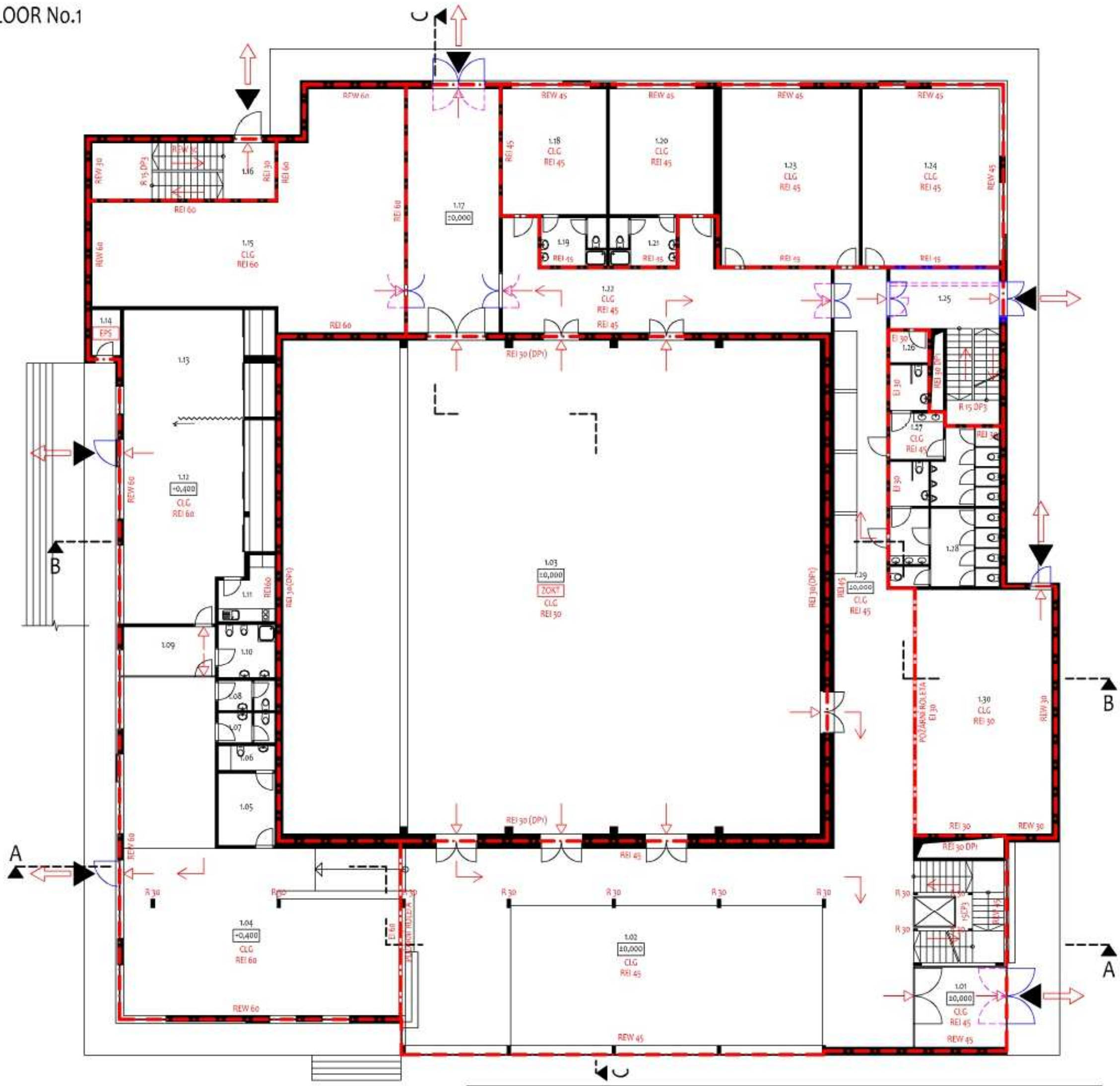
- R LOAD-BEARING CAPACITY AND STABILITY
- E INTEGRITY
- I INSULATING ABILITY
- W LIMITATION OF HEAT RADIATION

Community centre - Vodňany - UG FL No.1

NO.	ROOM	AREA [m²]
0.01	CORRIDOR	30,4
0.02	STORAGE	10,2
0.03	REHEARSAL ROOM	29,5
0.04	UTILITY ROOM	70,3
0.05	STORAGE	19,5
0.06	WORKSHOP	33,3
0.07	CORRIDOR	26,5
0.08	STORAGE	31,6
0.09	CORRIDOR	11,7
	TOTAL	263,0



FLOOR No.1

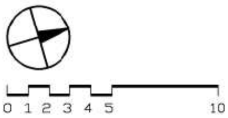


LEGEND OF THE ELEMENTS:

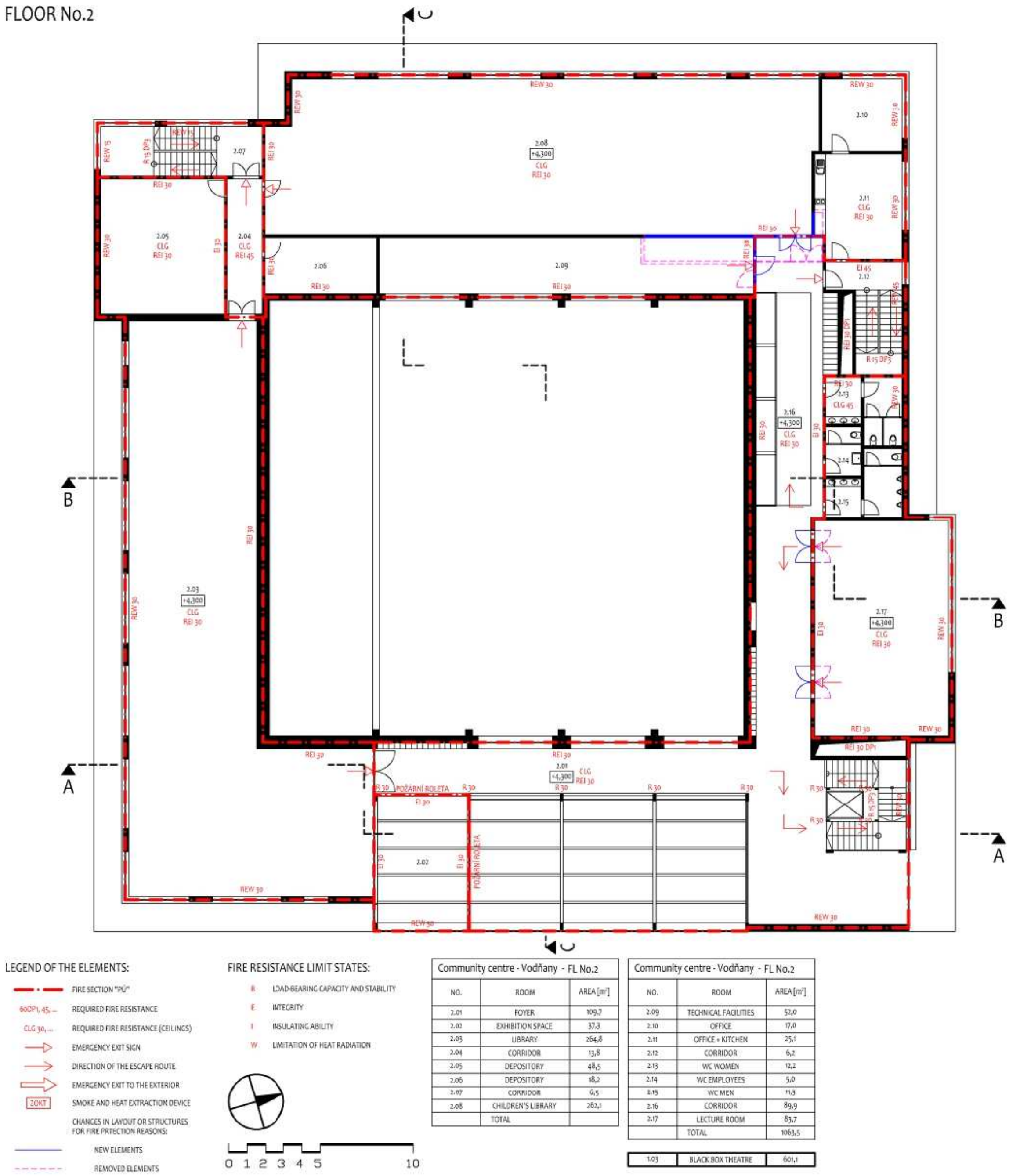
- FIRE SECTION "PÚ"
- 60DP1, 45, ... REQUIRED FIRE RESISTANCE
- CLG 30, ... REQUIRED FIRE RESISTANCE (CEILINGS)
- EMERGENCY EXIT SIGN
- DIRECTION OF THE ESCAPE ROUTE
- EMERGENCY EXIT TO THE EXTERIOR
- ZOKT SMOKE AND HEAT EXTRACTION DEVICE
- CHANGES IN LAYOUT OR STRUCTURES FOR FIRE PRTECTION REASONS:
  - NEW ELEMENTS
  - REMOVED ELEMENTS

FIRE RESISTANCE LIMIT STATES:

- R LOAD-BEARING CAPACITY AND STABILITY
- E INTEGRITY
- I INSULATING ABILITY
- W LIMITATION OF HEAT RADIATION



Community centre - Vodňany - FL No.1			Community centre - Vodňany - FL No.1			Community centre - Vodňany - FL No.1		
NO.	ROOM	AREA [m²]	NO.	ROOM	AREA [m²]	NO.	ROOM	AREA [m²]
1.01	VESTIBULE	16,3	1.11	KITCHEN	6,8	1.21	WC WOMEN	7,1
1.02	FOYER + STAIRCASE	257,4	1.12	PLAYROOM	61,8	1.22	CORRIDOR	55,2
1.03	BLACK BOX THEATRE	601,1	1.13	BEDROOM	36,0	1.23	CLUBROOM	55,5
1.04	CAFÉ	142,5	1.14	TOY STORAGE	2,9	1.24	CLUBROOM	59,4
1.05	STORAGE + CLEANING ROOM	9,2	1.15	STORAGE	110,9	1.25	CORRIDOR	21,9
1.06	WC EMPLOYEES	3,2	1.16	CORRIDOR	23,1	1.26	CLEANING ROOM	2,6
1.07	WC WOMEN	3,7	1.17	VESTIBULE	50,6	1.27	WC MEN	20,5
1.08	WC MEN	3,7	1.18	DRESSING ROOM MEN	29,7	1.28	WC WOMEN	22,8
1.09	CLOAKROOM	10,2	1.19	WC MEN	7,0	1.29	CORRIDOR	68,9
1.10	WC CHILDREN	6,8	1.20	DRESSING ROOM WOMEN	29,7	1.30	CLOAKROOM	92,1
	TOTAL			TOTAL			TOTAL	1814,1



Community centre - Vodňany - FL No.2		
NO.	ROOM	AREA [m²]
2.01	FOYER	109,7
2.02	EXHIBITION SPACE	37,3
2.03	LIBRARY	264,8
2.04	CORRIDOR	13,8
2.05	DEPOSITORY	48,5
2.06	DEPOSITORY	18,2
2.07	CORRIDOR	6,5
2.08	CHILDREN'S LIBRARY	262,1
	TOTAL	

Community centre - Vodňany - FL No.2		
NO.	ROOM	AREA [m²]
2.09	TECHNICAL FACILITIES	52,0
2.10	OFFICE	17,0
2.11	OFFICE + KITCHEN	25,1
2.12	CORRIDOR	6,2
2.13	WC WOMEN	12,2
2.14	WC EMPLOYEES	5,0
2.15	WC MEN	11,5
2.16	CORRIDOR	89,9
2.17	LECTURE ROOM	83,7
	TOTAL	1063,5

1.03	BLACK BOX THEATRE	601,1

Note: Fire resistance was only determined for walls, ceilings (floors) and installation shafts. The fire resistance of doors, windows or other building components will be added to the section D.1.3 FIRE PROTECTION SOLUTIONS, if necessary.

For full size drawings, see drawings *D.1.3-1 to D.1.3-3 in subdivision D.1.3 FIRE PROTECTION SOLUTIONS*.

2.6. Structural system

After developing all the parts above (*Optimal temperatures, Values of the heat transfer coefficient, Specific heat demand and Heat transfer, Min. airborne sound insulation and Max. impact sound, Fire protection solutions*), through which I have established the conditions relating to either the structural system, the individual structures or the operation of the building, I can move on to the design of the structural system.

The selection of a suitable construction system needs to be looked at from several perspectives.

2.6.1. Factors influencing the selection of the construction system

- Environmental and material recyclability aspects:

  Wood structure seems to be the best option in terms of environmental sustainability and recyclability. Most of the structures contained in a wooden building can either be reused or recycled with much greater efficiency than, for example, concrete or steel.

- Energy performance, thermal and humidity aspects:

  In terms of energy efficiency and thermo-technical design, the load-bearing part of the structure does not have such an influence. The most important factor is the correct design of the thermal insulation and other components of the individual envelope structures.

  However, heavy structures (e.g. concrete structures) have better heat accumulation. However, I have to take into consideration that the building I am designing is a community centre, while heat accumulation plays a significant role mainly in residential buildings or buildings where people spend time for most of the day.

- Moisture spreading and its effects:

  In terms of moisture, wood is more vulnerable, as it can degrade more quickly. Moisture can also favour the spread of organic pests, whether wood-destroying fungi or insects. In the construction of timber buildings, therefore, much more care must be taken to ensure that all structures, joints, vapour barriers, etc., are correctly constructed.

- Acoustics and noise transmission through structures:

  In the section focused on acoustics I came to the conclusion that it would be necessary to separate the black box theatre from the rest of the building. This will therefore be reflected in the structural system, where a double load-bearing structure with a wide enough air gap will be needed around the black box theatre to prevent noise from spreading to the rest of the building. Also, to achieve better acoustic results in the black box theatre, it would be better to make its envelope structures of a heavy, more absorbent material such as concrete.

- Fire protection aspects:

  After completion of the fire protection part of the research, I came to the conclusion that the structures of the underground floor will need to be made of non-combustible materials, preferably concrete, while the above-ground floors will meet all the requirements for fire protection even if they are designed as a combustible structural system, i.e. a wooden structure.

- Aspect of the layout and operation of the building:

  From the architectural design it can be seen that the building is divided into smaller parts or rooms, and apart from the black box theatre and the foyer there are no large open spaces. From this point of view, it would be suitable to use a combined system of load-bearing walls and columns. The wall system will also add to the overall rigidity of the building and no additional bracing should be required.

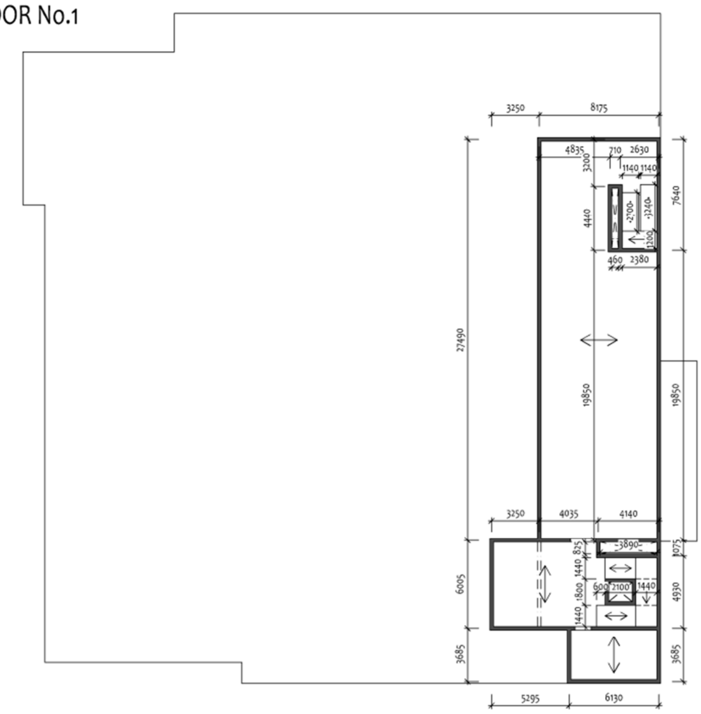
2.6.2. Structural system selection

After considering all the above mentioned aspects, I decided to choose this design system.

- underground floor: monolithic structures made of reinforced concrete
  system of load-bearing walls
  one-way floor slab system
- black box theatre: monolithic load-bearing walls made of reinfored concrete
  steel truss beams
- rest of the building: system of load-bearing walls and columns reinfored with beams
  one-way floor slab system
  wooden structures (SWP/CLT, BSH GL30)

In the following you can see the drawings of the structural system. The widths and dimensions of the individual load-bearing structures will have to be specified as part of the structural calculation.

UNDERGROUND FLOOR No.1



MATERIAL SOLUTION:

- LOAD-BEARING WALLS: (black box theatre) — RC, monolithic, thickness TBD; C30/37 XC1 (CZ) - Cl 0,2 - D_{max} 16 - S3
- LOAD-BEARING WALLS: (underground floor) — RC, monolithic, thickness TBD; C30/37 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3
- LOAD-BEARING WALLS: (rest of the building) — solid wooden panels, thickness TBD; CLT C24
- COLUMNS: (corner windows) — steel, dimensions TBD; S355J2
- COLUMNS: (rest of the building) — wood, dimensions TBD; KVH C24
- TRUSS BEAMS: (black box theatre) — steel / wood, dimensions TBD; KVH/DUO C24 (S4S)
- BEAMS: (underground floor) — RC, monolithic, dimensions TBD; C30/37 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3
- BEAMS: (rest of the building) — wood, dimensions TBD; BSH GL30
- FLOOR SLABS: (underground floor) — RC, monolithic, thickness TBD; C30/37 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3
- FLOOR SLABS: (rest of the building) — wood, thickness TBD; SWP + BSH GL32h
- STAIRCASE: (underground floor) — RC, prefabricated, dimensions TBD; C30/37 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3
- STAIRCASE: (rest of the building) — wood, dimensions TBD; KVH C24
- FOUNDATIONS: — plain c., monolithic, dimensions TBD; C25/30 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3

MATERIALS USED:

REINFORCED CONCRETE STRUCTURES:
- CONCRETE C30/37 XC1 (CZ) - Cl 0,2 - D_{max} 16 - S3
- CONCRETE C30/37 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3
- STEEL B 500 B

FOUNDATIONS:
- CONCRETE C25/30 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3

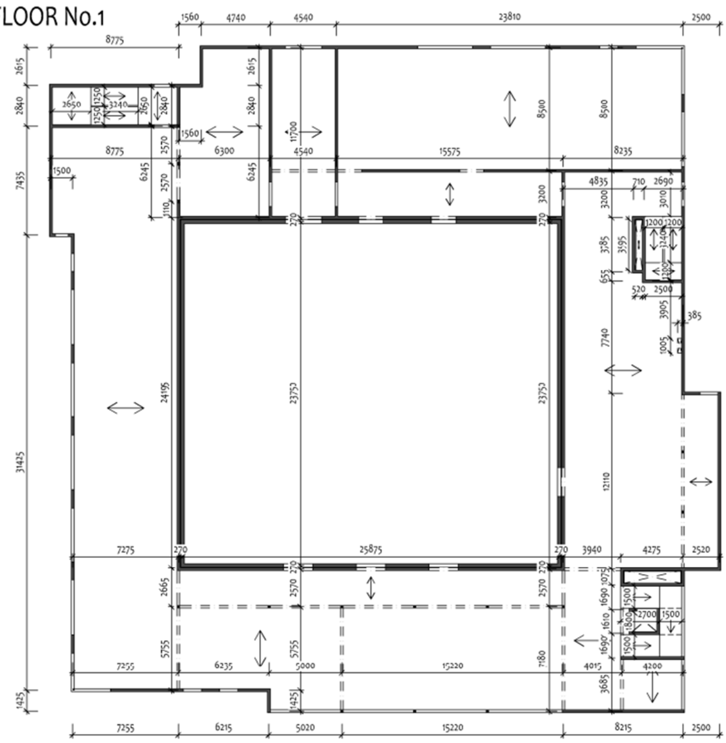
TRUSS BEAMS:
- WOOD KVH/DUO C24 (S4S)

WOODEN STRUCTURES:
- WOOD KVH C24
- WOOD CLT C24
- WOOD SWP + BSH GL32h
- WOOD BSH GL30

CONSTRUCTION SOLUTION:

- UDERGROUND FLOOR:
  - monolithic constructions made of reinforced concrete
  - system of load-bearing walls
  - one-way floor slab system
- BLACK BOX THEATRE
  - monolithic load-bearing walls made of reinforced concrete
  - steel / wooden truss beams
- REST OF THE BUILDING
  - combined system of load-bearing walls and columns reinforced with beams
  - one-way floor slab system
  - wooden scructures (KVH, CLT, SWP, BSH)

FLOOR No.1



MATERIAL SOLUTION:

- LOAD-BEARING WALLS: (black box theatre) — RC, monolithic, thickness TBD; C30/37 XC1 (CZ) - Cl 0,2 - D_{max} 16 - S3
- LOAD-BEARING WALLS: (underground floor) — RC, monolithic, thickness TBD; C30/37 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3
- LOAD-BEARING WALLS: (rest of the building) — solid wooden panels, thickness TBD; CLT C24
- COLUMNS: (corner windows) — steel, dimensions TBD; S355J2
- COLUMNS: (rest of the building) — wood, dimensions TBD; KVH C24
- TRUSS BEAMS: (black box theatre) — steel / wood, dimensions TBD; KVH/DUO C24 (S4S)
- BEAMS: (underground floor) — RC, monolithic, dimensions TBD; C30/37 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3
- BEAMS: (rest of the building) — wood, dimensions TBD; BSH GL30
- FLOOR SLABS: (underground floor) — RC, monolithic, thickness TBD; C30/37 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3
- FLOOR SLABS: (rest of the building) — wood, thickness TBD; SWP + BSH GL32h
- STAIRCASE: (underground floor) — RC, prefabricated, dimensions TBD; C30/37 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3
- STAIRCASE: (rest of the building) — wood, dimensions TBD; KVH C24
- FOUNDATIONS: — plain c., monolithic, dimensions TBD; C25/30 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3

MATERIALS USED:

REINFORCED CONCRETE STRUCTURES:
- CONCRETE C30/37 XC1 (CZ) - Cl 0,2 - D_{max} 16 - S3
- CONCRETE C30/37 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3
- STEEL B 500 B

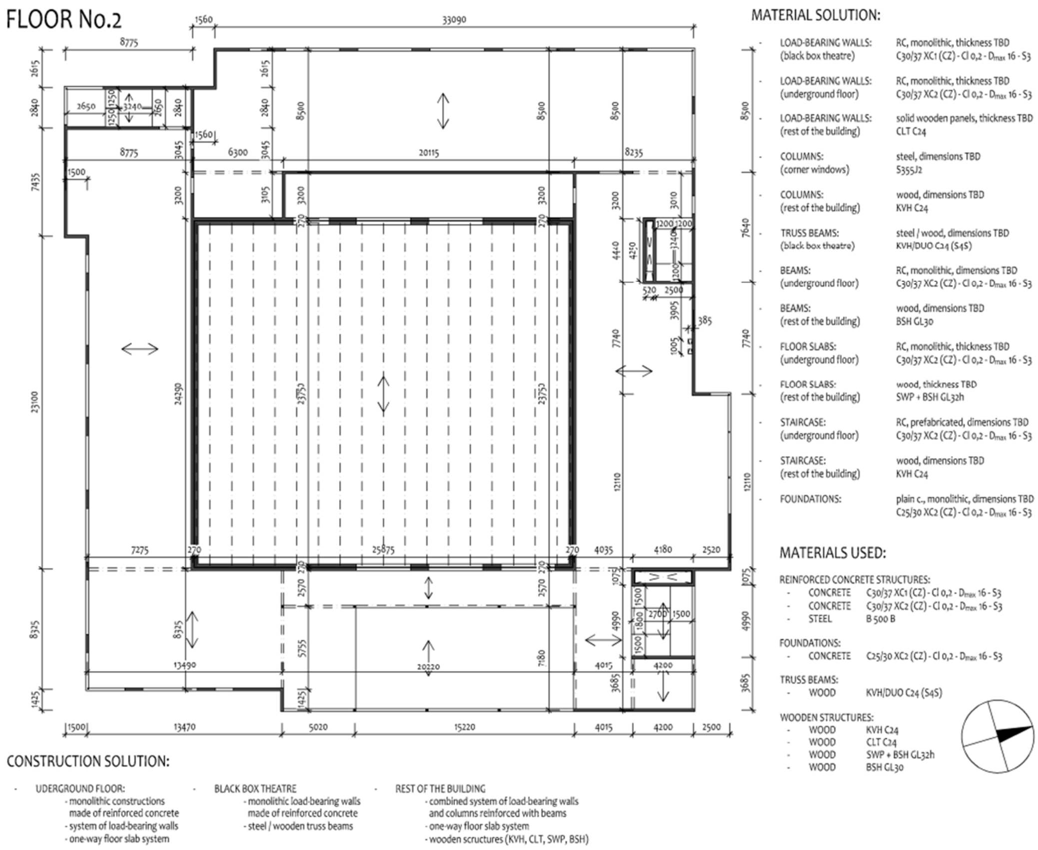
FOUNDATIONS:
- CONCRETE C25/30 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3

TRUSS BEAMS:
- WOOD KVH/DUO C24 (S4S)

WOODEN STRUCTURES:
- WOOD KVH C24
- WOOD CLT C24
- WOOD SWP + BSH GL32h
- WOOD BSH GL30

CONSTRUCTION SOLUTION:

- UDERGROUND FLOOR:
  - monolithic constructions made of reinforced concrete
  - system of load-bearing walls
  - one-way floor slab system
- BLACK BOX THEATRE
  - monolithic load-bearing walls made of reinforced concrete
  - steel / wooden truss beams
- REST OF THE BUILDING
  - combined system of load-bearing walls and columns reinforced with beams
  - one-way floor slab system
  - wooden scructures (KVH, CLT, SWP, BSH)



Notes: For full size drawings and more detailed listing of used materials and division of the structural system, see drawings *D.1.2-1 to D.1.2-3 in subdivision D.1.2 STRUCTURAL DESIGN*.

The centre-to-centre distances of the individual load-bearing structures may slightly change in the later stages of the project, depending on the subsequently selected dimensions of the load-bearing elements, modifications of the individual compositions, etc. Changes will be in the range of millimetres or tens of millimetres at most. These changes will therefore have a minimal effect on the results and designs resulting from the preliminary structural calculation and can be disregarded.

3. Conclusion

This research was intended to find as many criteria and conditions as possible needed for the detailed design of the compositions, and the subsequent correct design of the whole building. In the research, I focused on several different perspectives from which I looked at the issue, and identified all the necessary data.

Now, I can proceed with the design of the individual compositions of the structures and then to develop all the main parts of the project.

For indiv. p. of the project, see A, C.3, D.1.1, D.1.2, D.1.3, D.1.4, Thermal and moisture assessment.

Conclusion

The goal of this master‘s thesis was to develop selected parts of the project documentation of a new building of a community centre for a building permit as close to the passive standard as possible.

In order to meet this requirement, I firstly carried out an initial research and analysis of the various issues, which subsequently helped me to design the structural system of the building, the various structural compositions and to properly adjust the layout. I also verified the fire resistance of the individual compositions as part of the fire safety. Last but not least, I then designed the plumbing, water supply, and HVAC systems.

The documentation of this master‘s thesis consists of the Initial research and analysis, and subdivisions A, C.3, D.1.1, D.1.2, D.1.3, D.1.4 and the Thermal and moisture assessment.

The project documentation was developed to the required extent and in accordance with applicable laws, decrees and standards.

Used software

- AutoCAD 2018 (student version)
- AutoCAD 2023 (student version)
- SCIA Engineer 20 (student version)
- Agrop Nova – Novatop Elements (free software)
- Teplo 2017 EDU (student version)
- Microsoft Office 365 (student version)

List of references

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  ARCHCON atelier s.r.o., [cit. 2023-01-08], [https://www.archcon.cz/projekt/kd-vodnany/]

- NOVATOP SYSTEM [online], AGROP NOVA a.s., [cit. 2023-01-08], [https://novatop-system.cz/]
- KNAUF [online], Knauf Praha spol. s.r.o., [cit. 2023-01-08], [https://www.knauf.cz/]
- FATRAFOL [online], Fatra a.s., [cit. 2023-01-08], [https://www.fatrafol.cz/]
- ISOVER [online], SGCP CZ a.s., [cit. 2023-01-08], [https://www.isover.cz/]
- DEK [online], DEK a.s., [cit. 2023-01-08], [https://www.dek.cz/]
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- STEICO [online], STEICO SE, [cit. 2023-01-08], [https://web.steico.com/cz/]
- CETRIS [online], CIDEM Hranice, a.s., [cit. 2023-01-08], [https://www.cetris.cz/]
- BAUMIT [online], BAUMIT spol. s r.o., [cit. 2023-01-08], [https://baumit.cz/]
- DAFE [online], DAFE-PLAST Jihlava s.r.o., [cit. 2023-01-08], [https://dafe.cz/]
- SCHÜCO [online], Schüco CZ, [cit. 2023-01-08], [https://www.schueco.com/cz/]
- VÝTAHY VOTO [online], Výtahy VOTO s.r.o., [cit. 2023-01-08], [https://www.vytahy-voto.cz/]

- TZB-info [online], Topinfo s.r.o., [cit. 2023-01-08], [https://www.tzb-info.cz/]
- Katastr nemovitostí [online], ČÚZK, [cit. 2023-01-08], [https://www.cuzk.cz/]
- Meteoblue [online], meteoblue AG, [cit. 2023-01-08], [https://www.meteoblue.com/]
- Google Maps [online], Google LLC, [cit. 2023-01-08], [https://www.google.com/maps/]

List of used standards, laws and decrees

- ČSN 01 3420 Výkresy pozemních staveb – Kreslení výkresů stavební část
- ČSN 73 5305 Administrativní budovy a prostory
- ČSN 73 5245 Kulturní objekty s hledištěm. Podmínky viditelnosti
- ČSN 73 1901 Navrhování střech – Základní ustanovení
- ČSN 73 4130 Schodiště a šikmé rampy – Základní požadavky

- ČSN 73 0532 Akustika – Ochrana proti hluku v budovách a posuzování akustických vlastností stavebních konstrukcí a výrobků – Požadavky
- ČSN 73 0525 Akustika – Projektování v oboru prostorové akustiky – Všeobecné zásady
- ČSN 73 0527 Akustika – Projektování v oboru prostorové akustiky – Prostory pro kulturní účely – Prostory ve školách – Prostory pro veřejné účely

- ČSN 01 3495 Výkresy ve Stavebnictví – Výkresy požární bezpečnosti staveb
- ČSN 73 0802 ed. 2 Požární bezpečnost staveb – Nevýrobní objekty
- ČSN 73 0831 ed. 2 Požární bezpečnost staveb – Shromažďovací prostory
- ČSN 73 0818 Požární bezpečnost staveb – Obsazení objektů osobami
- ČSN 73 0821 ed. 2 Požární bezpečnost staveb – 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 0540-1 Tepelná ochrana budov – Část 1: Terminologie
- ČSN 73 0540-2 Tepelná ochrana budov – Část 2: Změna 10/2011 Tepelná ochrana budov – požadavky
- ČSN 73 0540-3 Tepelná ochrana budov – Část 3: Návrhové hodnoty veličin
- ČSN 73 2901 Provádění vnějších tepelně izolačních kompozitních systémů (ETICS)
- ČSN 73 2902 Vnější tepelně izolační kompozitní systémy (ETICS) - Navrhování a použití mechanického upevnění pro spojení s podkladem

- ČSN 73 0580-1 Denní osvětlení budov. Část 1: Základní požadavky
- ČSN 73 0580-4 Denní osvětlení budov. Část 4: Denní osvětlení průmyslových budov
- ČSN EN 12 464-1 Světlo a osvětlení – Osvětlení pracovních prostorů – Část 1: Vnitřní pracovní prostory

- ČSN EN 1990 Eurokód: Zásady navrhování konstrukcí
- ČSN EN 1991-1-1 Eurokód 1: Zatížení konstrukcí – Část 1-1: Obecná zatížení – Objemové tíhy, vlastní tíha a užitná zatížení pozemních staveb
- ČSN EN 1991-1-3 Eurokód 1: Zatížení konstrukcí – Část 1-3: Obecná zatížení – Zatížení sněhem
- ČSN EN 1991-1-4 Eurokód 1: Zatížení konstrukcí – Část 1-4: Obecná zatížení – Zatížení větrem
- ČSN EN 1992-1-1 Eurokód 2: Navrhování betonových konstrukcí – Část 1-1: Obecná pravidla a pravidla pro pozemní stavby
- ČSN EN 206-1 Beton – část 1: Specifikace, vlastnosti, výroba, shoda
- ČSN 73 1201 Navrhování betonových konstrukcí
- ČSN EN 1997-1 Eurokód 7: Navrhování geotechnických konstrukcí – Část 1: Obecná pravidla

- ČSN 75 5411 Vodovodní přípojky
- ČSN 73 6101 Stokové a kanalizační přípojky
- ČSN 73 6005 Prostorové uspořádání sítí technického vybavení
- ČSN 06 0320 Tepelné soustavy v budovách – Příprava teplé vody – Navrhování a projektování
- ČSN EN 15665 Větrání budov – Stanovení výkonových kritérií pro větrací systémy obytných budov

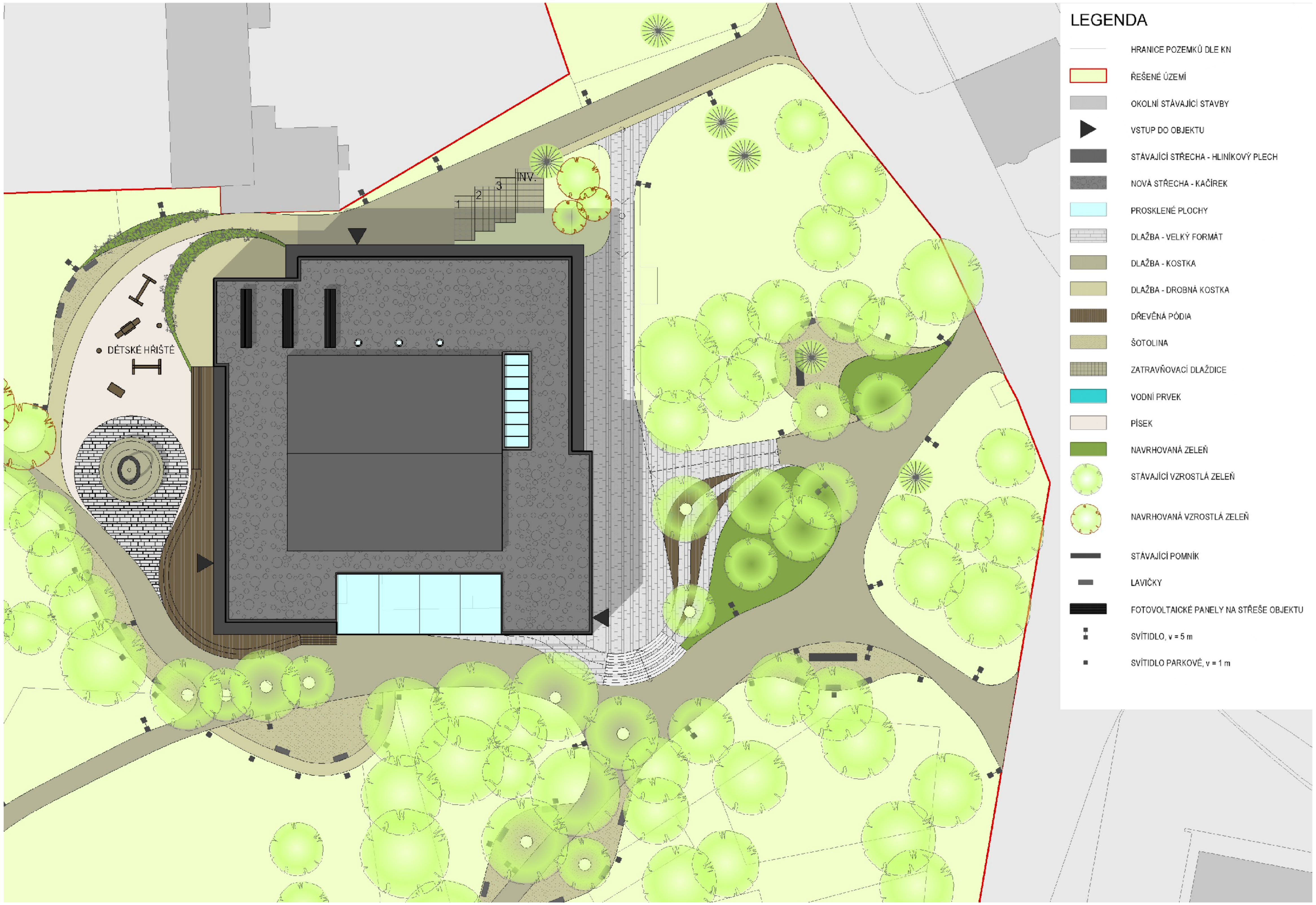
- Zákon č. 183/2006 Sb., o územním plánování a stavebním řádu (stavební zákon)
- Zákon č. 201/2012 Sb., o ochraně ovzduší
- Zákon č. 262/2006 Sb., zákoník práce
- Zákon č. 263/2016 Sb., atomový zákon
- Zákon č. 541/2020 Sb., zákon o odpadech
- Zákon č. 100 / 2001 Sb., o posuzování vlivů na životní prostředí a o změně některých souvisejících zákonů (zákon o posuzování vlivů na životní prostředí)
- Zákon č. 185/2001 Sb., o odpadech a o změně některých dalších zákonů
- Zákon č. 258/2000 Sb., o ochraně veřejného zdraví a o změně některých souvisejících zákonů
- Zákon č. 309/2006 Sb., o zajištění dalších podmínek bezpečnosti a ochrany zdraví při práci

- Nařízení vlády č. 163/2002 Sb., ověření o shodě výrobku
- Nařízení vlády č. 101/2005 Sb., o podrobnějších požadavcích na pracoviště a pracovní prostředí
- Nařízení vlády č. 272/2011 Sb., o ochraně zdraví před nepříznivými účinky hluku a vibrací
- Nařízení vlády č. 361/2007 Sb., kterým se stanoví podmínky ochrany zdraví při práci
- Nařízení vlády č. 591/2006 Sb., o bližších minimálních požadavcích na bezpečnost a ochranu zdraví při práci na staveništích
- Nařízení vlády č. 494/2001 Sb., kterým se stanoví způsob evidence, hlášení a zasílání záznamu o úrazu, vzor záznamu o úrazu a okruh orgánů a institucí, kterým se ohlašuje pracovní úraz a zasílá záznam o úrazu
- Nařízení vlády č. 495/2001 Sb., kterým se stanoví rozsah a bližší podmínky poskytování osobních ochranných pracovních prostředků, mycích, čisticích a dezinfekčních prostředků

- Vyhláška č. 268/2009 Sb., o technických požadavcích na stavby
- Vyhláška č. 499/2001 Sb., o dokumentaci staveb
- Vyhláška č. 78/2013 Sb., o energetické náročnosti budov
- Vyhláška č. 398/2009 Sb., o obecných technických požadavcích zabezpečujících bezbariérové užívání staveb
- Vyhláška č. 23/2008 Sb., o technických podmínkách požární ochrany staveb
- Vyhláška č. 422/2016 Sb., o radiační ochraně a zabezpečení radionuklidového zdroje
- Vyhláška č. 120/2011 Sb., kterou se mění vyhláška Ministerstva zemědělství č. 428/2001 Sb., kterou se provádí zákon č. 274/2001 Sb., o vodovodech a kanalizacích pro veřejnou potřebu a o změně některých zákonů (zákon o vodovodech a kanalizacích), ve znění pozdějších předpisů

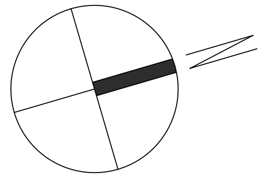

H2O


H20



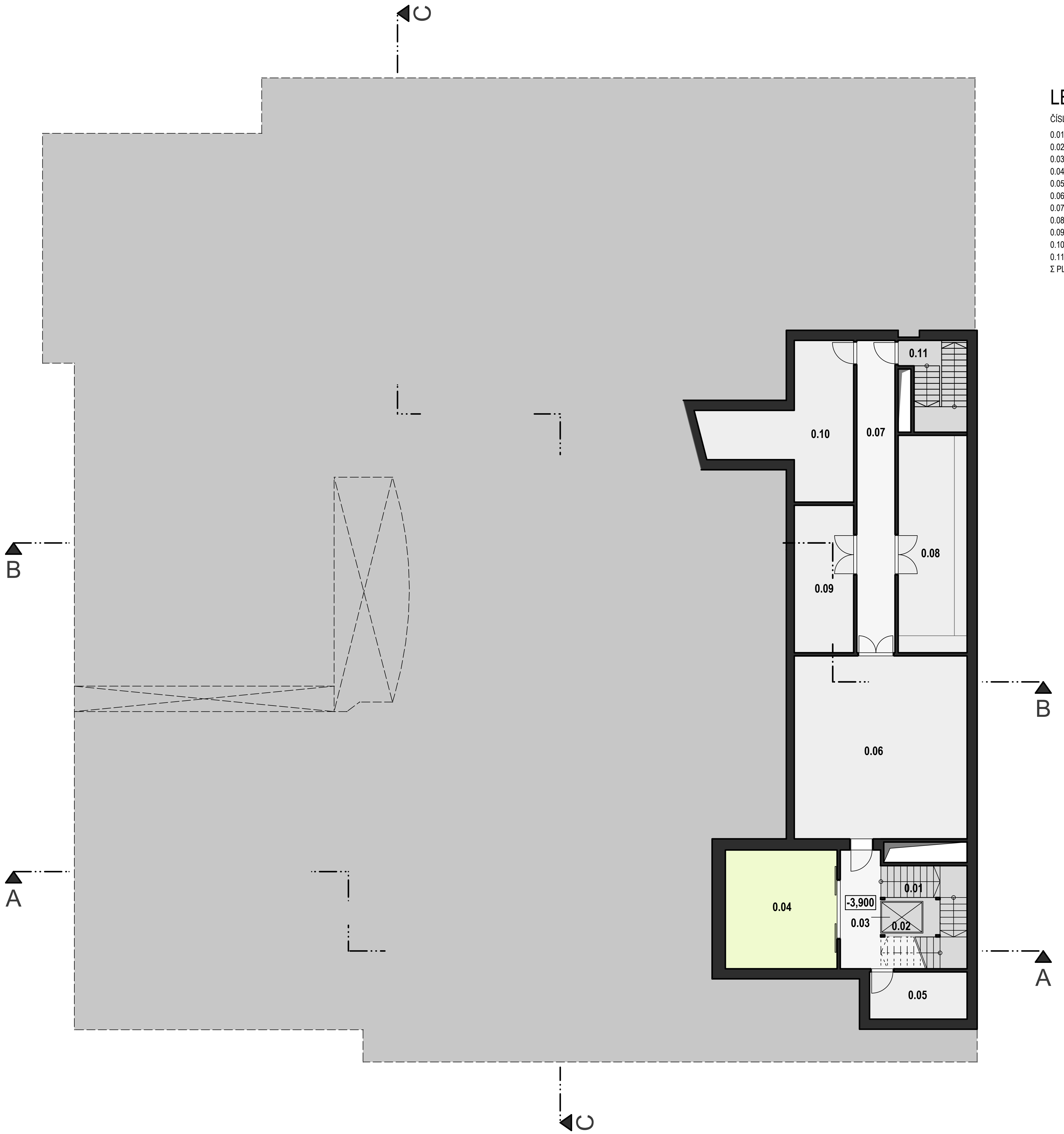
LEGENDA

- HRANICE POZEMKŮ DLE KN
- ŘEŠENÉ ÚZEMÍ
- OKOLNÍ STÁVAJÍCÍ STAVBY
- VSTUP DO OBJEKTU
- STÁVAJÍCÍ STŘECHA - HLINÍKOVÝ PLECH
- NOVÁ STŘECHA - KAČÍREK
- PROSKLENÉ PLOCHY
- DLAŽBA - VELKÝ FORMÁT
- DLAŽBA - KOSTKA
- DLAŽBA - DROBNÁ KOSTKA
- DŘEVĚNÁ PÓDIA
- ŠOTOLINA
- ZATRAVŇOVACÍ DLAŽDICE
- VODNÍ PRVEK
- PÍSEK
- NAVRHOVANÁ ZELEŇ
- STÁVAJÍCÍ VZROSTLÁ ZELEŇ
- NAVRHOVANÁ VZROSTLÁ ZELEŇ
- STÁVAJÍCÍ POMNÍK
- LAVIČKY
- FOTOVOLTAICKÉ PANELY NA STŘEŠE OBJEKTU
- SVÍTIDLO, v = 5 m
- SVÍTIDLO PARKOVÉ, v = 1 m



PROJEKT / PROJECT	OBNOVA KD VODŇANY
MÍSTO STAVBY / SITE PLACE: -	STUPEŇ / PHASE: ARCHITEKTONICKÁ STUDIE
INVESTOR / CLIENT	MĚSTO VODŇANY
GENERÁLNÍ PROJEKTANT / PROJECT DIRECTOR: ARCHCON ATELIER	ARCHCON atelier, s.r.o. NÁRODNÍ OBRANY 31 160 00 PRAHA 6 +420 226 807 030-2 ARCHCON@ARCHCON.CZ
AUTORIZACE / AUTORIZATION	ZODPOVĚDNÝ PROJEKTANT / RESPONSIBLE DESIGNER: ING. IRENA TRUHLÁŘOVÁ
	VYPRACOVAL / ELABORATED: ING. IRENA TRUHLÁŘOVÁ ING. KATEŘINA VÝBORNÁ ING. ARCH. JANA ZÍBAROVÁ
VÝKRES / DRAWING	SITUACE

MĚŘÍTKO / SCALE	STAVEBNÍ OBJEKT / CONSTRUCTION NR.	ZAKÁZKOVÉ Č. / CUSTOM NO.	Č.PARÉ / FOLDER NO.
-	SO 01	I-2012-000005	
DATUM / DATE	POČET A4 / A4 NO.	Č.VÝKRESU / DRAWING NO.	
06/2012	2xA4	1	



LEGENDA MÍSTNOSTÍ 1.PP

ČÍSLO	NÁZEV MÍSTNOSTI	PLOCHA
0.01	SCHODIŠTĚ	15.12 m2
0.02	VÝTAH	4.63 m2
0.03	CHODBA	10.64 m2
0.04	ZKUŠEBNA	29.51 m2
0.05	SKLAD	10.24 m2
0.06	STROJOVNA VZT	70.29 m2
0.07	CHODBA	26.51 m2
0.08	DÍLNA	33.30 m2
0.09	SKLAD	19.46 m2
0.10	KOTELNA	31.64 m2
0.11	SCHODIŠTĚ	11.72 m2
Σ PLOCHA MÍSTNOSTÍ		263.06 m2

0 1 2 3 4 5 10 15m

PROJEKT
PROJECT
OBNOVA KD VODŇANY

MÍSTO STAVBY
SITE PLACE
-

STUPEŇ
PHASE
ARCHITEKTONICKÁ STUDIE

INVESTOR
CLIENT
MĚSTO VODŇANY

GENERÁLNÍ PROJEKTANT
PROJECT DIRECTOR
ARCHCON ATELIER
ARCHCON atelier, s.r.o.
NÁRODNÍ OBRANY 31
160 00 PRAHA 6
+420 226 807 030-2
ARCHCON@ARCHCON.CZ

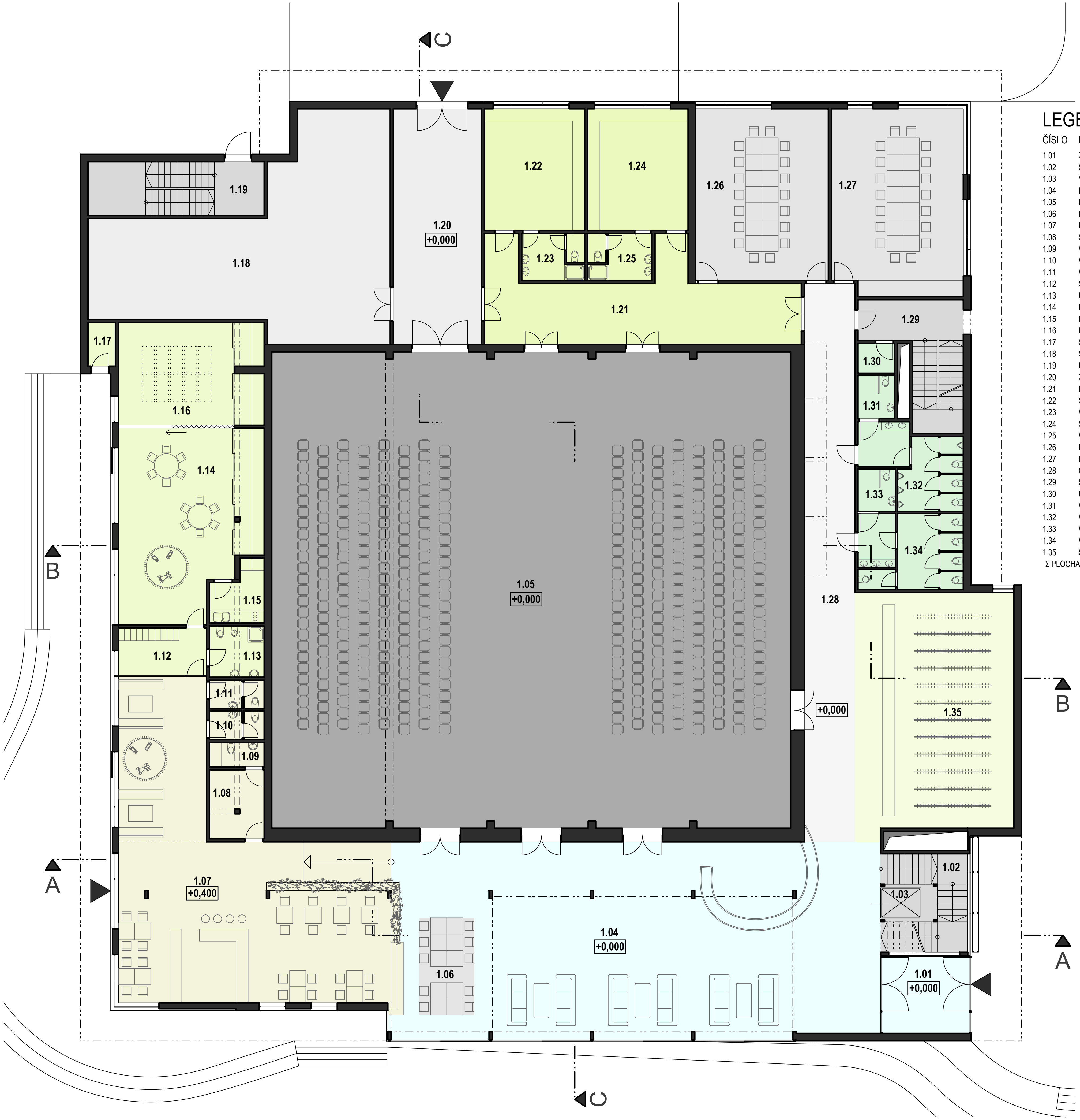
AUTORIZACE
AUTORIZATION

ZODPOVĚDNÝ PROJEKTANT
RESPONSIBLE DESIGNER
ING. IRENA TRUHLÁŘOVÁ

VYPRACOVAL
ELABORATED
ING. IRENA TRUHLÁŘOVÁ
ING. KATEŘINA VÝBORNÁ
ING. ARCH. JANA ZÍBAROVÁ

VÝKRES
DRAWING
PŮDORYS 1.PP

MĚŘÍTKO SCALE	STAVEBNÍ OBJEKT CONSTRUCTION NR.	ZAKÁZKOVÉ Č. CUSTOM NO.	Č.PARÉ FOLDER NO.
1:100	SO 01	I-2012-000005	
DATUM DATE	POČET A4 A4 NO.	Č.VÝKRESU DRAWING NO.	
06/2012	2xA4	2	

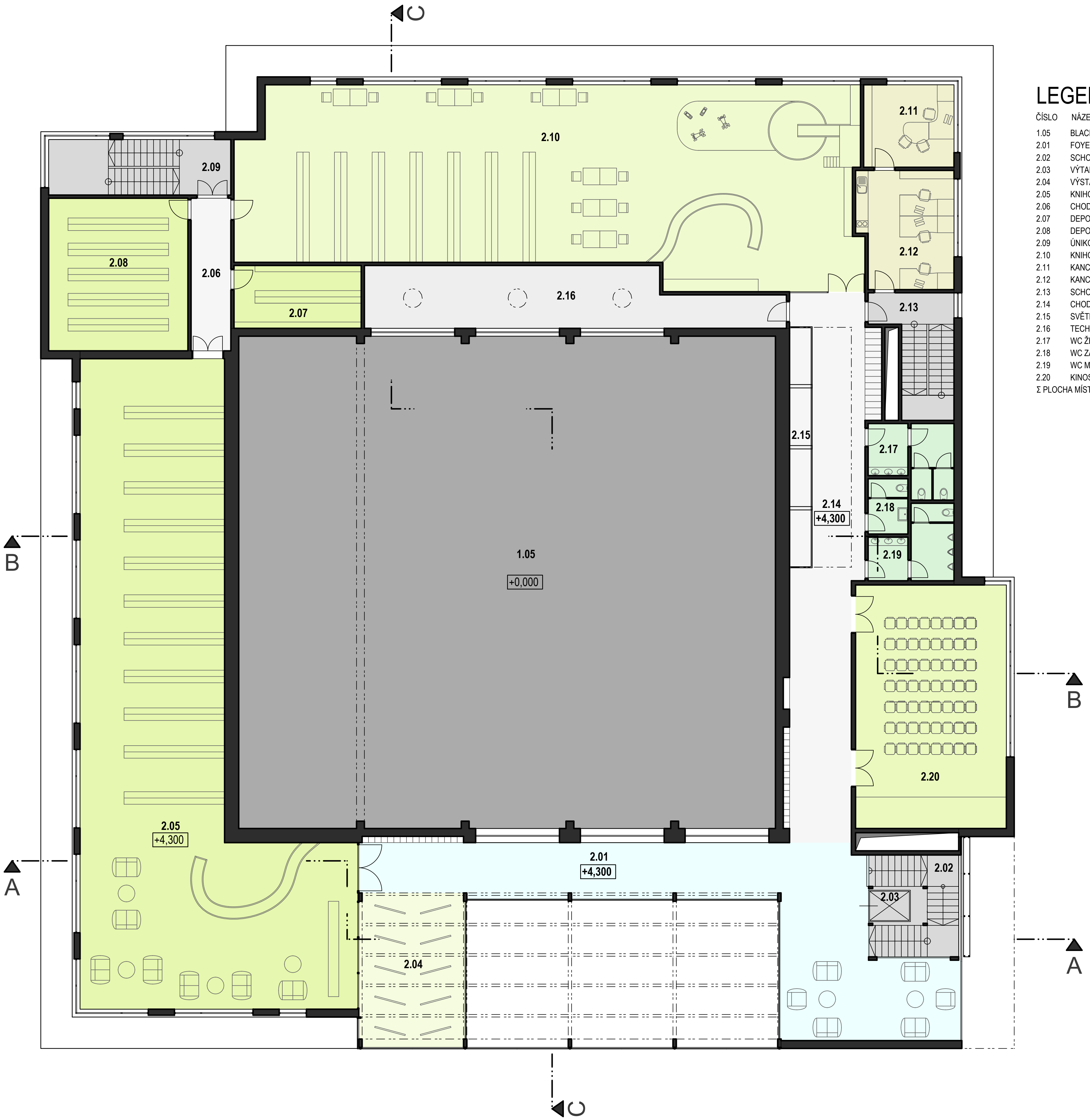


LEGENDA MÍSTNOSTÍ 1.NP

ČÍSLO	NÁZEV MÍSTNOSTI	PLOCHA
1.01	ZÁDVEŘÍ	16.25 m2
1.02	SCHODIŠTĚ	15.99 m2
1.03	VÝTAH	4.94 m2
1.04	FOYER	218.52 m2
1.05	BLACK BOX THEATRE	601.14 m2
1.06	PC KOUTEK	12.96 m2
1.07	KAVÁRNA	142.46 m2
1.08	SKLAD	9.18 m2
1.09	WC + ÚKLIDOVÁ KOMORA	3.24 m2
1.10	WC ŽENY	3.67 m2
1.11	WC MUŽI	3.67 m2
1.12	ŠATNA	10.22 m2
1.13	UMÝVÁRNA + WC	6.82 m2
1.14	DENNÍ MÍSTNOST	61.78 m2
1.15	KUCHYŇKA	6.84 m2
1.16	LOŽNICE	36.00 m2
1.17	SKLAD HRAČEK	2.90 m2
1.18	SKLAD	110.86 m2
1.19	ÚNIKOVÉ SCHODIŠTĚ	23.06 m2
1.20	ZÁDVEŘÍ	50.57 m2
1.21	NÁSTUP ÚČINKUJÍCÍCH	55.21 m2
1.22	ŠATNA MUŽI	29.73 m2
1.23	WC MUŽI	6.98 m2
1.24	ŠATNA ŽENY	29.73 m2
1.25	WC ŽENY	7.13 m2
1.26	KLUBOVNA	55.50 m2
1.27	KLUBOVNA	59.39 m2
1.28	CHODBA	68.88 m2
1.29	SCHODIŠTĚ	21.88 m2
1.30	ÚKLIDOVÁ KOMORA	2.64 m2
1.31	WC INVALIDI - MUŽI	3.87 m2
1.32	WC MUŽI	16.60 m2
1.33	WC INVALIDI - ŽENY	3.89 m2
1.34	WC ŽENY	18.94 m2
1.35	ŠATNA DIVÁCI	92.11 m2
Σ PLOCHA MÍSTNOSTÍ		1813.55 m2

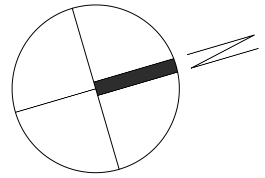
PROJEKT / PROJECT	OBNOVA KD VODŇANY
MÍSTO STAVBY / SITE PLACE	-
STUPEŇ / PHASE	ARCHITEKTONICKÁ STUDIE
INVESTOR / CLIENT	MĚSTO VODŇANY
GENERÁLNÍ PROJEKTANT / PROJECT DIRECTOR	ARCHCON ATELIER ARCHCON atelier, s.r.o. NÁRODNÍ OBRANY 31 160 00 PRAHA 6 +420 226 807 030-2 ARCHCON@ARCHCON.CZ
AUTORIZACE / AUTORIZATION	
ZODPOVĚDNÝ PROJEKTANT / RESPONSIBLE DESIGNER	ING. IRENA TRUHLÁŘOVÁ
VYPRACOVAL / ELABORATED	ING. IRENA TRUHLÁŘOVÁ ING. KATEŘINA VÝBORNÁ ING. ARCH. JANA ZÍBAROVÁ
VÝKRES / DRAWING	PŮDORYS 1.NP

MĚŘÍTKO / SCALE	STAVEBNÍ OBJEKT / CONSTRUCTION NR.	ZAKÁZKOVÉ Č. / CUSTOM NO.	Č.PARÉ / FOLDER NO.
1:100	SO 01	I-2012-000005	
DATUM / DATE	**POČET A4 / A4 NO.**	**Č.VÝKRESU / DRAWING NO.**	
06/2012	2xA4	3	



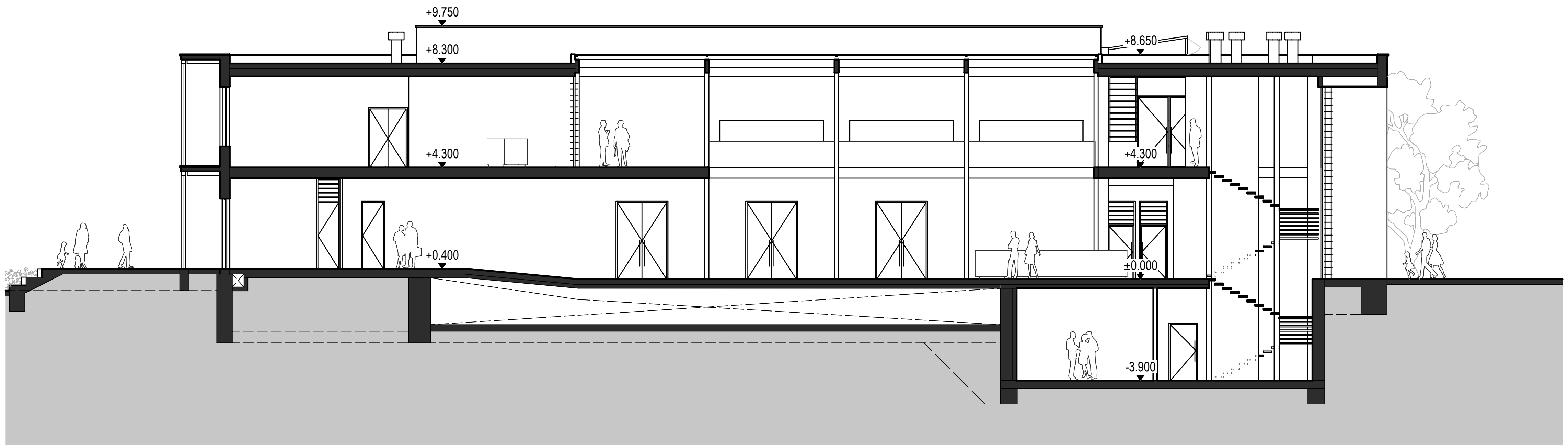
LEGENDA MÍSTNOSTÍ 2.NP

ČÍSLO	NÁZEV MÍSTNOSTI	PLOCHA
1.05	BLACK BOX THEATRE	601.14 m2
2.01	FOYER	109.67 m2
2.02	SCHODIŠTĚ	15.66 m2
2.03	VÝTAH	5.19 m2
2.04	VÝSTAVNÍ PROSTOR	37.27 m2
2.05	KNIHOVNA PRO DOSPĚLÉ	264.75 m2
2.06	CHODBA	13.84 m2
2.07	DEPOZITÁŘ	18.23 m2
2.08	DEPOZITÁŘ	48.45 m2
2.09	ÚNIKOVÉ SCHODIŠTĚ	23.06 m2
2.10	KNIHOVNA PRO DĚTI S HERNOU	262.14 m2
2.11	KANCELÁŘ	16.99 m2
2.12	KANCELÁŘ S KUCHYŇKOU	25.13 m2
2.13	SCHODIŠTĚ	17.63 m2
2.14	CHODBA	77.49 m2
2.15	SVĚTLÍK	12.43 m2
2.16	TECHNICKÝ MŮSTEK	51.96 m2
2.17	WC ŽENY	12.22 m2
2.18	WC ZAMĚSTNANCI	5.01 m2
2.19	WC MUŽI	11.54 m2
2.20	KINOSÁL	83.70 m2
Σ PLOCHA MÍSTNOSTÍ		1713.50 m2

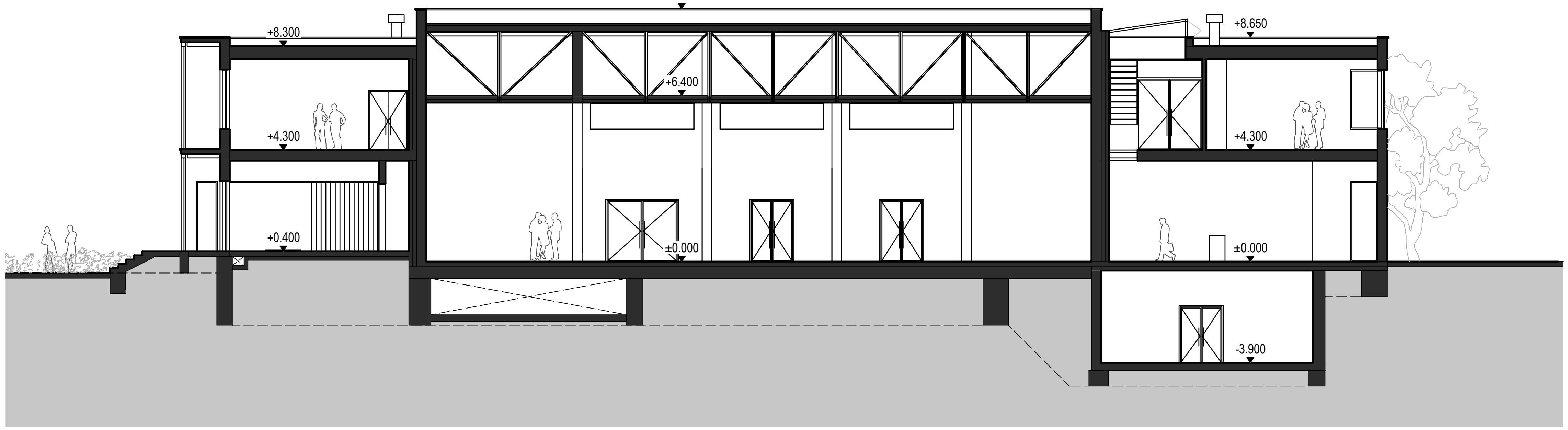


PROJEKT / PROJECT	OBNOVA KD VODŇANY
MÍSTO STAVBY / SITE PLACE: -	STUPEŇ / PHASE: ARCHITEKTONICKÁ STUDIE
INVESTOR / CLIENT	MĚSTO VODŇANY
GENERÁLNÍ PROJEKTANT / PROJECT DIRECTOR: ARCHCON ATELIER	ARCHCON atelier, s.r.o. NÁRODNÍ OBRANY 31 160 00 PRAHA 6 +420 226 807 030-2 ARCHCON@ARCHCON.CZ
AUTORIZACE / AUTORIZATION	ZODPOVĚDNÝ PROJEKTANT / RESPONSIBLE DESIGNER: ING. IRENA TRUHLÁŘOVÁ
	VYPRACOVAL / ELABORATED: ING. IRENA TRUHLÁŘOVÁ ING. KATEŘINA VÝBORNÁ ING. ARCH. JANA ZÍBAROVÁ
VÝKRES / DRAWING	PŮDORYS 2.NP

MĚŘÍTKO / SCALE	STAVEBNÍ OBJEKT / CONSTRUCTION NR.	ZAKÁZKOVÉ Č. / CUSTOM NO.	Č.PARÉ / FOLDER NO.
1:100	SO 01	I-2012-000005	
DATUM / DATE	**POČET A4 / A4 NO.**	**Č.VÝKRESU / DRAWING NO.**	
06/2012	2xA4	4	



ŘEZ A



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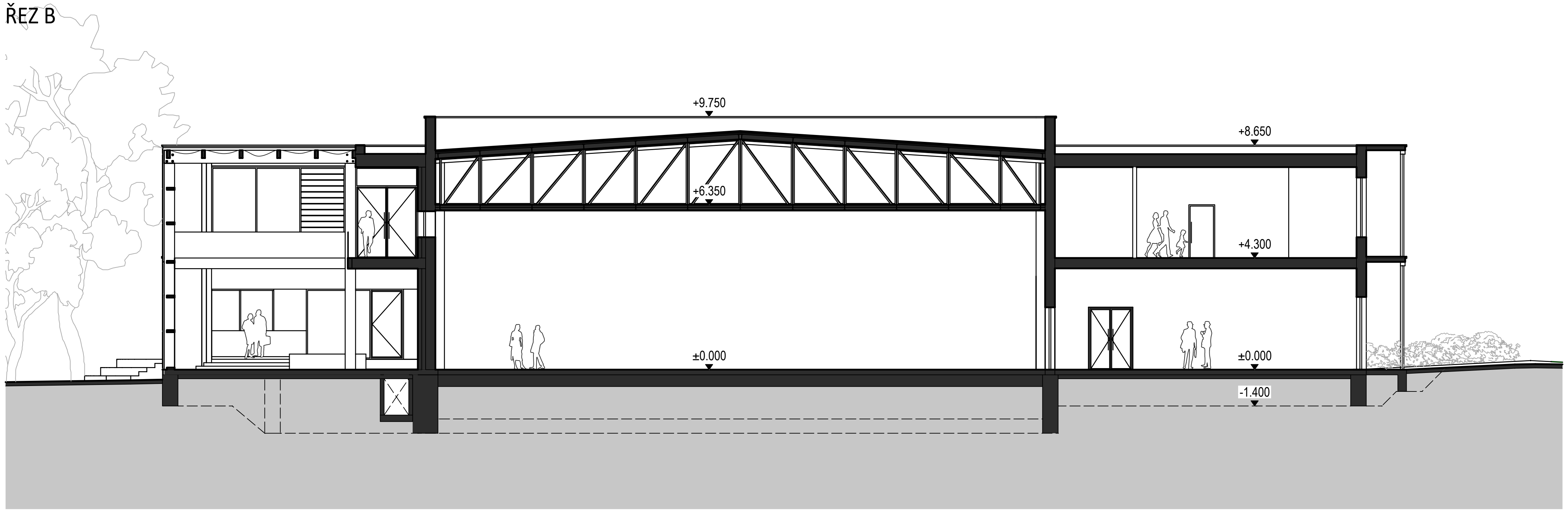

ŘEZ C

PROJEKT / PROJECT	OBNOVA KD VODŇANY
MÍSTO STAVBY / SITE PLACE	-
STUPEŇ / PHASE	ARCHITEKTONICKÁ STUDIE
INVESTOR / CLIENT	MĚSTO VODŇANY
GENERÁLNÍ PROJEKTANT / PROJECT DIRECTOR	ARCHCON ATELIER ARCHCON atelier, s.r.o. NÁRODNÍ OBRANY 31 160 00 PRAHA 6 +420 226 807 030-2 ARCHCON@ARCHCON.CZ
AUTORIZACE / AUTORIZATION	
ZODPOVĚDNÝ PROJEKTANT / RESPONSIBLE DESIGNER	ING. IRENA TRUHLÁŘOVÁ
VYPRACOVAL / ELABORATED	ING. IRENA TRUHLÁŘOVÁ ING. KATEŘINA VÝBORNÁ ING. ARCH. JANA ZÍBAROVÁ
VÝKRES / DRAWING	ŘEZY

MĚŘÍTKO / SCALE	STAVEBNÍ OBJEKT / CONSTRUCTION NR.	ZAKÁZKOVÉ Č. / CUSTOM NO.	Č.PARÉ / FOLDER NO.
1:100	SO 01	I-2012-000005	
DATUM / DATE	**POČET A4 / A4 NO.**	**Č.VÝKRESU / DRAWING NO.**	
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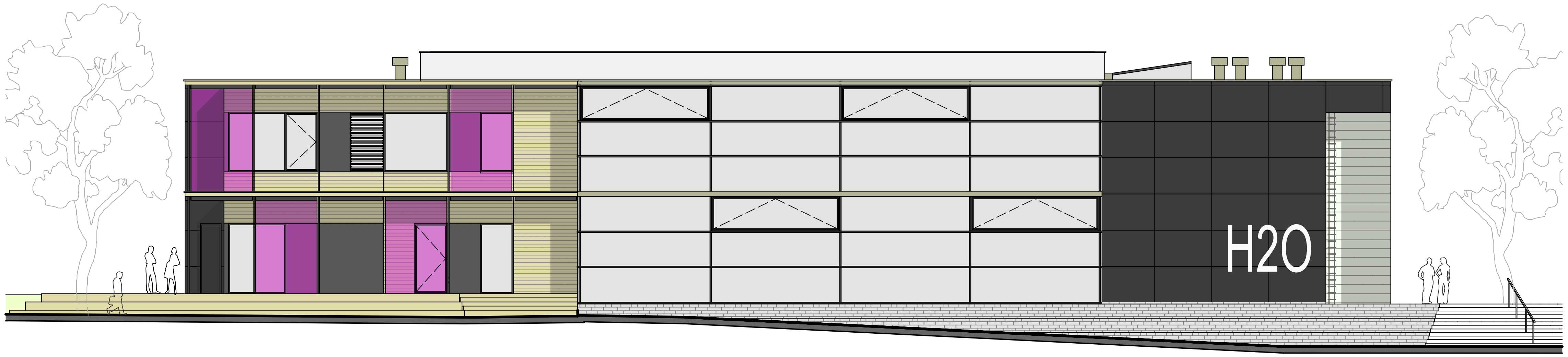


PROJEKT
PROJECT
OBNOVA KD VODŇANY

MÍSTO STAVBY
SITE PLACE
-

STUPEŇ
PHASE
ARCHITEKTONICKÁ STUDIE

INVESTOR
CLIENT
MĚSTO VODŇANY

GENERÁLNÍ PROJEKTANT
PROJECT DIRECTOR
ARCHCON ATELIER

ARCHCON atelier, s.r.o.
NÁRODNÍ OBRANY 31
160 00 PRAHA 6
+420 226 807 030-2
ARCHCON@ARCHCON.CZ

AUTORIZACE
AUTORIZATION

ZODPOVĚDNÝ PROJEKTANT
RESPONSIBLE DESIGNER
ING. IRENA TRUHLÁŘOVÁ

VYPRACOVAL
ELABORATED
ING. IRENA TRUHLÁŘOVÁ
ING. KATEŘINA VÝBORNÁ
ING. ARCH. JANA ZÍBAROVÁ

VÝKRES
DRAWING
VÝCHODNÍ POHLED, ZÁPADNÍ POHLED

MĚŘÍTKO
SCALE
1:100

STAVEBNÍ OBJEKT
CONSTRUCTION NR.
SO 01

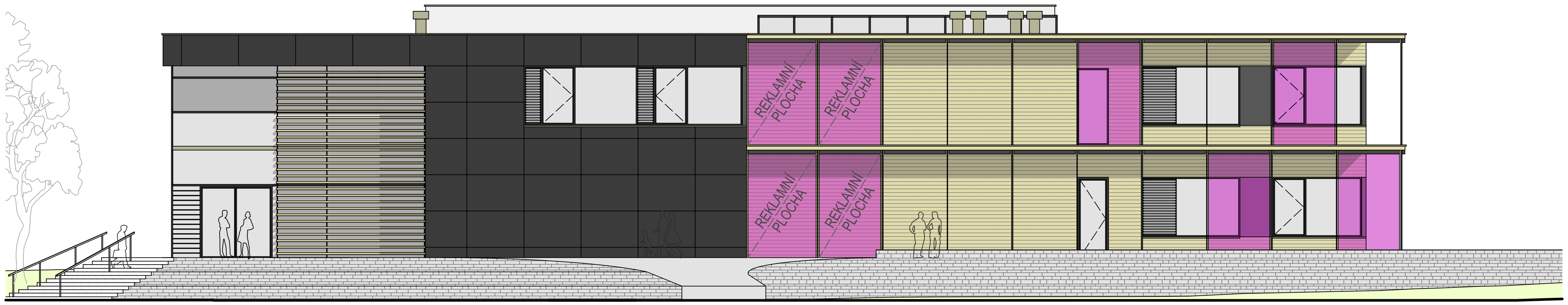
ZAKÁZKOVÉ Č.
CUSTOM NO.
I-2012-000005

Č.PARÉ
FOLDER NO.

DATUM
DATE
06/2012

POČET A4
A4 NO.
2xA4

Č.VÝKRESU
DRAWING NO.
6



PROJEKT / PROJECT: OBNOVA KD VODŇANY

MÍSTO STAVBY / SITE PLACE: -

STUPEŇ / PHASE: ARCHITEKTONICKÁ STUDIE

INVESTOR / CLIENT: MĚSTO VODŇANY

GENERÁLNÍ PROJEKTANT / PROJECT DIRECTOR: ARCHCON ATELIER

ARCHCON atelier, s.r.o.
NÁRODNÍ OBRANY 31
160 00 PRAHA 6
+420 226 807 030-2
ARCHCON@ARCHCON.CZ

AUTORIZACE / AUTORIZATION

ZODPOVĚDNÝ PROJEKTANT / RESPONSIBLE DESIGNER: ING. IRENA TRUHLÁŘOVÁ

VYPRACOVAL / ELABORATED:
ING. IRENA TRUHLÁŘOVÁ
ING. KATEŘINA VÝBORNÁ
ING. ARCH. JANA ZÍBAROVÁ

VÝKRES / DRAWING: JIŽNÍ POHLED, SEVERNÍ POHLED

MĚŘÍTKO / SCALE	STAVEBNÍ OBJEKT / CONSTRUCTION NR.	ZAKÁZKOVÉ Č. / CUSTOM NO.	Č.PARÉ / FOLDER NO.
1:100	SO 01	I-2012-000005	
DATUM / DATE	POČET A4 / A4 NO.	Č.VÝKRESU / DRAWING NO.	
06/2012	2xA4	7	

BASIC DATA

Basic description of the zone:

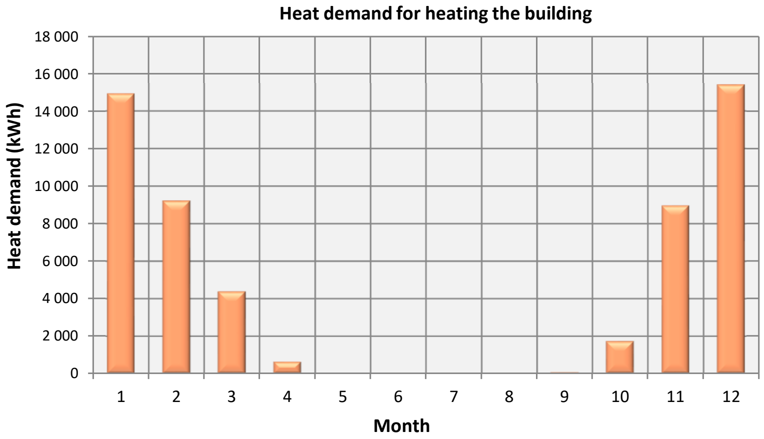
Number of persons	n_{os}	156	os	
Presence of persons (percentage of time)	p	70%		
Required indoor temperature	θ_i	20	°C	
Volume of zone to be heated	V	18 387,8	m^3	← from external dimensions
Area of the envelope of the heated zone	A	5 949,1	m^2	
Floor area of heated zone	A_f	3141,0	m^2	← from total internal dimensions
Volume factor of building form	A/V	0,32	-	

HEAT DEMAND

according to ČSN EN ISO 13790

Heat demand for heating the building Q_h (kWh):

month	period t days d	period t hours hod	outdoor temperature θ_e (°C)	indoor temperature θ_i (°C)	thermal loss Q_L (kWh)	total usable heat gains Q_g (kWh)	heat demand Q_h (kWh)
1	31	744	-1,0	20,0	27 025	12 073	14 952
2	28	672	1,0	20,0	22 323	13 087	9 236
3	31	744	4,0	20,0	21 150	16 753	4 397
4	30	720	9,0	20,0	14 634	13 998	636
5	31	744	14,6	20,0	8 318	8 300	18
6	30	720	17,0	20,0	5 149	5 147	1
7	31	744	18,2	20,0	3 761	3 760	0
8	31	744	18,8	20,0	2 951	2 951	0
9	30	720	13,8	20,0	8 628	8 544	84
10	31	744	9,4	20,0	14 224	12 478	1 745
11	30	720	4,0	20,0	20 117	11 150	8 967
12	31	744	-0,5	20,0	26 305	10 876	15 430
				TOTAL PER YEAR	174 585	119 118	55 466



Specific heat demand of the building:

Specific heat demand of the building in relation to the heated area	E_A	17,7	kWh/(m²·a)
Specific heat demand of the building in relation to the heated volume	E_V	3,0	kWh/(m³·a)

HEAT TRANSFER THROUGH THE BUILDING ENVELOPE

according to ČSN 730540-2

Calculated value	U_{em}	0,26	W/(m²·K)

HEAT LOSS - SINGLE ZONE CALCULATION - WITHOUT INTERMITTENT HEATING

according to ČSN EN ISO 13790

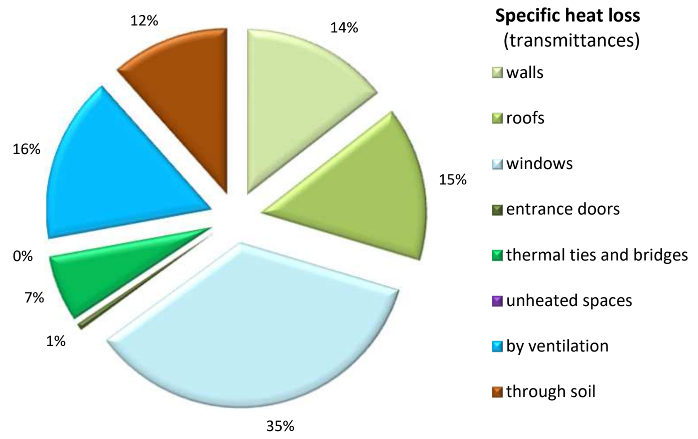
Total heat loss Q_L (kWh):

month	period t		outdoor	indoor	heat loss through penetration							heat loss	heat loss	heat loss
	days	hours	temperature	temperature	walls	roofs	windows	doors	thermal ties and bridges	unheated	**TOTAL**	**by ventilation**	**through soil**	**Q_L**
	d	hod	θ_e (°C)	θ_i (°C)	kWh	kWh	kWh	kWh	kWh	kWh	**kWh**	**kWh**	**kWh**	**kWh**
1	31	744	-1,0	20,0	4121	4324	10060	189	1859	0	**20 553**	**4 647**	**1 826**	**27 025**
2	28	672	1,0	20,0	3368	3533	8221	154	1519	0	**16 796**	**3 797**	**1 730**	**22 323**
3	31	744	4,0	20,0	3140	3294	7665	144	1416	0	**15 659**	**3 540**	**1 951**	**21 150**
4	30	720	9,0	20,0	2089	2192	5099	96	942	0	**10 418**	**2 355**	**1 860**	**14 634**
5	31	744	14,6	20,0	1060	1112	2587	49	478	0	**5 285**	**1 195**	**1 838**	**8 318**
6	30	720	17,0	20,0	570	598	1391	26	257	0	**2 841**	**642**	**1 665**	**5 149**
7	31	744	18,2	20,0	353	371	862	16	159	0	**1 762**	**398**	**1 601**	**3 761**
8	31	744	18,8	20,0	235	247	575	11	106	0	**1 174**	**266**	**1 511**	**2 951**
9	30	720	13,8	20,0	1177	1235	2874	54	531	0	**5 872**	**1 328**	**1 428**	**8 628**
10	31	744	9,4	20,0	2080	2182	5078	95	938	0	**10 374**	**2 345**	**1 504**	**14 224**
11	30	720	4,0	20,0	3039	3188	7417	139	1371	0	**15 154**	**3 426**	**1 537**	**20 117**
12	31	744	-0,5	20,0	4023	4221	9820	184	1815	0	**20 063**	**4 536**	**1 706**	**26 305**
				CELKEM	25 256	26 497	61 649	1 158	11 392	0	**125 951**	**28 476**	**20 157**	**174 585**
					14,5%	15,2%	35,3%	0,7%	6,5%	0,0%	72,1%	16,3%	11,5%	100,0%

Recapitulation of specific heat losses:

Thermal transmittance - walls	$L_{D,1}$	263,8	W/K
Thermal transmittance - roofs	$L_{D,2}$	276,7	W/K
Thermal transmittance - windows	$L_{D,3}$	643,9	W/K
Thermal transmittance - entrance doors	$L_{D,4}$	12,1	W/K
Thermal transmittance - thermal ties and bridges	$L_{D,5}$	119,0	W/K
Thermal transmittance - unheated spaces	$L_{D,6}$	0,0	W/K
Specific heat loss through penetration	H_T	**1315,4**	**W/K**
Specific heat loss through ventilation	H_V	**297,4**	**W/K**
Steady-state thermal transmittance through soil	L_s	210,7	W/K
Specific heat loss (without loss through soil)	H'	**1612,9**	**W/K**
Specific heat loss (with loss through soil L_s)	H	1823,5	W/K
↑ to calculate the time constant of the building			
Heat loss (required power delivered by the heat source)	Q	65 647	W

Surcharge for thermal ties and bridges 0,02 W/(m²·K)



HEAT GAINS - INDOOR AND SOLAR

according to ČSN EN ISO 13790

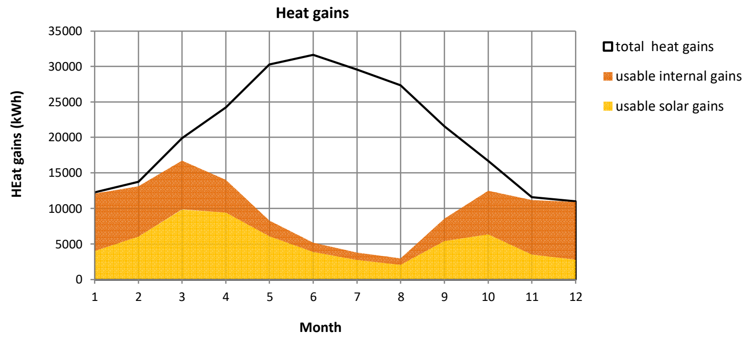
Internal heat gains:

Specific internal heat gains		100	W/os
Internal heat gains	Q_i	11020	W

Recapitulation of the total collection area of windows A_s:

Orientation	collection area $A_{s,j}$ (m²)
S	34,3
J	21,2
V	161,2
Z	17,4
H	0,0
SV	0,0
SZ	0,0
JV	0,0
JZ	0,0
TOTAL	**234,17**

← fill according to the table for windows



Net solar gains, internal heat gains and heat gain recovery rate:

month	period t		net solar gains for each orientation										internal heat gains	total heat gains	gain nad loss ratio	**degree of use**
	days	hours	N	S	E	W	H	NE	NW	SE	SW	TOTAL				
	d	hod	$Q_{s,j}$ (kWh)										Q_i (kWh)	Q_g (kWh)	γ (-)	η (-)
1	31	744	240	1060	2419	349	0	0	0	0	0	4067	8199	12266	0,45	**0,98**
2	28	672	446	1187	4192	488	0	0	0	0	0	6313	7405	13719	0,61	**0,95**
3	31	744	789	1738	8223	924	0	0	0	0	0	11674	8199	19873	0,94	**0,84**
4	30	720	1098	2014	11932	1256	0	0	0	0	0	16299	7934	24233	1,66	**0,58**
5	31	744	1612	2056	16769	1622	0	0	0	0	0	22059	8199	30258	3,64	**0,27**
6	30	720	1784	1844	18542	1535	0	0	0	0	0	23705	7934	31639	6,15	**0,16**
7	31	744	1612	1971	16124	1622	0	0	0	0	0	21329	8199	29528	7,85	**0,13**
8	31	744	1303	2120	14189	1535	0	0	0	0	0	19147	8199	27346	9,27	**0,11**
9	30	720	823	2014	9674	1116	0	0	0	0	0	13627	7934	21562	2,50	**0,40**
10	31	744	583	1590	5482	837	0	0	0	0	0	8492	8199	16691	1,17	**0,75**
11	30	720	309	763	2257	314	0	0	0	0	0	3643	7934	11577	0,58	**0,96**
12	31	744	206	615	1774	209	0	0	0	0	0	2803	8199	11002	0,42	**0,99**
												153158,4		**249 694**		

Usable solar and internal heat gains:

month	period t		usable solar gains for each orientation										**usable int. heat gains**	**total usable heat gains**
	days	hours	N	S	E	W	H	NE	NW	SE	SW	**TOTAL**		
	d	hod	$Q_{s,j}$ (kWh)										Q_i **(kWh)**	Q_g **(kWh)**
1	31	744	236	1043	2381	343	0	0	0	0	0	**4 003**	**8 070**	**12 073**
2	28	672	425	1132	3999	466	0	0	0	0	0	**6 023**	**7 064**	**13 087**
3	31	744	665	1465	6932	779	0	0	0	0	0	**9 841**	**6 912**	**16 753**
4	30	720	634	1163	6892	725	0	0	0	0	0	**9 415**	**4 583**	**13 998**
5	31	744	442	564	4600	445	0	0	0	0	0	**6 051**	**2 249**	**8 300**
6	30	720	290	300	3017	250	0	0	0	0	0	**3 857**	**1 291**	**5 147**
7	31	744	205	251	2053	207	0	0	0	0	0	**2 716**	**1 044**	**3 760**
8	31	744	141	229	1531	166	0	0	0	0	0	**2 066**	**885**	**2 951**
9	30	720	326	798	3834	442	0	0	0	0	0	**5 400**	**3 144**	**8 544**
10	31	744	436	1189	4098	626	0	0	0	0	0	**6 349**	**6 130**	**12 478**
11	30	720	297	735	2174	302	0	0	0	0	0	**3 509**	**7 642**	**11 150**
12	31	744	203	608	1753	207	0	0	0	0	0	**2 771**	**8 104**	**10 876**
											TOTAL	**62 001**	**57 118**	**119 118**

Auxiliary characteristics for calculating the degree of heat gain recovery:

Numerical parameter	a_0	1	-	← value for permanently heated buildings and monthly calculation
Time constant	τ_0	15	h	← value for permanently heated buildings and monthly calculation
Numerical parameter	a	4,5	-	

SPECIFIC HEAT LOSS THROUGH PENETRATION - OPAQUE CONSTRUCTION

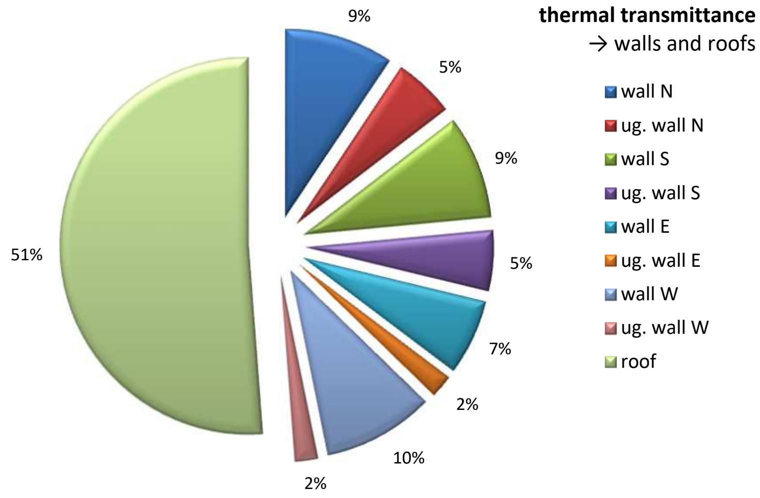
according to ČSN EN ISO 13789 - direct heat transfer to the external environment (→ flat opaque constructions, except doors)

Exterior walls between the heated space and the outside environment:

walls	orientation	width	height	total area	area of windows and doors		net wall area	heat transfer coefficient	thermal transmittance
		b	h	A_T	A_G		A	U	$L_{D,1,i}$
		m	m	m^2	m^2	%	m^2	$W/(m^2.K)$	W/K
wall N	N	46,38	8,65	401,14	119,61	29,8	281,5	0,180	**50,68**
ug. wall N	N	32,95	3,90	128,51	0,00	0,0	128,5	0,220	**28,27**
wall S	S	46,38	8,65	401,14	133,34	33,2	267,8	0,180	**48,20**
ug. wall S	S	32,95	3,90	128,51	0,00	0,0	128,5	0,220	**28,27**
wall E	E	46,38	8,65	401,14	205,61	51,3	195,5	0,180	**35,20**
ug. wall E	E	12,50	3,90	48,75	0,00	0,0	48,8	0,220	**10,73**
wall W	W	46,38	8,65	401,14	113,92	28,4	287,2	0,180	**51,70**
ug. wall W	W	12,50	3,90	48,75	0,00	0,0	48,8	0,220	**10,73**
				1959,09	572,47		**1386,6**		**263,8**
								TOTAL	

Roofs between the heated space and the outdoor environment:

roofs		width	height	total area	area of windows and doors		net roof area	heat transfer coefficient	thermal transmittance
		b	h	A_T	A_G		A	U	$L_{D,2,i}$
		m	m	m^2	m^2	%	m^2	$W/(m^2.K)$	W/K
roof		-	-	1995,0	150,12	7,5	1844,9	0,150	**276,73**
				1995,0			**1844,88**		**276,7**
								TOTAL	



SPECIFIC HEAT LOSS THROUGH PENETRATION - WINDOWS AND DOORS

according to ČSN EN ISO 10077-1 and ČSN EN ISO 13790

Windows between the heated space and the outside environment:

Windows	heat transfer coefficient U_g W/(m²·K)	U_f W/(m²·K)	U_w W/(m²·K)	floor	orientation	energy transmittance g_{normal} -	width b m	height h m	area A_w m²	number ks	total area A_w m²	area of glazing A_g m²	correction coefficients F_F -	F_C -	F_o -	F_f -	F_h -	collection area A_s m²	lining length o_1 m	sill length o_2 m	thermal transmittance $L_{D,3,j}$ W/K
window1	0,80	1,10	0,86	1+2	S	0,60	8,86	5,65	50,06	1	50,1	45,05	0,90	1,00	1,00	1,00	0,90	24,33	20,16	8,86	**43,16**
window2	0,80	1,10	0,95	1	S	0,60	1,20	2,80	3,36	1	3,4	3,02	0,90	0,35	1,00	1,00	0,90	0,57	6,80	1,20	**3,21**
window3	0,80	1,10	0,94	1&2	S	0,60	3,75	2,30	8,63	2	17,3	15,53	0,90	0,35	1,00	1,00	0,90	2,93	8,35	3,75	**16,21**
window4	0,80	1,10	0,94	1&2	S	0,60	3,45	2,30	7,94	2	15,9	14,28	0,90	0,35	1,00	1,00	0,90	2,70	8,05	3,45	**14,99**
window5	0,80	1,10	0,88	2	S	0,60	8,43	2,30	19,39	1	19,4	17,45	0,90	0,35	1,00	1,00	0,90	3,30	13,03	8,43	**17,10**
window6	0,80	1,10	0,97	2	S	0,60	1,20	2,30	2,76	1	2,8	2,48	0,90	0,35	1,00	1,00	0,90	0,47	5,80	1,20	**2,67**
window7	0,80	1,10	0,95	1	J	0,60	1,30	2,80	3,64	1	3,6	3,28	0,90	0,35	0,80	1,00	0,90	0,50	6,90	1,30	**3,46**
window8	0,80	1,10	0,99	1	J	0,60	3,75	2,80	10,50	5	52,5	47,25	0,90	0,35	0,80	1,00	0,90	7,14	9,35	3,75	**51,82**
window9	0,80	1,10	0,91	1	J	0,60	2,60	2,80	7,28	1	7,3	6,55	0,90	0,35	0,80	1,00	0,90	0,99	8,20	2,60	**6,66**
window10	0,80	1,10	0,90	1+2	J	0,60	1,50	8,05	12,08	1	12,1	10,87	0,90	1,00	0,80	1,00	0,90	4,69	17,60	1,50	**10,81**
window11	0,80	1,10	0,92	2	J	0,60	2,50	2,30	5,75	1	5,8	5,18	0,90	0,35	0,80	1,00	0,90	0,78	7,10	2,50	**5,32**
window12	0,80	1,10	0,96	2	J	0,60	1,30	2,30	2,99	1	3,0	2,69	0,90	0,35	0,80	1,00	0,90	0,41	5,90	1,30	**2,88**
window13	0,80	1,10	1,00	2	J	0,60	3,75	2,30	8,63	5	43,1	38,81	0,90	0,35	0,80	1,00	0,90	5,87	8,35	3,75	**43,27**
window14	0,80	1,10	0,92	2	J	0,60	2,60	2,30	5,98	1	6,0	5,38	0,90	0,35	0,80	1,00	0,90	0,81	7,20	2,60	**5,52**
window15	0,80	1,10	0,92	1	V	0,60	2,20	2,80	6,16	1	6,2	5,54	0,90	0,35	1,00	1,00	0,90	1,05	7,80	2,20	**5,68**
window16	0,80	1,10	1,00	1	V	0,60	1,30	2,80	3,64	2	7,3	6,55	0,90	0,35	1,00	1,00	0,90	1,24	6,90	1,30	**7,27**
window17	0,80	1,10	0,85	1+2	V	0,60	20,25	8,40	170,10	1	170,1	153,09	0,90	1,00	1,00	1,00	0,90	82,67	37,05	20,25	**144,15**
window18	0,80	1,10	0,91	2	V	0,60	3,45	2,30	7,94	1	7,9	7,14	0,90	0,35	1,00	1,00	0,90	1,35	8,05	3,45	**7,23**
window19	0,80	1,10	0,91	2	V	0,60	3,75	2,30	8,63	1	8,6	7,76	0,90	0,35	1,00	1,00	0,90	1,47	8,35	3,75	**7,83**
window20	0,80	1,10	0,96	2	V	0,60	1,30	2,30	2,99	1	3,0	2,69	0,90	0,35	1,00	1,00	0,90	0,51	5,90	1,30	**2,88**
window21	0,80	1,10	0,85	stř	V	0,60	20,15	7,45	150,12	1	150,1	135,11	0,90	1,00	1,00	1,00	0,90	72,96	35,05	20,15	**127,39**
window22	0,80	1,10	1,05	1&2	Z	0,60	3,75	2,30	8,63	8	69,0	62,10	0,90	0,35	0,90	1,00	0,90	10,56	8,35	3,75	**72,40**
window23	0,80	1,10	0,96	1	Z	0,60	1,25	2,30	2,88	1	2,9	2,59	0,90	0,35	0,90	1,00	0,90	0,44	5,85	1,25	**2,77**
window24	0,80	1,10	0,94	1&2	Z	0,60	3,45	2,30	7,94	2	15,9	14,28	0,90	0,35	0,90	1,00	0,90	2,43	8,05	3,45	**14,99**
window25	0,80	1,10	0,96	1	Z	0,60	1,05	2,80	2,94	1	2,9	2,65	0,90	0,35	0,90	1,00	0,90	0,45	6,65	1,05	**2,83**
window26	0,80	1,10	0,91	2	Z	0,60	3,15	2,30	7,25	1	7,2	6,52	0,90	0,35	0,90	1,00	0,90	1,11	7,75	3,15	**6,63**
window27	0,80	1,10	0,90	2	Z	0,60	4,40	2,30	10,12	1	10,1	9,11	0,90	0,35	0,90	1,00	0,90	1,55	9,00	4,40	**9,12**
window28	0,80	1,10	0,96	2	Z	0,60	1,30	2,30	2,99	1	3,0	2,69	0,90	0,35	0,90	1,00	0,90	0,46	5,90	1,30	**2,88**
window29	0,80	1,10	0,96	2	Z	0,60	1,25	2,30	2,88	1	2,9	2,59	0,90	0,35	0,90	1,00	0,90	0,44	5,85	1,25	**2,77**
										48	709,2						**TOTAL**	**234,2**	**299,3**	**118,2**	**643,9**

Uprům **0,91** W/m2K

Recap. of windows by orientation *j* :

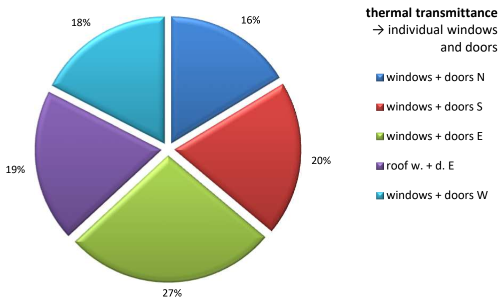
orientation	total area $A_{w,j}$ m²	collection area $A_{s,j}$ m²	thermal transmittance $L_{D,A,j}$ W/K
windows N	108,7	**34,3**	97,3
windows S	133,3	**21,2**	129,7
windows E	203,1	**88,3**	175,0
roof w. E	150,1	**73,0**	127,4
windows W	113,9	**17,4**	114,4
CELKEM	**709,2**	**234,2**	**643,9**

The door between the heated space and the outside environment:

doors	orientation	width b m	height h m	area A_D m²	number ks	total area A_D m²	lining length o_1 m	sill length o_2 m	heat transfer coefficient U W/(m²·K)	thermal transmittance $L_{D,4,j}$ W/K
door1	doors N	3,90	2,80	10,92	1	10,92	9,50	3,90	0,90	**9,83**
door2	doors S	0,00	0,00	0,00	0	0,00	0,00	0,00	0,90	**0,00**
door3	doors E	0,90	2,80	2,52	1	2,52	6,50	0,90	0,90	**2,27**
door4	roof d. E	0,00	0,00	0,00	0	0,00	0,00	0,00	0,90	**0,00**
door5	doors W	0,00	0,00	0,00	0	0,00	0,00	0,00	0,90	**0,00**
					TOTAL	**13,44**	**16,00**	**4,80**		**12,1**

Total area of windows and doors according to orientation *j* :

orientation	total area A_j m²	total thermal transmittance $L_{D,4,j}$ W/K
windows + doors N	**119,6**	**107,15**
windows + doors S	**133,3**	**129,73**
windows + doors E	**205,6**	**177,30**
roof w. + d. E	**150,1**	**127,39**
windows + doors W	**113,9**	**114,39**
TOTAL	**722,6**	**656,0**



SPECIFIC HEAT LOSS THROUGH PENETRATION - UNHEATED SPACES

according to ČSN EN ISO 13789

Specific heat loss from unheated space to outdoor environment H_{ue} (W/K):

element	orientation	total area A_T m²	net area A m²	heat transfer coefficient U W/(m².K)	thermal transmittance L_{Due} W/K	
xxx					0,0	
xxx					0,0	
xxx					0,0	
xxx					0,0	
xxx					0,0	
xxx					0,0	
xxx					0,0	
xxx					0,0	
xxx					0,0	
xxx					0,0	
xxx					0,0	
				TOTAL	0,0	W/K

Specific heat loss from heated space to unheated H_{iu} (W/K):

element	total area A_T m²	net area A m²	heat transfer coefficient U W/(m².K)	thermal transmittance L_{Diu} W/K	
xxx				0,0	
xxx				0,0	
xxx				0,0	
xxx				0,0	
xxx				0,0	
xxx				0,0	
xxx				0,0	
xxx				0,0	
xxx				0,0	
xxx				0,0	
xxx				0,0	
			TOTAL	0,0	W/K

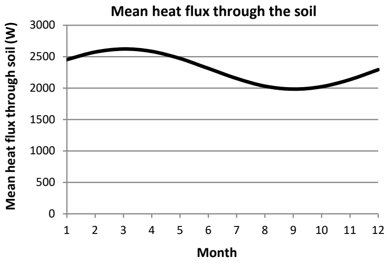
Temp. reduction factor between heated and unheated space	b	**1,00**	-
Specific heat loss through the unheated space	H_U	**0,0**	**W/K**

HEAT FLOW THROUGH THE SOIL - FLOOR ON THE GROUND

according to ČSN EN ISO 13370 - in detail according to annexes B and C

Mean heat flux through the soil Φ_G (W) in month m :

month	monthly average indoor temp. $T_{i,m}$ (°C)	monthly average outdoor temp. $T_{e,m}$ (°C)	mean heat flux through the soil Φ_G (W)
1	20,0	-0,9	2454
2	20,0	0,5	2574
3	20,0	4,1	2622
4	20,0	9,1	2584
5	20,0	14,0	2471
6	20,0	17,7	2312
7	20,0	19,0	2151
8	20,0	17,7	2031
9	20,0	14,0	1984
10	20,0	9,1	2021
11	20,0	4,1	2135
12	20,0	0,5	2293
		9,1	



Annual average indoor temperature	$T_{i,mean}$	20,00	°C
Annual average outdoor temperature	$T_{e,mean}$	9,07	°C
Amplitude of variation of monthly average indoor temperatures	$T_{i,amp}$	0,00	K
Amplitude of variation of monthly average outdoor temperatures	$T_{e,amp}$	9,95	K
Serial number of the month when the lowest outside temp. is reached	τ	1	-

Basic value of floor heat transfer coefficient U_0 (W/(m^2.K)):

(for both cases: well insulated floor where $d_t \geq B'$ / uninsulated or slightly insulated floor where $d_t < B'$)

Floor area	A	1995,0	m^2
Exposed floor perimeter	P	185,7	m
Characteristic floor dimension	B'	21,5	m
Exterior wall thickness	w	0,5	m
Thermal conductivity of the soil	λ	2,0	W/(m·K)
Resistance to heat transfer at inner side of the floor	$R_{si,f}$	0,17	m^2·K/W
Heat transfer resistance at the floor/soil interface	$R_{se,g}$	0,00	m^2·K/W
Resistance to heat transfer at the ground surface	R_{se}	0,04	m^2·K/W
Thermal resistance of the floor composition	R_f	4,4	m^2·K/W
Equivalent floor thickness	d_t	9,67	m
Fulfilment of the condition $d_t \geq B'$		NE	
Basic value of the floor heat transfer coefficient	U_0	**0,108**	**W/(m^2·K)**

Thermal-technical properties of soil:

category	description	thermal conductivity λ (W/(m·K))	Volumetric heat capacity $(\rho \cdot c)$ (J/(m^3·K))
1	Hlíny a jíly	1,5	3,00E+06
2	Písky a štěrky	2,0	2,00E+06
3	Stejnorodá skála	3,5	2,00E+06

Heat transfer coefficient of the floor composition

U_f 0,220 W/(m^2.K)

Steady-state thermal transmittance L_s (W/K):

(floor on the ground with vertical edge insulation)

Thickness of vertical edge insulation	d_n	0,1	m
Thermal conductivity of vertical edge insulation	λ_n	0,041	W/(m·K)
Thermal resistance of the vertical edge insulation	R_n	2,44	m^2·K/W
Additional effective thickness when placing edge insulation	d'	2,39	m
Depth of vertical edge insulation below ground	D	1	m
Add. lin. heat transfer coeff. at the location of the vertical edge insulation	$\Delta\Psi$	-0,0220	W/(m·K)
Steady state thermal transmittance through the soil	L_s	**210,7**	**W/K**

→ temperature reduction factor (according to ČSN 730540-4:2005 - annex H.2.2)

b 0,48 -

Periodic thermal transmittance:

(floor on ground with vertical edge insulation)

Volumetric heat capacity of soil	$(\rho \cdot c)$	2,50E+06	J/(m^3·K)
Periodic penetration depth	δ	2,83	m
Time advance of the heat flux cycle compared to the internal temp. cycle	α	0,243	months
Time delay of heat flux cycle compared to external temperature cycle	β	2,057	months
Internal periodic thermal transmittance	L_{pi}	**357,0**	**W/K**
External periodic thermal transmittance	L_{pe}	**32,1**	**W/K**

CLIMATE DATA - MONTHLY

Location description:

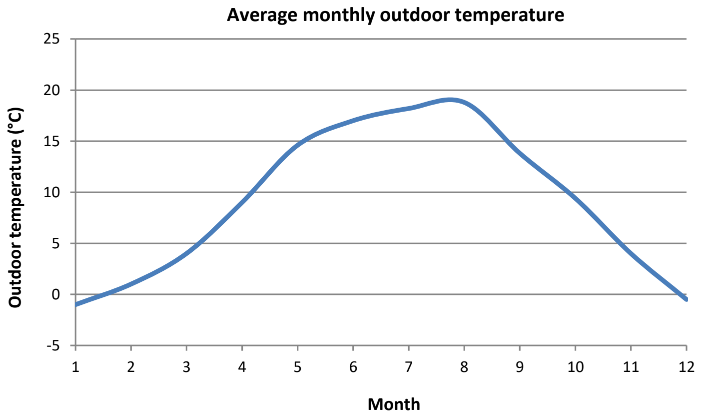
Location: Praha

GPS: 50° s.š. / 14° v.d.

Altitude: 220 m.n.m.

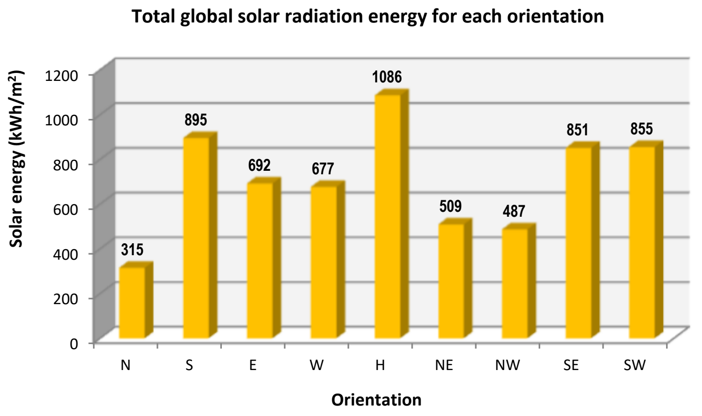
Solar energy in MJ/m²:

month	number of days	outdoor temperature θ_e (°C)	Total global solar radiation energy for each orientation $I_{s,j}$ N	S	E	W	H	NE	NW	SE	SW
			MJ/m²								
1	31	-2,4	47	104	58	58	76	47	47	86	86
2	28	-0,9	72	162	97	97	133	76	76	137	137
3	31	3,0	115	234	162	162	259	122	122	209	209
4	30	7,7	158	292	238	238	410	184	184	277	277
5	31	12,7	209	313	299	299	536	245	245	320	320
6	30	15,9	216	284	292	292	526	248	248	299	299
7	31	17,5	212	292	288	288	518	245	245	302	302
8	31	17,0	184	320	277	277	490	216	216	313	313
9	30	13,3	126	256	187	187	313	140	140	234	234
10	31	8,3	86	220	126	126	205	90	90	184	184
11	30	2,9	47	112	61	61	90	47	47	94	94
12	31	-0,6	32	72	40	40	54	32	32	61	61



Solar energy in kWh/m²:

month	number of days	outdoor temperature θ_e (°C)	Total global solar radiation energy for each orientation $I_{s,j}$ N	S	E	W	H	NE	NW	SE	SW
			kWh/m²								
1	31	-1,0	7	50	15	20	23	12	12	37	44
2	28	1,0	13	56	26	28	40	20	20	47	51
3	31	4,0	23	82	51	53	79	36	37	73	76
4	30	9,0	32	95	74	72	118	51	49	92	86
5	31	14,6	47	97	104	93	161	79	73	109	98
6	30	17,0	52	87	115	88	166	91	73	108	88
7	31	18,2	47	93	100	93	162	78	75	103	97
8	31	18,8	38	100	88	88	143	64	63	101	100
9	30	13,8	24	95	60	64	96	38	40	82	86
10	31	9,4	17	75	34	48	57	21	25	51	71
11	30	4,0	9	36	14	18	24	10	11	25	32
12	31	-0,5	6	29	11	12	17	9	9	23	26
	365	**9,1**	**315**	**895**	**692**	**677**	**1086**	**509**	**487**	**851**	**855**



SPECIFIC HEAT LOSS THROUGH VENTILATION - MECHANICAL VENTILATION WITH HEAT RECOVERY

according to ČSN EN ISO 13790

Input parameters:

Indoor air volume	V_a	18387,8	m^3
Measured volume flow of fresh air supply		35	$m^3/(os \cdot h)$
Multiplicity of air exchange	n	0,21	1/h
Volume flow rate at Δp = 50 Pa	n_{50}	0,60	1/h
Wind exposure coefficient	e	0,01	-
Wind exposure coefficient	f	20	-

Wind exposure coefficients *e* and *f*:

coefficient *e* for shading class:	more than one exposed facade	one exposed facade
no shading	0,10	0,03
moderate shading	0,07	0,02
significant shading	0,04	0,01
coefficient *f*	15	20

Volumetric air flow:

Volumetric flow of supply air	V_f	3822,0	m^3/h
Heat recovery efficiency	η	80%	
Reduced volumetric flow rate of supply air	V	764,4	m^3/h
Additional volumetric flow rate	V_x	110,3	m^3/h
Total volumetric flow rate	V	874,7	m^3/h

Specific heat loss through ventilation:

Specific heat capacity of air per unit volume	$\rho_a c_a$	0,34	$Wh/(m^3 \cdot K)$
Specific heat loss through ventilation	H_V	**297,41**	**W/K**

TIME CONSTANT OF THE BUILDING

according to ČSN EN ISO 13790

Constant for capacity calculation by building class	K	110 000	J/K
Floor area of heated zone	A_f	3141	m^2
Effective internal heat capacity of the building	C_m	95975	Wh/K
Time constant of the building	**τ**	**53**	**hod**

class	K J/K
very light	80 000
light	110 000
medium	165 000
heavy	260 000
very heavy	370 000

PARTIAL CORRECTION COEFFICIENTS OF SHADING

according to ČSN EN ISO 13790 - annex H

Partial correction coefficient of horizon shading F_h:

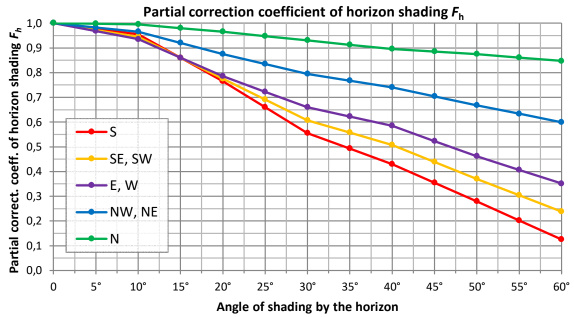
Standard values:

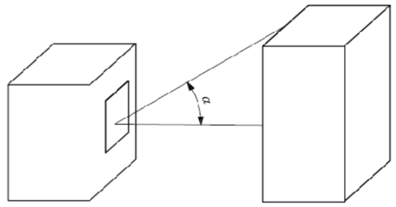
angle of shading by the horizon	45° north latitude S	45° north latitude E, W	45° north latitude N	55° north latitude S	55° north latitude E, W	55° north latitude N
0	1,00	1,00	1,00	1,00	1,00	1,00
5°						
10°	0,97	0,95	1,00	0,94	0,92	0,99
15°						
20°	0,85	0,82	0,98	0,68	0,75	0,95
25°						
30°	0,62	0,70	0,94	0,49	0,62	0,92
35°						
40°	0,46	0,61	0,90	0,40	0,56	0,89
45°						
50°						
55°						
60°						

Interpolated values:

50° north latitude

S	SE, SW	E, W	NW, NE	N
1,00	1,00	1,00	1,00	1,00
0,98	0,97	0,97	0,98	1,00
0,96	0,95	0,94	0,97	1,00
0,86	0,86	0,86	0,92	0,98
0,77	0,78	0,79	0,88	0,97
0,66	0,69	0,72	0,84	0,95
0,56	0,61	0,66	0,80	0,93
0,49	0,56	0,62	0,77	0,91
0,43	0,51	0,59	0,74	0,90
0,35	0,44	0,52	0,70	0,88
0,28	0,37	0,46	0,67	0,87
0,20	0,30	0,41	0,63	0,86
0,13	0,24	0,35	0,60	0,85





Partial correction coefficient of canopy shading F_o:

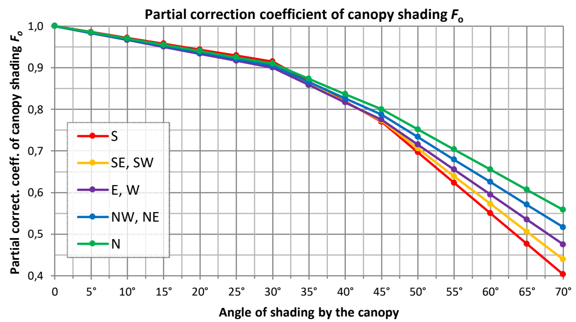
Standard values:

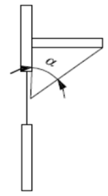
angle of shading by the canopy	45° north latitude S	45° north latitude E, W	45° north latitude N	55° north latitude S	55° north latitude E, W	55° north latitude N
0	1,00	1,00	1,00	1,00	1,00	1,00
5°						
10°						
15°						
20°						
25°						
30°	0,90	0,89	0,91	0,93	0,91	0,91
35°						
40°						
45°	0,74	0,76	0,80	0,80	0,79	0,80
50°						
55°						
60°	0,5	0,58	0,66	0,60	0,61	0,65
65°						
70°						

Interpolated values:

50° north latitude

S	SE, SW	E, W	NW, NE	N
1,00	1,00	1,00	1,00	1,00
0,99	0,98	0,98	0,98	0,99
0,97	0,97	0,97	0,97	0,97
0,96	0,95	0,95	0,95	0,96
0,94	0,94	0,93	0,94	0,94
0,93	0,92	0,92	0,92	0,93
0,92	0,91	0,90	0,91	0,91
0,87	0,86	0,86	0,87	0,87
0,82	0,82	0,82	0,83	0,84
0,77	0,77	0,78	0,79	0,80
0,70	0,71	0,72	0,73	0,75
0,62	0,64	0,66	0,68	0,70
0,55	0,57	0,60	0,63	0,66
0,48	0,51	0,54	0,57	0,61
0,40	0,44	0,48	0,52	0,56





Partial correction coefficient of the side rib shading F_f:

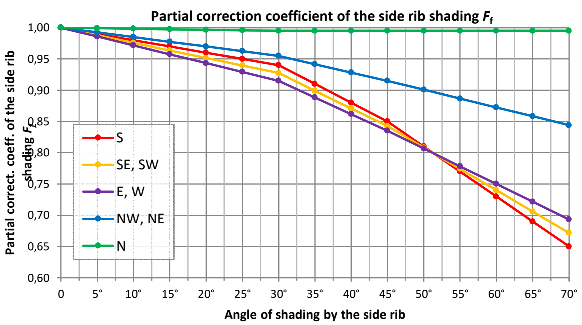
Standard values:

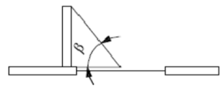
angle of shading by the side rib	45° north latitude S	45° north latitude E, W	45° north latitude N	55° north latitude S	55° north latitude E, W	55° north latitude N
0	1,00	1,00	1,00	1,00	1,00	1,00
5°						
10°						
15°						
20°						
25°						
30°	0,94	0,92	1,00	0,94	0,91	0,99
35°						
40°						
45°	0,84	0,84	1,00	0,86	0,83	0,99
50°						
55°						
60°	0,72	0,75	1	0,74	0,75	0,99
65°						
70°						

Interpolated values:

50° north latitude

S	SE, SW	E, W	NW, NE	N
1,00	1,00	1,00	1,00	1,00
0,99	0,99	0,99	0,99	1,00
0,98	0,98	0,97	0,99	1,00
0,97	0,96	0,96	0,98	1,00
0,96	0,95	0,94	0,97	1,00
0,95	0,94	0,93	0,96	1,00
0,94	0,93	0,92	0,96	1,00
0,91	0,90	0,89	0,94	1,00
0,88	0,87	0,86	0,93	1,00
0,85	0,84	0,84	0,92	1,00
0,81	0,81	0,81	0,90	1,00
0,77	0,77	0,78	0,89	1,00
0,73	0,74	0,75	0,87	1,00
0,69	0,71	0,72	0,86	1,00
0,65	0,67	0,69	0,84	1,00





BASIC DATA

Basic description of the zone:

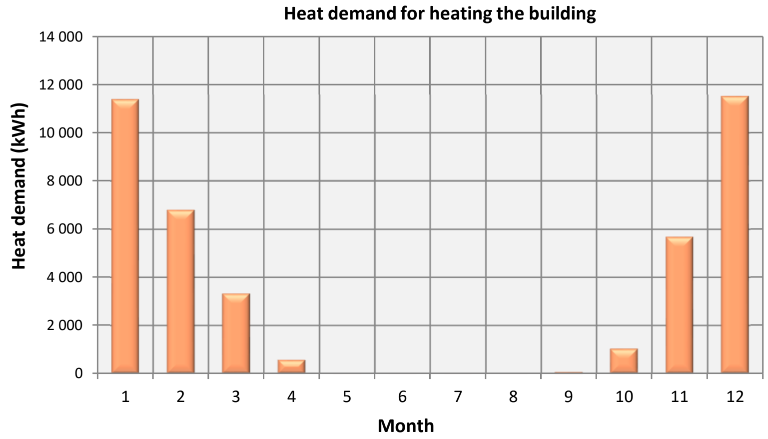
Number of persons	n_{os}	372	os	
Presence of persons (percentage of time)	p	70%		
Required indoor temperature	θ_i	20	°C	
Volume of zone to be heated	V	18 387,8	m^3	← from external dimensions
Area of the envelope of the heated zone	A	5 949,1	m^2	
Floor area of heated zone	A_f	3141,0	m^2	← from total internal dimensions
Volume factor of building form	A/V	0,32	-	

HEAT DEMAND

according to ČSN EN ISO 13790

Heat demand for heating the building Q_h (kWh):

month	period t		outdoor temperature	indoor temperature	thermal loss	total usable heat gains	heat demand
	days	hours					
	d	hod	θ_e (°C)	θ_i (°C)	Q_L (kWh)	Q_g (kWh)	Q_h (kWh)
1	31	744	-1,0	20,0	32 647	21 256	11 392
2	28	672	1,0	20,0	26 918	20 105	6 813
3	31	744	4,0	20,0	25 434	22 098	3 336
4	30	720	9,0	20,0	17 484	16 899	585
5	31	744	14,6	20,0	9 764	9 738	25
6	30	720	17,0	20,0	5 926	5 924	2
7	31	744	18,2	20,0	4 242	4 242	1
8	31	744	18,8	20,0	3 272	3 272	0
9	30	720	13,8	20,0	10 234	10 159	75
10	31	744	9,4	20,0	17 062	16 014	1 048
11	30	720	4,0	20,0	24 263	18 570	5 692
12	31	744	-0,5	20,0	31 794	20 267	11 526
				TOTAL PER YEAR	209 040	168 545	40 496



Specific heat demand of the building:

Specific heat demand of the building in relation to the heated area — E_A **12,9** kWh/(m²·a)

Specific heat demand of the building in relation to the heated volume — E_V 2,2 kWh/(m³·a)

HEAT TRANSFER THROUGH THE BUILDING ENVELOPE

according to ČSN 730540-2

Calculated value — U_{em} **0,26** W/(m²·K)

HEAT LOSS - SINGLE ZONE CALCULATION - WITHOUT INTERMITTENT HEATING

according to ČSN EN ISO 13790

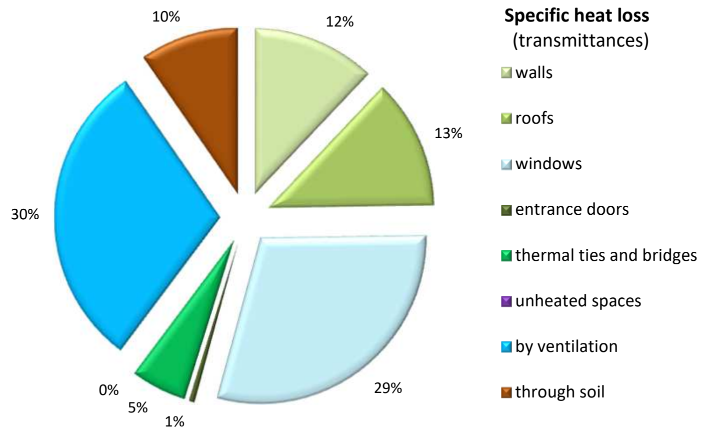
Total heat loss Q_L (kWh):

month	period t		outdoor	indoor	heat loss through penetration							heat loss	heat loss	heat loss
	days	hours	temperature	temperature	walls	roofs	windows	doors	thermal ties and bridges	unheated	**TOTAL**	**by ventilation**	**through soil**	Q_L
	d	hod	θ_e (°C)	θ_i (°C)	kWh	kWh	kWh	kWh	kWh	kWh	**kWh**	**kWh**	**kWh**	**kWh**
1	31	744	-1,0	20,0	4121	4324	10060	189	1859	0	**20 553**	**10 269**	**1 826**	**32 647**
2	28	672	1,0	20,0	3368	3533	8221	154	1519	0	**16 796**	**8 392**	**1 730**	**26 918**
3	31	744	4,0	20,0	3140	3294	7665	144	1416	0	**15 659**	**7 824**	**1 951**	**25 434**
4	30	720	9,0	20,0	2089	2192	5099	96	942	0	**10 418**	**5 206**	**1 860**	**17 484**
5	31	744	14,6	20,0	1060	1112	2587	49	478	0	**5 285**	**2 641**	**1 838**	**9 764**
6	30	720	17,0	20,0	570	598	1391	26	257	0	**2 841**	**1 420**	**1 665**	**5 926**
7	31	744	18,2	20,0	353	371	862	16	159	0	**1 762**	**880**	**1 601**	**4 242**
8	31	744	18,8	20,0	235	247	575	11	106	0	**1 174**	**587**	**1 511**	**3 272**
9	30	720	13,8	20,0	1177	1235	2874	54	531	0	**5 872**	**2 934**	**1 428**	**10 234**
10	31	744	9,4	20,0	2080	2182	5078	95	938	0	**10 374**	**5 183**	**1 504**	**17 062**
11	30	720	4,0	20,0	3039	3188	7417	139	1371	0	**15 154**	**7 572**	**1 537**	**24 263**
12	31	744	-0,5	20,0	4023	4221	9820	184	1815	0	**20 063**	**10 025**	**1 706**	**31 794**
				CELKEM	25 256	26 497	61 649	1 158	11 392	0	**125 951**	**62 932**	**20 157**	**209 040**
					12,1%	12,7%	29,5%	0,6%	5,4%	0,0%	60,3%	30,1%	9,6%	100,0%

Recapitulation of specific heat losses:

Thermal transmittance - walls	$L_{D,1}$	263,8	W/K
Thermal transmittance - roofs	$L_{D,2}$	276,7	W/K
Thermal transmittance - windows	$L_{D,3}$	643,9	W/K
Thermal transmittance - entrance doors	$L_{D,4}$	12,1	W/K
Thermal transmittance - thermal ties and bridges	$L_{D,5}$	119,0	W/K
Thermal transmittance - unheated spaces	$L_{D,6}$	0,0	W/K
Specific heat loss through penetration	H_T	**1315,4**	**W/K**
Specific heat loss through ventilation	H_V	**657,3**	**W/K**
Steady-state thermal transmittance through soil	L_s	**210,7**	**W/K**
Specific heat loss (without loss through soil)	H'	**1972,7**	**W/K**
Specific heat loss (with loss through soil L_s)	H	2183,4	W/K
↑ to calculate the time constant of the building			
Heat loss (required power delivered by the heat source)	Q	78 602	W

Surcharge for thermal ties and bridges: 0,02 W/(m²·K)



HEAT GAINS - INDOOR AND SOLAR

according to ČSN EN ISO 13790

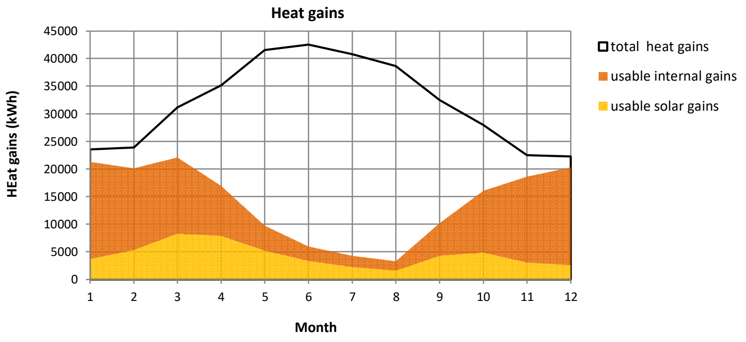
Internal heat gains:

Specific internal heat gains		100	W/os
Internal heat gains	Q_i	26140	W

Recapitulation of the total collection area of windows A_s:

Orientation	collection area $A_{s,j}$ (m^2)
S	34,3
J	21,2
V	161,2
Z	17,4
H	0,0
SV	0,0
SZ	0,0
JV	0,0
JZ	0,0
TOTAL	**234,17**

← fill according to the table for windows



Net solar gains, internal heat gains and heat gain recovery rate:

month	period t days d	period t hours hod	N	S	E	W	H	NE	NW	SE	SW	TOTAL	internal heat gains Q_i (kWh)	total heat gains Q_g (kWh)	gain nad loss ratio γ (-)	degree of use η (-)
			net solar gains for each orientation $Q_{s,j}$ (kWh)													
1	31	744	240	1060	2419	349	0	0	0	0	0	4067	19448	23515	0,72	**0,90**
2	28	672	446	1187	4192	488	0	0	0	0	0	6313	17566	23879	0,89	**0,84**
3	31	744	789	1738	8223	924	0	0	0	0	0	11674	19448	31123	1,22	**0,71**
4	30	720	1098	2014	11932	1256	0	0	0	0	0	16299	18821	35119	2,01	**0,48**
5	31	744	1612	2056	16769	1622	0	0	0	0	0	22059	19448	41507	4,25	**0,23**
6	30	720	1784	1844	18542	1535	0	0	0	0	0	23705	18821	42526	7,18	**0,14**
7	31	744	1612	1971	16124	1622	0	0	0	0	0	21329	19448	40777	9,61	**0,10**
8	31	744	1303	2120	14189	1535	0	0	0	0	0	19147	19448	38595	11,79	**0,08**
9	30	720	823	2014	9674	1116	0	0	0	0	0	13627	18821	32448	3,17	**0,31**
10	31	744	583	1590	5482	837	0	0	0	0	0	8492	19448	27940	1,64	**0,57**
11	30	720	309	763	2257	314	0	0	0	0	0	3643	18821	22464	0,93	**0,83**
12	31	744	206	615	1774	209	0	0	0	0	0	2803	19448	22252	0,70	**0,91**
												153158,4		**382 145**		

Usable solar and internal heat gains:

month	period t days d	period t hours hod	N	S	E	W	H	NE	NW	SE	SW	TOTAL	usable int. heat gains Q_i (kWh)	total usable heat gains Q_g (kWh)
			usable solar gains for each orientation $Q_{s,j}$ (kWh)											
1	31	744	217	958	2186	315	0	0	0	0	0	**3 676**	**17 579**	**21 256**
2	28	672	375	999	3529	411	0	0	0	0	0	**5 315**	**14 789**	**20 105**
3	31	744	560	1234	5839	656	0	0	0	0	0	**8 289**	**13 809**	**22 098**
4	30	720	528	969	5741	604	0	0	0	0	0	**7 843**	**9 057**	**16 899**
5	31	744	378	482	3934	381	0	0	0	0	0	**5 175**	**4 563**	**9 738**
6	30	720	248	257	2583	214	0	0	0	0	0	**3 302**	**2 622**	**5 924**
7	31	744	168	205	1677	169	0	0	0	0	0	**2 219**	**2 023**	**4 242**
8	31	744	111	180	1203	130	0	0	0	0	0	**1 623**	**1 649**	**3 272**
9	30	720	258	630	3029	349	0	0	0	0	0	**4 266**	**5 892**	**10 159**
10	31	744	334	911	3142	480	0	0	0	0	0	**4 867**	**11 146**	**16 014**
11	30	720	255	631	1866	259	0	0	0	0	0	**3 012**	**15 559**	**18 570**
12	31	744	187	560	1615	191	0	0	0	0	0	**2 553**	**17 714**	**20 267**
											TOTAL	**52 142**	**116 402**	**168 545**

Auxiliary characteristics for calculating the degree of heat gain recovery:

Numerical parameter	a_0	1	-	← value for permanently heated buildings and monthly calculation
Time constant	τ_0	15	h	← value for permanently heated buildings and monthly calculation
Numerical parameter	a	3,9	-	

SPECIFIC HEAT LOSS THROUGH PENETRATION - OPAQUE CONSTRUCTION

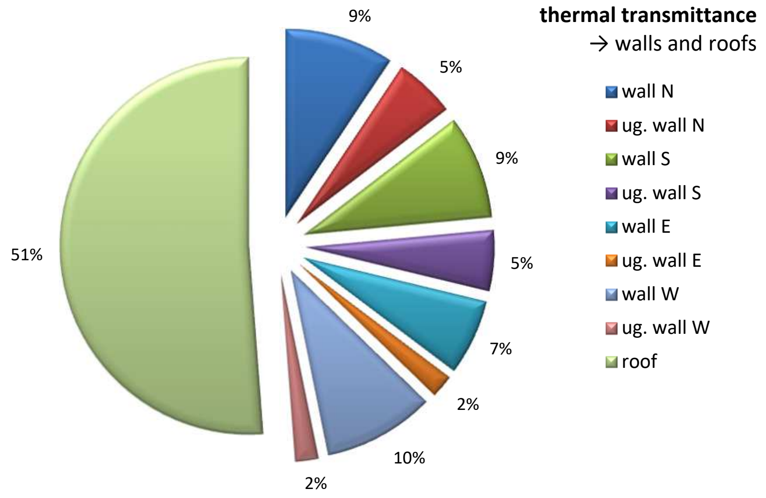
according to ČSN EN ISO 13789 - direct heat transfer to the external environment (→ flat opaque constructions, except doors)

Exterior walls between the heated space and the outside environment:

walls	orientation	width	height	total area	area of windows and doors		net wall area	heat transfer coefficient	thermal transmittance
		b	h	A_T	A_G		A	U	$L_{D,1,i}$
		m	m	m²	m²	%	m²	W/(m².K)	W/K
wall N	N	46,38	8,65	401,14	119,61	29,8	281,5	0,180	**50,68**
ug. wall N	N	32,95	3,90	128,51	0,00	0,0	128,5	0,220	**28,27**
wall S	S	46,38	8,65	401,14	133,34	33,2	267,8	0,180	**48,20**
ug. wall S	S	32,95	3,90	128,51	0,00	0,0	128,5	0,220	**28,27**
wall E	E	46,38	8,65	401,14	205,61	51,3	195,5	0,180	**35,20**
ug. wall E	E	12,50	3,90	48,75	0,00	0,0	48,8	0,220	**10,73**
wall W	W	46,38	8,65	401,14	113,92	28,4	287,2	0,180	**51,70**
ug. wall W	W	12,50	3,90	48,75	0,00	0,0	48,8	0,220	**10,73**
				1959,09	572,47		**1386,6**		**263,8**
								TOTAL	

Roofs between the heated space and the outdoor environment:

roofs		width	height	total area	area of windows and doors		net roof area	heat transfer coefficient	thermal transmittance
		b	h	A_T	A_G		A	U	$L_{D,2,i}$
		m	m	m²	m²	%	m²	W/(m².K)	W/K
roof		-	-	1995,0	150,12	7,5	1844,9	0,150	**276,73**
				1995,0			**1844,88**		**276,7**
								TOTAL	



SPECIFIC HEAT LOSS THROUGH PENETRATION - WINDOWS AND DOORS

according to ČSN EN ISO 10077-1 and ČSN EN ISO 13790

Windows between the heated space and the outside environment:

Windows	heat transfer coefficient			floor	orientation	energy transmittance	width	height	area	number	total area	area of glazing	correction coefficients					collection area	lining length	sill length	thermal transmittance
	U_g	U_f	U_w			g_{normal}	b	h	A_w		A_w	A_g	F_F	F_C	F_o	F_f	F_h	A_s	o_1	o_2	$L_{D,3,j}$
	W/(m²·K)	W/(m²·K)	W/(m²·K)			-	m	m	m²	ks	m²	m²	-	-	-	-	-	m²	m	m	W/K
window1	0,80	1,10	0,86	1+2	S	0,60	8,86	5,65	50,06	1	50,1	45,05	0,90	1,00	1,00	1,00	0,90	24,33	20,16	8,86	43,16
window2	0,80	1,10	0,95	1	S	0,60	1,20	2,80	3,36	1	3,4	3,02	0,90	0,35	1,00	1,00	0,90	0,57	6,80	1,20	3,21
window3	0,80	1,10	0,94	1&2	S	0,60	3,75	2,30	8,63	2	17,3	15,53	0,90	0,35	1,00	1,00	0,90	2,93	8,35	3,75	16,21
window4	0,80	1,10	0,94	1&2	S	0,60	3,45	2,30	7,94	2	15,9	14,28	0,90	0,35	1,00	1,00	0,90	2,70	8,05	3,45	14,99
window5	0,80	1,10	0,88	2	S	0,60	8,43	2,30	19,39	1	19,4	17,45	0,90	0,35	1,00	1,00	0,90	3,30	13,03	8,43	17,10
window6	0,80	1,10	0,97	2	S	0,60	1,20	2,30	2,76	1	2,8	2,48	0,90	0,35	1,00	1,00	0,90	0,47	5,80	1,20	2,67
window7	0,80	1,10	0,95	1	J	0,60	1,30	2,80	3,64	1	3,6	3,28	0,90	0,35	0,80	1,00	0,90	0,50	6,90	1,30	3,46
window8	0,80	1,10	0,99	1	J	0,60	3,75	2,80	10,50	5	52,5	47,25	0,90	0,35	0,80	1,00	0,90	7,14	9,35	3,75	51,82
window9	0,80	1,10	0,91	1	J	0,60	2,60	2,80	7,28	1	7,3	6,55	0,90	0,35	0,80	1,00	0,90	0,99	8,20	2,60	6,66
window10	0,80	1,10	0,90	1+2	J	0,60	1,50	8,05	12,08	1	12,1	10,87	0,90	1,00	0,80	1,00	0,90	4,69	17,60	1,50	10,81
window11	0,80	1,10	0,92	2	J	0,60	2,50	2,30	5,75	1	5,8	5,18	0,90	0,35	0,80	1,00	0,90	0,78	7,10	2,50	5,32
window12	0,80	1,10	0,96	2	J	0,60	1,30	2,30	2,99	1	3,0	2,69	0,90	0,35	0,80	1,00	0,90	0,41	5,90	1,30	2,88
window13	0,80	1,10	1,00	2	J	0,60	3,75	2,30	8,63	5	43,1	38,81	0,90	0,35	0,80	1,00	0,90	5,87	8,35	3,75	43,27
window14	0,80	1,10	0,92	2	J	0,60	2,60	2,30	5,98	1	6,0	5,38	0,90	0,35	0,80	1,00	0,90	0,81	7,20	2,60	5,52
window15	0,80	1,10	0,92	1	V	0,60	2,20	2,80	6,16	1	6,2	5,54	0,90	0,35	1,00	1,00	0,90	1,05	7,80	2,20	5,68
window16	0,80	1,10	1,00	1	V	0,60	1,30	2,80	3,64	2	7,3	6,55	0,90	0,35	1,00	1,00	0,90	1,24	6,90	1,30	7,27
window17	0,80	1,10	0,85	1+2	V	0,60	20,25	8,40	170,10	1	170,1	153,09	0,90	1,00	1,00	1,00	0,90	82,67	37,05	20,25	144,15
window18	0,80	1,10	0,91	2	V	0,60	3,45	2,30	7,94	1	7,9	7,14	0,90	0,35	1,00	1,00	0,90	1,35	8,05	3,45	7,23
window19	0,80	1,10	0,91	2	V	0,60	3,75	2,30	8,63	1	8,6	7,76	0,90	0,35	1,00	1,00	0,90	1,47	8,35	3,75	7,83
window20	0,80	1,10	0,96	2	V	0,60	1,30	2,30	2,99	1	3,0	2,69	0,90	0,35	1,00	1,00	0,90	0,51	5,90	1,30	2,88
window21	0,80	1,10	0,85	stř	V	0,60	20,15	7,45	150,12	1	150,1	135,11	0,90	1,00	1,00	1,00	0,90	72,96	35,05	20,15	127,39
window22	0,80	1,10	1,05	1&2	Z	0,60	3,75	2,30	8,63	8	69,0	62,10	0,90	0,35	0,90	1,00	0,90	10,56	8,35	3,75	72,40
window23	0,80	1,10	0,96	1	Z	0,60	1,25	2,30	2,88	1	2,9	2,59	0,90	0,35	0,90	1,00	0,90	0,44	5,85	1,25	2,77
window24	0,80	1,10	0,94	1&2	Z	0,60	3,45	2,30	7,94	2	15,9	14,28	0,90	0,35	0,90	1,00	0,90	2,43	8,05	3,45	14,99
window25	0,80	1,10	0,96	1	Z	0,60	1,05	2,80	2,94	1	2,9	2,65	0,90	0,35	0,90	1,00	0,90	0,45	6,65	1,05	2,83
window26	0,80	1,10	0,91	2	Z	0,60	3,15	2,30	7,25	1	7,2	6,52	0,90	0,35	0,90	1,00	0,90	1,11	7,75	3,15	6,63
window27	0,80	1,10	0,90	2	Z	0,60	4,40	2,30	10,12	1	10,1	9,11	0,90	0,35	0,90	1,00	0,90	1,55	9,00	4,40	9,12
window28	0,80	1,10	0,96	2	Z	0,60	1,30	2,30	2,99	1	3,0	2,69	0,90	0,35	0,90	1,00	0,90	0,46	5,90	1,30	2,88
window29	0,80	1,10	0,96	2	Z	0,60	1,25	2,30	2,88	1	2,9	2,59	0,90	0,35	0,90	1,00	0,90	0,44	5,85	1,25	2,77
										48	709,2						**TOTAL**	**234,2**	**299,3**	**118,2**	**643,9**

Uprům **0,91** W/m2K

Recap. of windows by orientation *j* :

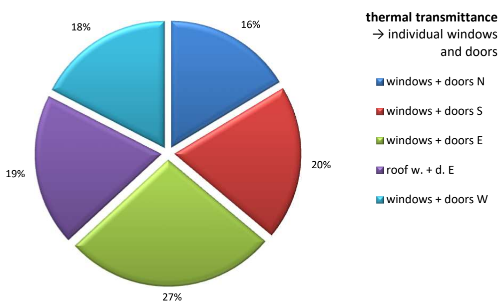
orientation	total area	collection area	thermal transmittance
	$A_{w,j}$	$A_{s,j}$	$L_{D,A,j}$
	m²	m²	W/K
windows N	108,7	34,3	97,3
windows S	133,3	21,2	129,7
windows E	203,1	88,3	175,0
roof w. E	150,1	73,0	127,4
windows W	113,9	17,4	114,4
CELKEM	**709,2**	**234,2**	**643,9**

The door between the heated space and the outside environment:

doors	orientation	width	height	area	number	total area	lining length	sill length	heat transfer coefficient	thermal transmittance
		b	h	A_D		A_D	o_1	o_2	U	$L_{D,4,j}$
		m	m	m²	ks	m²	m	m	W/(m²·K)	W/K
door1	doors N	3,90	2,80	10,92	1	10,92	9,50	3,90	0,90	9,83
door2	doors S	0,00	0,00	0,00	0	0,00	0,00	0,00	0,90	0,00
door3	doors E	0,90	2,80	2,52	1	2,52	6,50	0,90	0,90	2,27
door4	roof d. E	0,00	0,00	0,00	0	0,00	0,00	0,00	0,90	0,00
door5	doors W	0,00	0,00	0,00	0	0,00	0,00	0,00	0,90	0,00
					TOTAL	**13,44**	**16,00**	**4,80**		**12,1**

Total area of windows and doors according to orientation *j* :

orientation	total area	total thermal transmittance
	A_j	$L_{D,4,j}$
	m²	W/K
windows + doors N	119,6	107,15
windows + doors S	133,3	129,73
windows + doors E	205,6	177,30
roof w. + d. E	150,1	127,39
windows + doors W	113,9	114,39
TOTAL	**722,6**	**656,0**



SPECIFIC HEAT LOSS THROUGH PENETRATION - UNHEATED SPACES

according to ČSN EN ISO 13789

Specific heat loss from unheated space to outdoor environment H_{ue} (W/K):

element	orientation	total area A_T m^2	net area A m^2	heat transfer coefficient U $W/(m^2.K)$	**thermal transmittance** L_{Due} **W/K**	
xxx					**0,0**	
xxx					**0,0**	
xxx					**0,0**	
xxx					**0,0**	
xxx					**0,0**	
xxx					**0,0**	
xxx					**0,0**	
xxx					**0,0**	
xxx					**0,0**	
xxx					**0,0**	
xxx					**0,0**	
				TOTAL	**0,0**	**W/K**

Specific heat loss from heated space to unheated H_{iu} (W/K):

element	total area A_T m^2	net area A m^2	heat transfer coefficient U $W/(m^2.K)$	**thermal transmittance** L_{Diu} **W/K**	
xxx				**0,0**	
xxx				**0,0**	
xxx				**0,0**	
xxx				**0,0**	
xxx				**0,0**	
xxx				**0,0**	
xxx				**0,0**	
xxx				**0,0**	
xxx				**0,0**	
xxx				**0,0**	
xxx				**0,0**	
			TOTAL	**0,0**	**W/K**

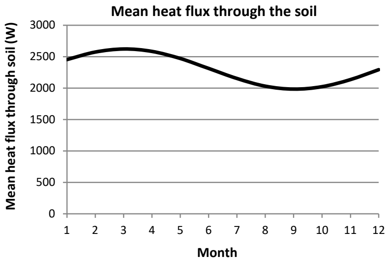
Temp. reduction factor between heated and unheated space	b	**1,00**	**-**
Specific heat loss through the unheated space	H_U	**0,0**	**W/K**

HEAT FLOW THROUGH THE SOIL - FLOOR ON THE GROUND

according to ČSN EN ISO 13370 - in detail according to annexes B and C

Mean heat flux through the soil Φ_G (W) in month *m* :

month	monthly average indoor temp. $T_{i,m}$ (°C)	monthly average outdoor temp. $T_{e,m}$ (°C)	mean heat flux through the soil Φ_G (W)
1	20,0	-0,9	**2454**
2	20,0	0,5	**2574**
3	20,0	4,1	**2622**
4	20,0	9,1	**2584**
5	20,0	14,0	**2471**
6	20,0	17,7	**2312**
7	20,0	19,0	**2151**
8	20,0	17,7	**2031**
9	20,0	14,0	**1984**
10	20,0	9,1	**2021**
11	20,0	4,1	**2135**
12	20,0	0,5	**2293**
		9,1	



Annual average indoor temperature	$T_{i,mean}$	20,00	°C
Annual average outdoor temperature	$T_{e,mean}$	9,07	°C
Amplitude of variation of monthly average indoor temperatures	$T_{i,amp}$	0,00	K
Amplitude of variation of monthly average outdoor temperatures	$T_{e,amp}$	9,95	K
Serial number of the month when the lowest outside temp. is reached	τ	1	-

Basic value of floor heat transfer coefficient U_0 (W/(m^2.K)):

(for both cases: well insulated floor where $d_t \geq B'$ / uninsulated or slightly insulated floor where $d_t < B'$)

Floor area	A	1995,0	m^2
Exposed floor perimeter	P	185,7	m
Characteristic floor dimension	B'	21,5	m
Exterior wall thickness	w	0,5	m
Thermal conductivity of the soil	λ	2,0	W/(m·K)
Resistance to heat transfer at inner side of the floor	$R_{si,f}$	0,17	m^2·K/W
Heat transfer resistance at the floor/soil interface	$R_{se,g}$	0,00	m^2·K/W
Resistance to heat transfer at the ground surface	R_{se}	0,04	m^2·K/W
Thermal resistance of the floor composition	R_f	4,4	m^2·K/W
Equivalent floor thickness	d_t	9,67	m
Fulfilment of the condition $d_t \geq B'$		NE	
Basic value of the floor heat transfer coefficient	U_0	**0,108**	**W/(m^2·K)**

Thermal-technical properties of soil:

category	description	thermal conductivity λ (W/(m·K))	Volumetric heat capacity $(\rho \cdot c)$ (J/(m^3·K))
1	Hlíny a jíly	1,5	3,00E+06
2	Písky a štěrky	2,0	2,00E+06
3	Stejnorodá skála	3,5	2,00E+06

Heat transfer coefficient of the floor composition

U_f 0,220 W/(m^2.K)

Steady-state thermal transmittance L_s (W/K):

(floor on the ground with vertical edge insulation)

Thickness of vertical edge insulation	d_n	0,1	m
Thermal conductivity of vertical edge insulation	λ_n	0,041	W/(m·K)
Thermal resistance of the vertical edge insulation	R_n	2,44	m^2·K/W
Additional effective thickness when placing edge insulation	d'	2,39	m
Depth of vertical edge insulation below ground	D	1	m
Add. lin. heat transfer coeff. at the location of the vertical edge insulation	$\Delta\Psi$	-0,0220	W/(m·K)
Steady state thermal transmittance through the soil	L_s	**210,7**	**W/K**

→ temperature reduction factor (according to ČSN 730540-4:2005 - annex H.2.2)

b 0,48 -

Periodic thermal transmittance:

(floor on ground with vertical edge insulation)

Volumetric heat capacity of soil	$(\rho \cdot c)$	2,50E+06	J/(m^3·K)
Periodic penetration depth	δ	2,83	m
Time advance of the heat flux cycle compared to the internal temp. cycle	α	0,243	months
Time delay of heat flux cycle compared to external temperature cycle	β	2,057	months
Internal periodic thermal transmittance	L_{pi}	**357,0**	**W/K**
External periodic thermal transmittance	L_{pe}	**32,1**	**W/K**

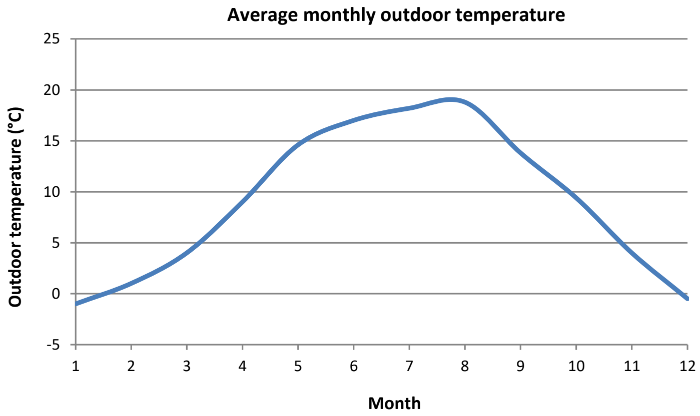
CLIMATE DATA - MONTHLY

Location description:

Location:	Praha
GPS:	50° s.š. / 14° v.d.
Altitude:	220 m.n.m.

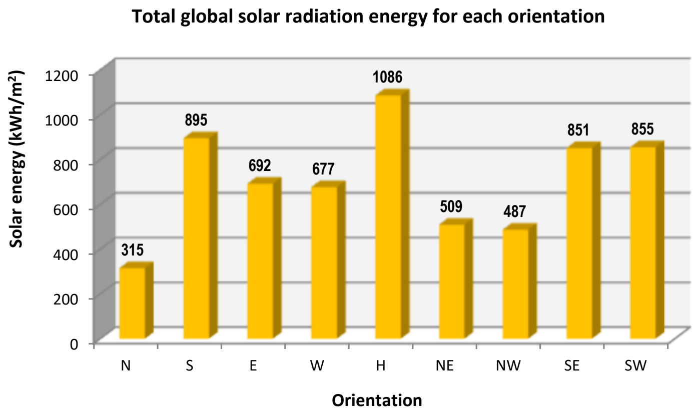
Solar energy in MJ/m²:

month	number of days	outdoor temperature θ_e (°C)	Total global solar radiation energy for each orientation $I_{s,j}$								
			N	S	E	W	H	NE	NW	SE	SW
			MJ/m²								
1	31	-2,4	47	104	58	58	76	47	47	86	86
2	28	-0,9	72	162	97	97	133	76	76	137	137
3	31	3,0	115	234	162	162	259	122	122	209	209
4	30	7,7	158	292	238	238	410	184	184	277	277
5	31	12,7	209	313	299	299	536	245	245	320	320
6	30	15,9	216	284	292	292	526	248	248	299	299
7	31	17,5	212	292	288	288	518	245	245	302	302
8	31	17,0	184	320	277	277	490	216	216	313	313
9	30	13,3	126	256	187	187	313	140	140	234	234
10	31	8,3	86	220	126	126	205	90	90	184	184
11	30	2,9	47	112	61	61	90	47	47	94	94
12	31	-0,6	32	72	40	40	54	32	32	61	61



Solar energy in kWh/m²:

month	number of days	outdoor temperature θ_e (°C)	Total global solar radiation energy for each orientation $I_{s,j}$								
			N	S	E	W	H	NE	NW	SE	SW
			kWh/m²								
1	31	-1,0	7	50	15	20	23	12	12	37	44
2	28	1,0	13	56	26	28	40	20	20	47	51
3	31	4,0	23	82	51	53	79	36	37	73	76
4	30	9,0	32	95	74	72	118	51	49	92	86
5	31	14,6	47	97	104	93	161	79	73	109	98
6	30	17,0	52	87	115	88	166	91	73	108	88
7	31	18,2	47	93	100	93	162	78	75	103	97
8	31	18,8	38	100	88	88	143	64	63	101	100
9	30	13,8	24	95	60	64	96	38	40	82	86
10	31	9,4	17	75	34	48	57	21	25	51	71
11	30	4,0	9	36	14	18	24	10	11	25	32
12	31	-0,5	6	29	11	12	17	9	9	23	26
	365	**9,1**	**315**	**895**	**692**	**677**	**1086**	**509**	**487**	**851**	**855**



SPECIFIC HEAT LOSS THROUGH VENTILATION - MECHANICAL VENTILATION WITH HEAT RECOVERY

according to ČSN EN ISO 13790

Input parameters:

Indoor air volume	V_a	18387,8	m^3
Measured volume flow of fresh air supply		35	$m^3/(os{\cdot}h)$
Multiplicity of air exchange	n	0,50	1/h
Volume flow rate at Δp = 50 Pa	n_{50}	0,60	1/h
Wind exposure coefficient	e	0,01	-
Wind exposure coefficient	f	20	-

Wind exposure coefficients *e* and *f*:

coefficient *e* for shading class:	more than one exposed facade	one exposed facade
no shading	0,10	0,03
moderate shading	0,07	0,02
significant shading	0,04	0,01
coefficient *f*	15	20

Volumetric air flow:

Volumetric flow of supply air	V_f	9114,0	m^3/h
Heat recovery efficiency	η	80%	
Reduced volumetric flow rate of supply air	V	1822,8	m^3/h
Additional volumetric flow rate	V_x	110,3	m^3/h
Total volumetric flow rate	V	1933,1	m^3/h

Specific heat loss through ventilation:

Specific heat capacity of air per unit volume	$\rho_a c_a$	0,34	$Wh/(m^3{\cdot}K)$
Specific heat loss through ventilation	H_V	**657,26**	**W/K**

TIME CONSTANT OF THE BUILDING

according to ČSN EN ISO 13790

Constant for capacity calculation by building class	K	110 000	J/K
Floor area of heated zone	A_f	3141	m^2
Effective internal heat capacity of the building	C_m	95975	Wh/K
Time constant of the building	**τ**	**44**	**hod**

class	K J/K
very light	80 000
light	110 000
medium	165 000
heavy	260 000
very heavy	370 000

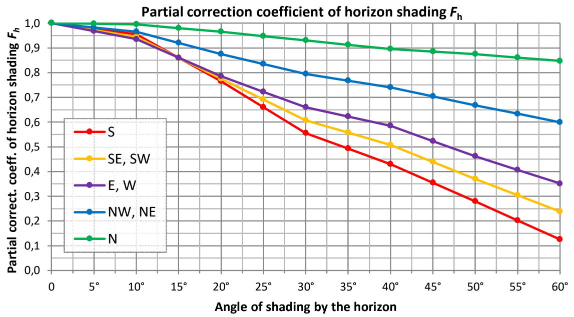
PARTIAL CORRECTION COEFFICIENTS OF SHADING

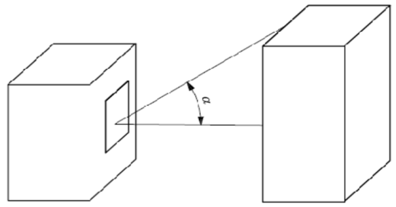
according to ČSN EN ISO 13790 - annex H

Partial correction coefficient of horizon shading F_h:

Standard values: 45° north latitude / 55° north latitude. Interpolated values: 50° north latitude

angle of shading by the horizon	45° S	45° E, W	45° N	55° S	55° E, W	55° N	50° S	50° SE, SW	50° E, W	50° NW, NE	50° N
0	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
5°							0,98	0,97	0,97	0,98	1,00
10°	0,97	0,95	1,00	0,94	0,92	0,99	0,96	0,95	0,94	0,97	1,00
15°							0,86	0,86	0,86	0,92	0,98
20°	0,85	0,82	0,98	0,68	0,75	0,95	0,77	0,78	0,79	0,88	0,97
25°							0,66	0,69	0,72	0,84	0,95
30°	0,62	0,70	0,94	0,49	0,62	0,92	0,56	0,61	0,66	0,80	0,93
35°							0,49	0,56	0,62	0,77	0,91
40°	0,46	0,61	0,90	0,40	0,56	0,89	0,43	0,51	0,59	0,74	0,90
45°							0,35	0,44	0,52	0,70	0,88
50°							0,28	0,37	0,46	0,67	0,87
55°							0,20	0,30	0,41	0,63	0,86
60°							0,13	0,24	0,35	0,60	0,85

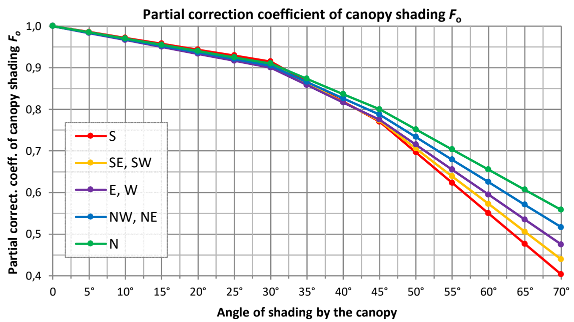


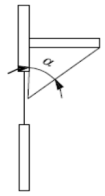


Partial correction coefficient of canopy shading F_o:

Standard values: 45° north latitude / 55° north latitude. Interpolated values: 50° north latitude

angle of shading by the canopy	45° S	45° E, W	45° N	55° S	55° E, W	55° N	50° S	50° SE, SW	50° E, W	50° NW, NE	50° N
0	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
5°							0,99	0,98	0,98	0,98	0,99
10°							0,97	0,97	0,97	0,97	0,97
15°							0,96	0,95	0,95	0,95	0,96
20°							0,94	0,94	0,93	0,94	0,94
25°							0,93	0,92	0,92	0,92	0,93
30°	0,90	0,89	0,91	0,93	0,91	0,91	0,92	0,91	0,90	0,91	0,91
35°							0,87	0,86	0,86	0,87	0,87
40°							0,82	0,82	0,82	0,83	0,84
45°	0,74	0,76	0,80	0,80	0,79	0,80	0,77	0,77	0,78	0,79	0,80
50°							0,70	0,71	0,72	0,73	0,75
55°							0,62	0,64	0,66	0,68	0,70
60°	0,5	0,58	0,66	0,60	0,61	0,65	0,55	0,57	0,60	0,63	0,66
65°							0,48	0,51	0,54	0,57	0,61
70°							0,40	0,44	0,48	0,52	0,56

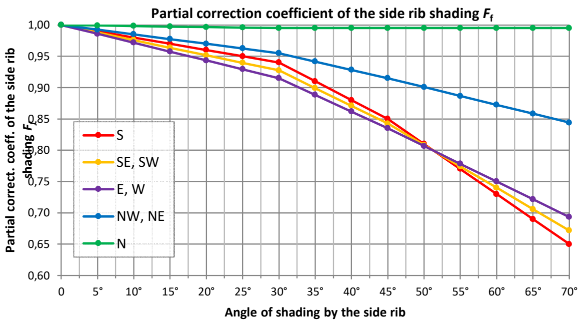


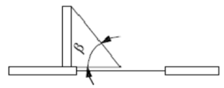


Partial correction coefficient of the side rib shading F_f:

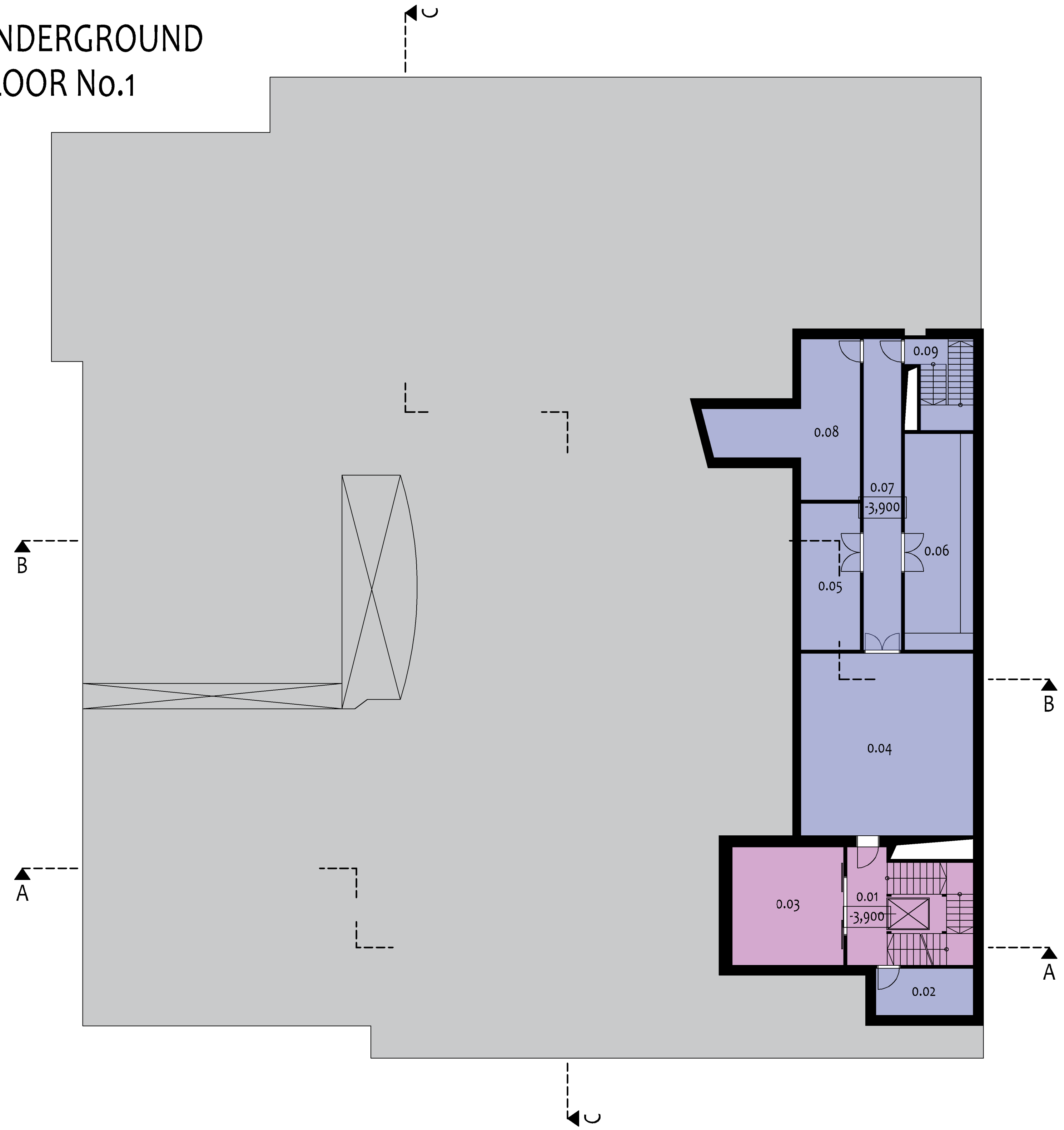
Standard values: 45° north latitude / 55° north latitude. Interpolated values: 50° north latitude

angle of shading by the side rib	45° S	45° E, W	45° N	55° S	55° E, W	55° N	50° S	50° SE, SW	50° E, W	50° NW, NE	50° N
0	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
5°							0,99	0,99	0,99	0,99	1,00
10°							0,98	0,98	0,97	0,99	1,00
15°							0,97	0,96	0,96	0,98	1,00
20°							0,96	0,95	0,94	0,97	1,00
25°							0,95	0,94	0,93	0,96	1,00
30°	0,94	0,92	1,00	0,94	0,91	0,99	0,94	0,93	0,92	0,96	1,00
35°							0,91	0,90	0,89	0,94	1,00
40°							0,88	0,87	0,86	0,93	1,00
45°	0,84	0,84	1,00	0,86	0,83	0,99	0,85	0,84	0,84	0,92	1,00
50°							0,81	0,81	0,81	0,90	1,00
55°							0,77	0,77	0,78	0,89	1,00
60°	0,72	0,75	1	0,74	0,75	0,99	0,73	0,74	0,75	0,87	1,00
65°							0,69	0,71	0,72	0,86	1,00
70°							0,65	0,67	0,69	0,84	1,00





UNDERGROUND FLOOR No.1



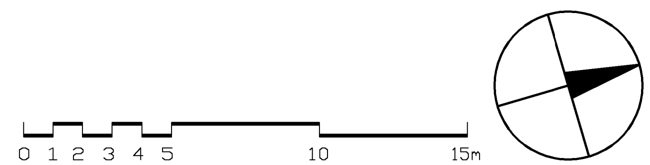
LEGEND OF THE OPTIMAL TEMPERATURES:

- 24 °C
- 22 °C
- 20 °C
- 15 °C

NOTES:

- the project documentation can be used only as DSP and in case of any questions it is necessary to contact the responsible designer

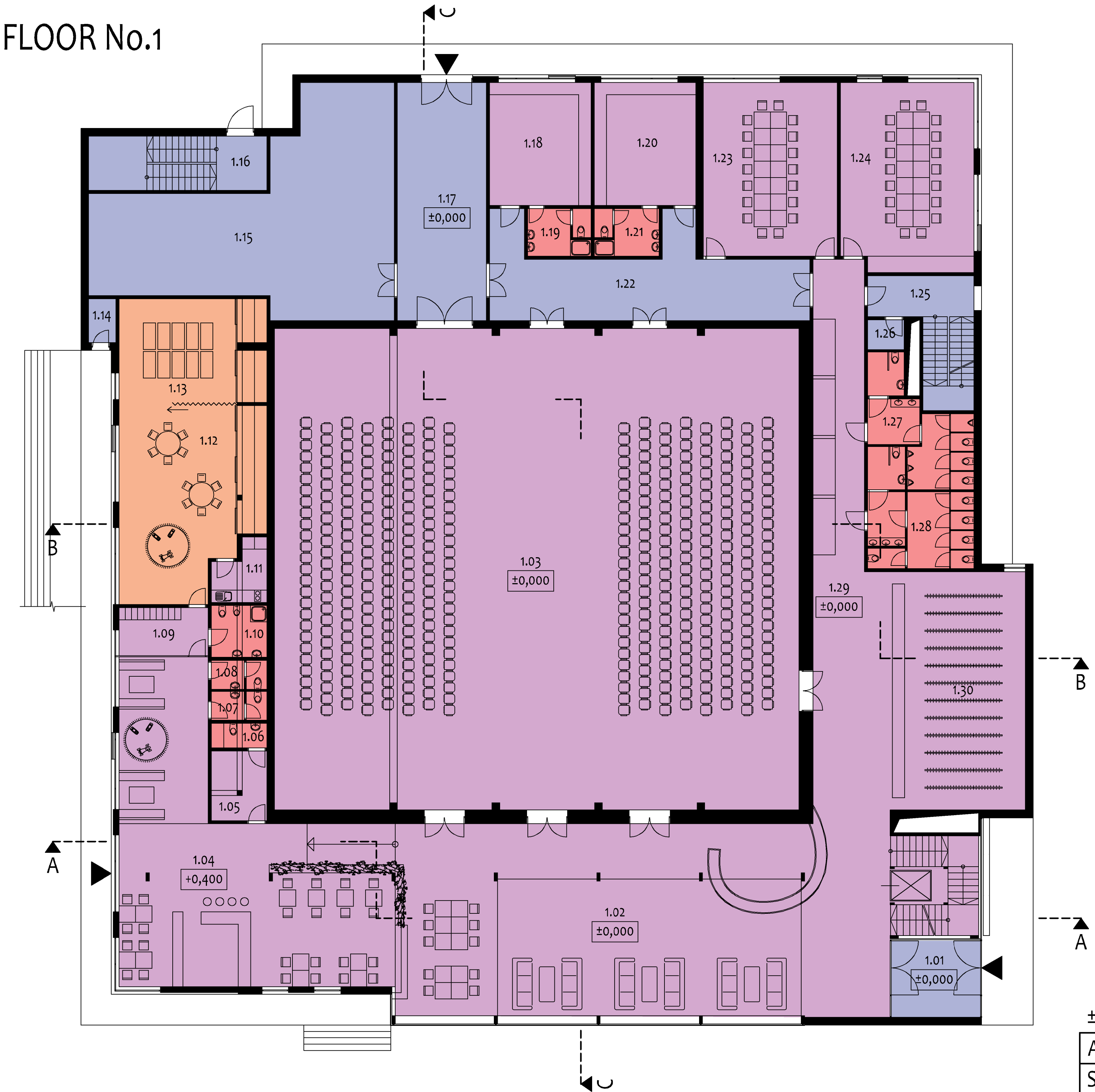
Community centre - Vodňany - UG FL No.1		
NO.	ROOM	AREA [m²]
0.01	CORRIDOR	30,4
0.02	STORAGE	10,2
0.03	REHEARSAL ROOM	29,5
0.04	UTILITY ROOM	70,3
0.05	STORAGE	19,5
0.06	WORKSHOP	33,3
0.07	CORRIDOR	26,5
0.08	STORAGE	31,6
0.09	CORRIDOR	11,7
	TOTAL	263,0



±0,000 = 401,5 m.s.l. (B.p.v.)

AUTHOR	Bc. Tadeáš Petřík	CTU Prague Faculty of Civil Engineering	
SUPERVISOR	Ing. Kamil Staněk, Ph.D.		
CONSULTANT	Professor Climent Molins Borrell		
TYPE OF THESIS	Master's Thesis		
YEAR	2022/2023	FORMAT	2 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	INITIAL RESEARCH AND ANALYSIS	SCALE	NO.
CONTENT	LAYOUT OF OPTIMAL TEMPERATURES - UG FL No.1	1:250	T-01

FLOOR No.1



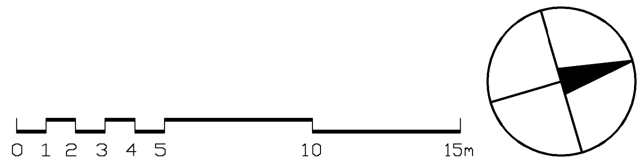
LEGEND OF THE OPTIMAL TEMPERATURES:

- 24 °C
- 22 °C
- 20 °C
- 15 °C

NOTES:

- the project documentation can be used only as DSP and in case of any questions it is necessary to contact the responsible designer

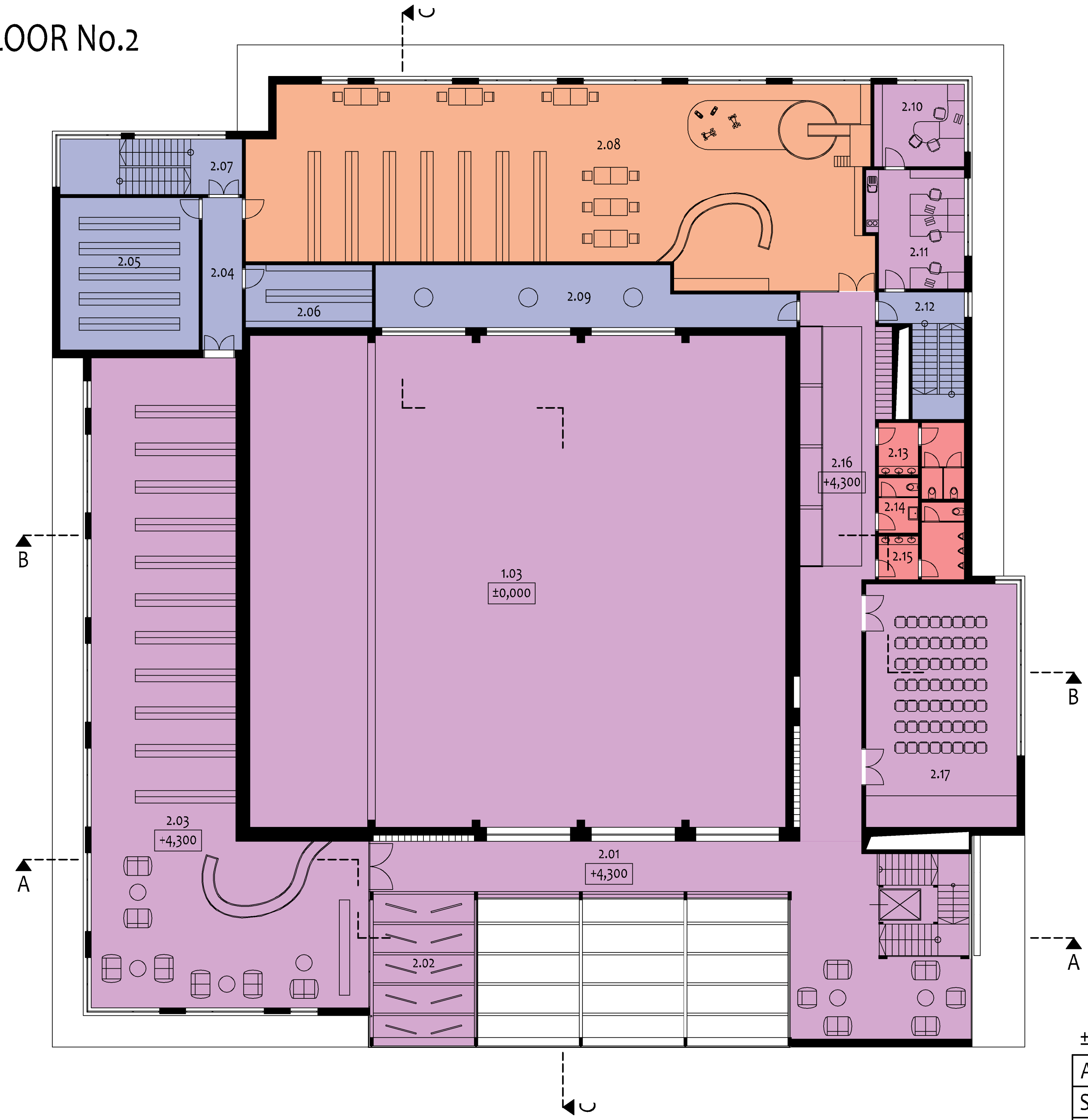
Community centre - Vodňany - FL No.1		
NO.	ROOM	AREA [m²]
1.01	VESTIBULE	16,3
1.02	FOYER + STAIRCASE	252,4
1.03	BLACK BOX THEATRE	601,1
1.04	CAFÉ	142,5
1.05	STORAGE + CLEANING ROOM	9,2
1.06	WC EMPLOYEES	3,2
1.07	WC WOMEN	3,7
1.08	WC MEN	3,7
1.09	CLOAKROOM	10,2
1.10	WC CHILDREN	6,8
1.11	KITCHEN	6,8
1.12	PLAYROOM	61,8
1.13	BEDROOM	36,0
1.14	TOY STORAGE	2,9
1.15	STORAGE	110,9
1.16	CORRIDOR	23,1
1.17	VESTIBULE	50,6
1.18	DRESSING ROOM MEN	29,7
1.19	WC MEN	7,0
1.20	DRESSING ROOM WOMEN	29,7
1.21	WC WOMEN	7,1
1.22	CORRIDOR	55,2
1.23	CLUBROOM	55,5
1.24	CLUBROOM	59,4
1.25	CORRIDOR	21,9
1.26	CLEANING ROOM	2,6
1.27	WC MEN	20,5
1.28	WC WOMEN	22,8
1.29	CORRIDOR	68,9
1.30	CLOAKROOM	92,1
	TOTAL	1814,1



±0,000 = 401,5 m.s.l. (B.p.v.)

AUTHOR	Bc. Tadeáš Petřík	CTU Prague Faculty of Civil Engineering	
SUPERVISOR	Ing. Kamil Staněk, Ph.D.		
CONSULTANT	Professor Climent Molins Borrell		
TYPE OF THESIS	Master's Thesis		
YEAR	2022/2023	FORMAT	2 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	INITIAL RESEARCH AND ANALYSIS	SCALE	NO.
CONTENT	LAYOUT OF OPTIMAL TEMPERATURES - FL No.1	1:250	T-02

FLOOR No.2



LEGEND OF THE OPTIMAL TEMPERATURES:

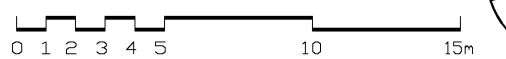
- 24 °C
- 22 °C
- 20 °C
- 15 °C

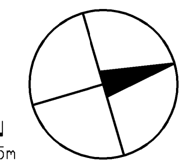
NOTES:

- the project documentation can be used only as DSP and in case of any questions it is necessary to contact the responsible designer

Community centre - Vodňany - FL No.2		
NO.	ROOM	AREA [m²]
2.01	FOYER	109,7
2.02	EXHIBITION SPACE	37,3
2.03	LIBRARY	264,8
2.04	CORRIDOR	13,8
2.05	DEPOSITORY	48,5
2.06	DEPOSITORY	18,2
2.07	CORRIDOR	6,5
2.08	CHILDREN'S LIBRARY	262,1
2.09	TECHNICAL FACILITIES	52,0
2.10	OFFICE	17,0
2.11	OFFICE + KITCHEN	25,1
2.12	CORRIDOR	6,2
2.13	WC WOMEN	12,2
2.14	WC EMPLOYEES	5,0
2.15	WC MEN	11,5
2.16	CORRIDOR	89,9
2.17	LECTURE ROOM	83,7
	TOTAL	1063,5

1.03	BLACK BOX THEATRE	601,1

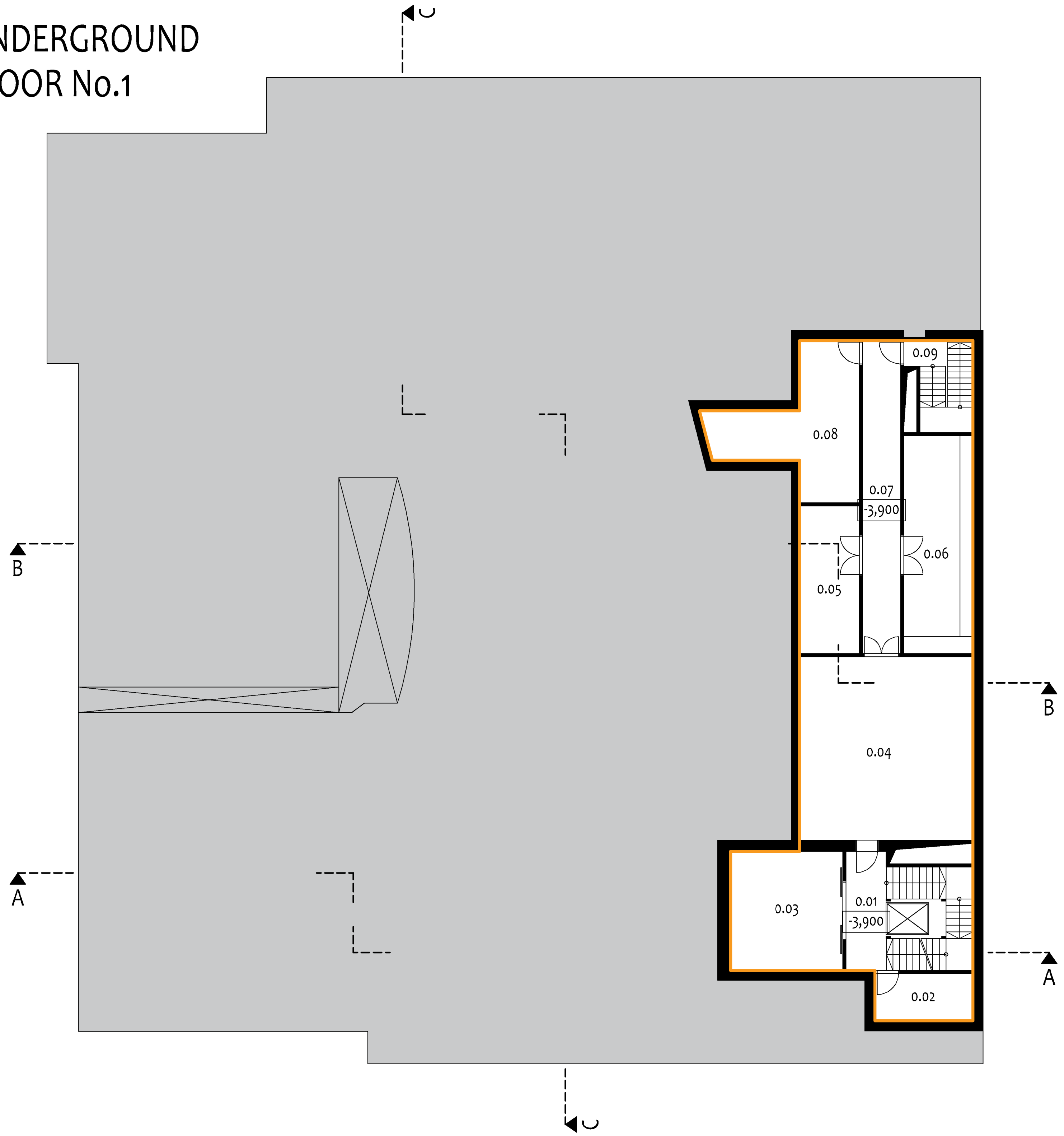




±0,000 = 401,5 m.s.l. (B.p.v.)

AUTHOR	Bc. Tadeáš Petřík	CTU Prague Faculty of Civil Engineering	
SUPERVISOR	Ing. Kamil Staněk, Ph.D.		
CONSULTANT	Professor Climent Molins Borrell		
TYPE OF THESIS	Master's Thesis		
YEAR	2022/2023	FORMAT	2 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	INITIAL RESEARCH AND ANALYSIS	SCALE	NO.
CONTENT	LAYOUT OF OPTIMAL TEMPERATURES - FL No.2	1:250	T-03

UNDERGROUND FLOOR No.1



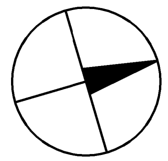
LEGEND OF THE ELEMENTS:

- POSITION OF THE MAIN AIR SEALING LAYER
- EXTERNAL WALLS ADJACENT TO THE GROUND $U_{real} \leq U_{pas,20}$ = 0,22 W/m2K

NOTES:

- the project documentation can be used only as DSP and in case of any questions it is necessary to contact the responsible designer

Community centre - Vodňany - UG FL No.1		
NO.	ROOM	AREA [m²]
0.01	CORRIDOR	30,4
0.02	STORAGE	10,2
0.03	REHEARSAL ROOM	29,5
0.04	UTILITY ROOM	70,3
0.05	STORAGE	19,5
0.06	WORKSHOP	33,3
0.07	CORRIDOR	26,5
0.08	STORAGE	31,6
0.09	CORRIDOR	11,7
	TOTAL	263,0

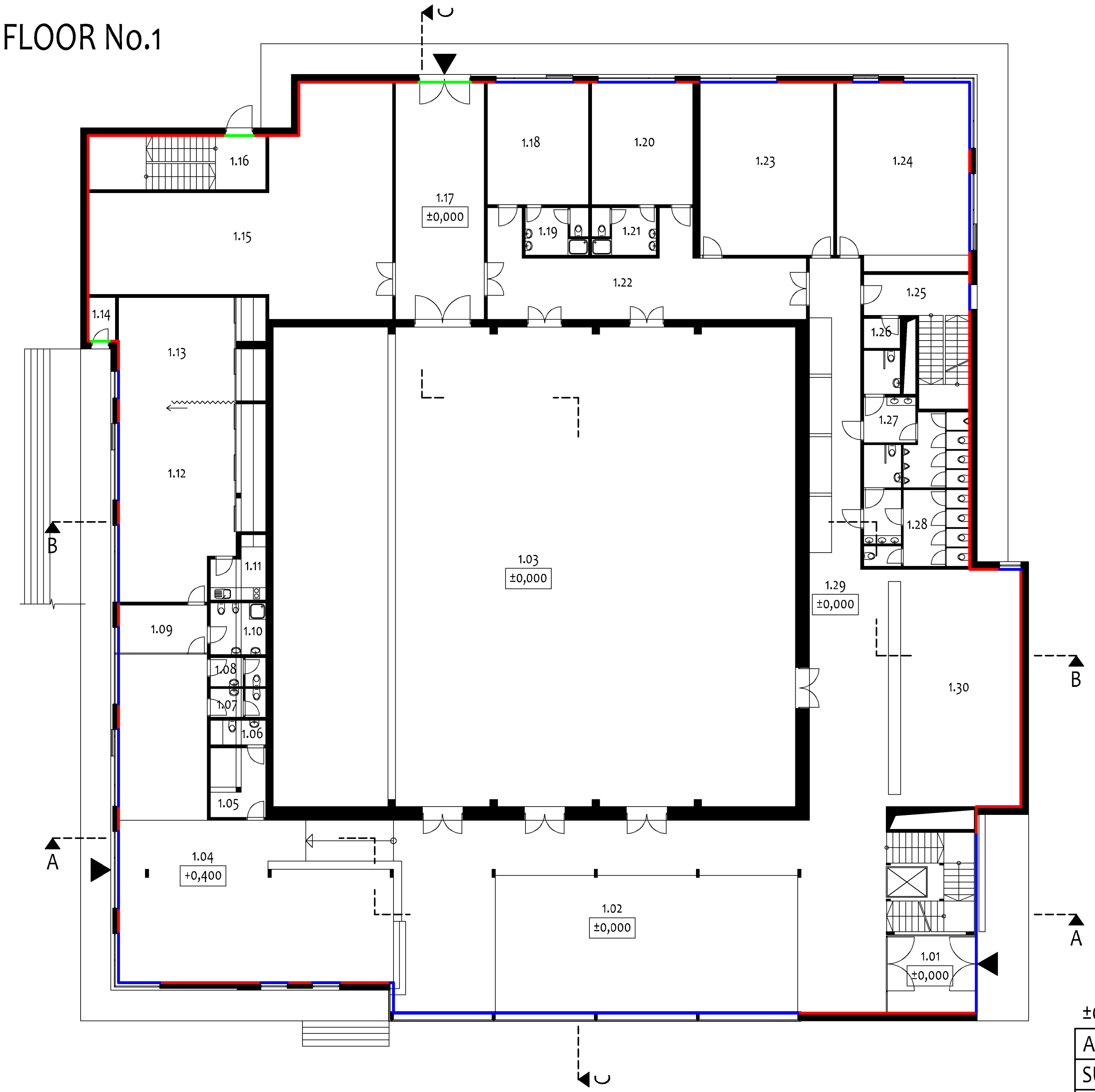


0 1 2 3 4 5 10 15m

±0,000 = 401,5 m.s.l. (B.p.v.)

AUTHOR	Bc. Tadeáš Petřík	CTU Prague Faculty of Civil Engineering	
SUPERVISOR	Ing. Kamil Staněk, Ph.D.		
CONSULTANT	Professor Climent Molins Borrell		
TYPE OF THESIS	Master's Thesis		
YEAR	2022/2023	FORMAT	2 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	INITIAL RESEARCH AND ANALYSIS	SCALE	NO.
CONTENT	VALUES OF THE HEAT TRANSFER COEF. - UG FL No.1	1:250	H-01

FLOOR No.1



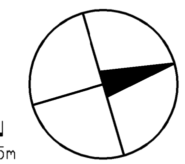
LEGEND OF THE ELEMENTS:

- POSITION OF THE MAIN AIR SEALING LAYER
- EXTERNAL WALLS $U_{real} \leq U_{pas,20}$ = 0,18 W/m2K
- WINDOWS $U_{real} \leq U_{pas,20}$ = 0,8 W/m2K
- DOORS $U_{real} \leq U_{pas,20}$ = 0,9 W/m2K

NOTES:

- the project documentation can be used only as DSP and in case of any questions it is necessary to contact the responsible designer

Community centre - Vodňany - FL No.1		
NO.	ROOM	AREA [m²]
1.01	VESTIBULE	16,3
1.02	FOYER + STAIRCASE	252,4
1.03	BLACK BOX THEATRE	601,1
1.04	CAFÉ	142,5
1.05	STORAGE + CLEANING ROOM	9,2
1.06	WC EMPLOYEES	3,2
1.07	WC WOMEN	3,7
1.08	WC MEN	3,7
1.09	CLOAKROOM	10,2
1.10	WC CHILDREN	6,8
1.11	KITCHEN	6,8
1.12	PLAYROOM	61,8
1.13	BEDROOM	36,0
1.14	TOY STORAGE	2,9
1.15	STORAGE	110,9
1.16	CORRIDOR	23,1
1.17	VESTIBULE	50,6
1.18	DRESSING ROOM MEN	29,7
1.19	WC MEN	7,0
1.20	DRESSING ROOM WOMEN	29,7
1.21	WC WOMEN	7,1
1.22	CORRIDOR	55,2
1.23	CLUBROOM	55,5
1.24	CLUBROOM	59,4
1.25	CORRIDOR	21,9
1.26	CLEANING ROOM	2,6
1.27	WC MEN	20,5
1.28	WC WOMEN	22,8
1.29	CORRIDOR	68,9
1.30	CLOAKROOM	92,1
	TOTAL	1814,1

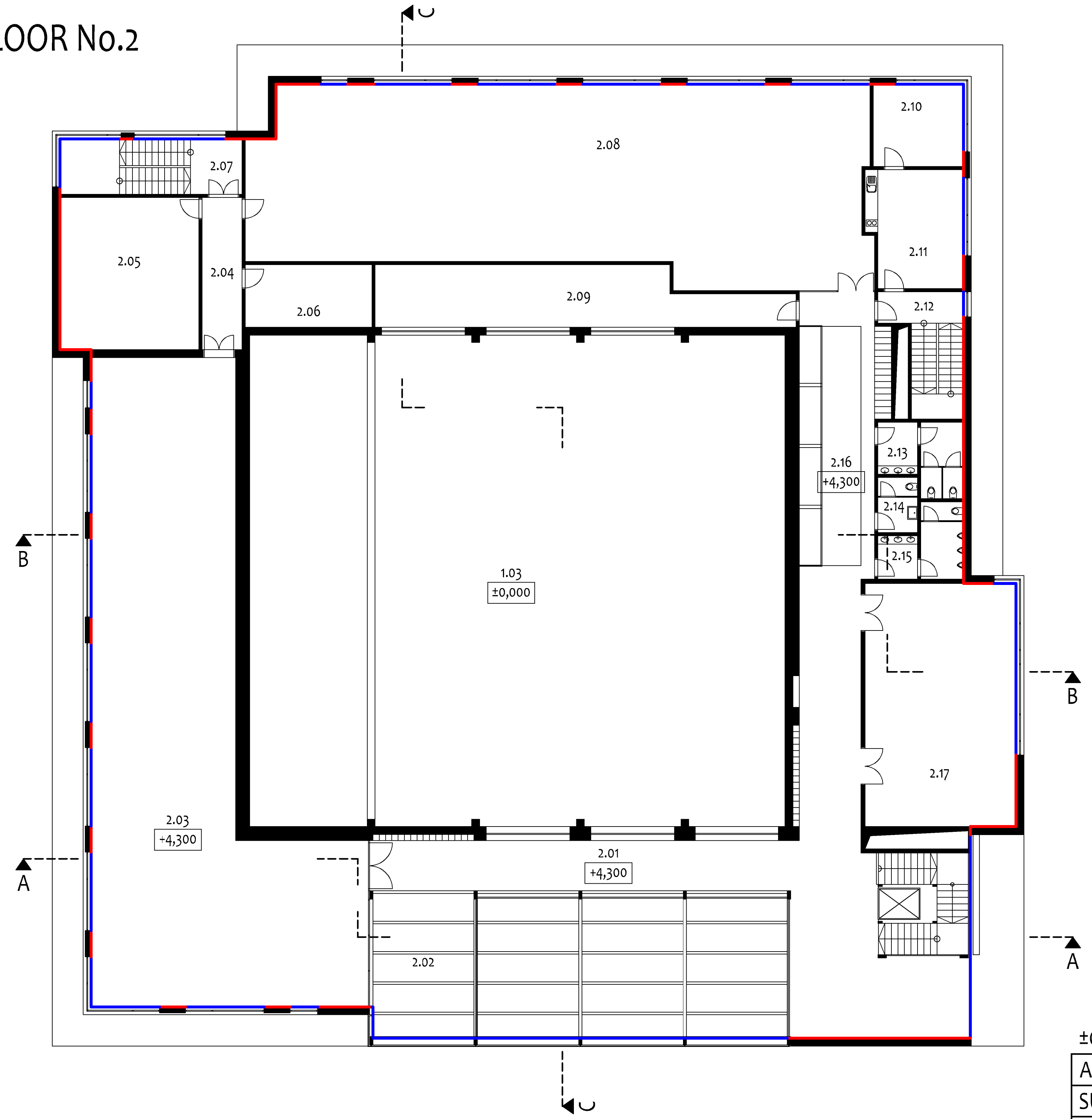


±0,000 = 401,5 m.s.l. (B.p.v.)

0 1 2 3 4 5 10 15m

AUTHOR	Bc. Tadeáš Petřík	CTU Prague Faculty of Civil Engineering	
SUPERVISOR	Ing. Kamil Staněk, Ph.D.		
CONSULTANT	Professor Climent Molins Borrell		
TYPE OF THESIS	Master's Thesis		
YEAR	2022/2023	FORMAT	2 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	INITIAL RESEARCH AND ANALYSIS	SCALE	NO.
CONTENT	VALUES OF THE HEAT TRANSFER COEF. - FL No.1	1:250	H-02

FLOOR No.2



LEGEND OF THE ELEMENTS:

- POSITION OF THE MAIN AIR SEALING LAYER
- EXTERNAL WALLS $U_{real} \leq U_{pas,20}$ = 0,18 W/m2K
- WINDOWS $U_{real} \leq U_{pas,20}$ = 0,8 W/m2K

NOTES:

- the project documentation can be used only as DSP and in case of any questions it is necessary to contact the responsible designer

Community centre - Vodňany - FL No.2

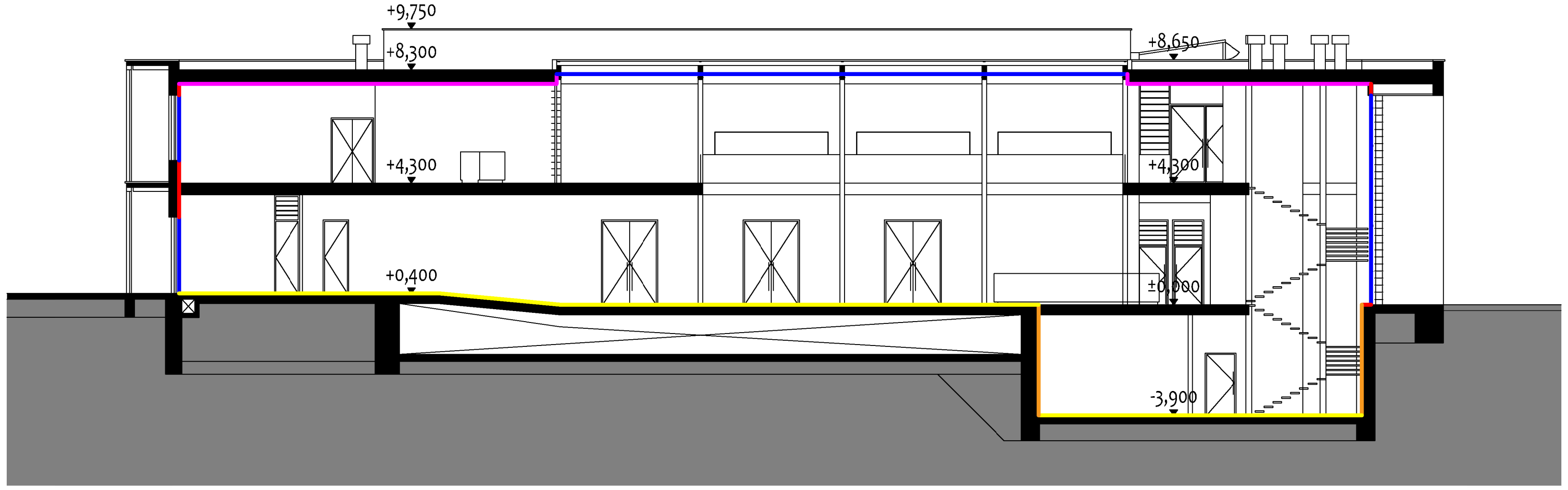
NO.	ROOM	AREA [m²]
2.01	FOYER	109,7
2.02	EXHIBITION SPACE	37,3
2.03	LIBRARY	264,8
2.04	CORRIDOR	13,8
2.05	DEPOSITORY	48,5
2.06	DEPOSITORY	18,2
2.07	CORRIDOR	6,5
2.08	CHILDREN'S LIBRARY	262,1
2.09	TECHNICAL FACILITIES	52,0
2.10	OFFICE	17,0
2.11	OFFICE + KITCHEN	25,1
2.12	CORRIDOR	6,2
2.13	WC WOMEN	12,2
2.14	WC EMPLOYEES	5,0
2.15	WC MEN	11,5
2.16	CORRIDOR	89,9
2.17	LECTURE ROOM	83,7
	TOTAL	1063,5
1.03	BLACK BOX THEATRE	601,1

±0,000 = 401,5 m.s.l. (B.p.v.)

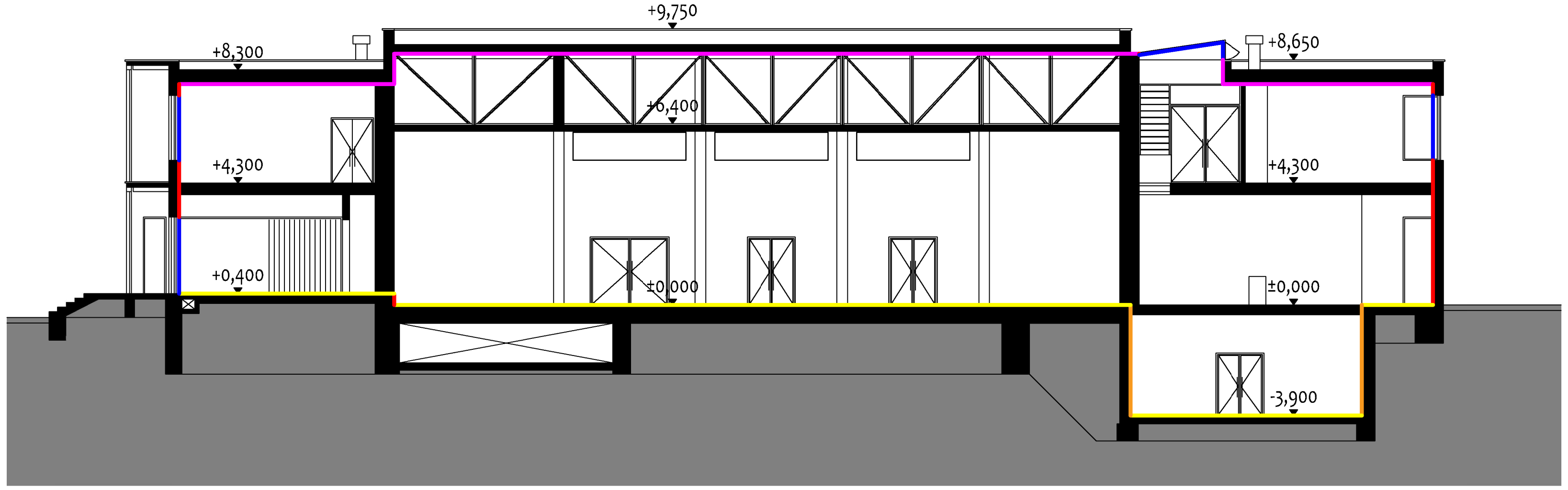
0 1 2 3 4 5 10 15m

AUTHOR	Bc. Tadeáš Petřík	CTU Prague Faculty of Civil Engineering	
SUPERVISOR	Ing. Kamil Staněk, Ph.D.		
CONSULTANT	Professor Climent Molins Borrell		
TYPE OF THESIS	Master's Thesis		
YEAR	2022/2023	FORMAT	2 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	INITIAL RESEARCH AND ANALYSIS	SCALE	NO.
CONTENT	VALUES OF THE HEAT TRANSFER COEF. - FL No.2	1:250	H-03

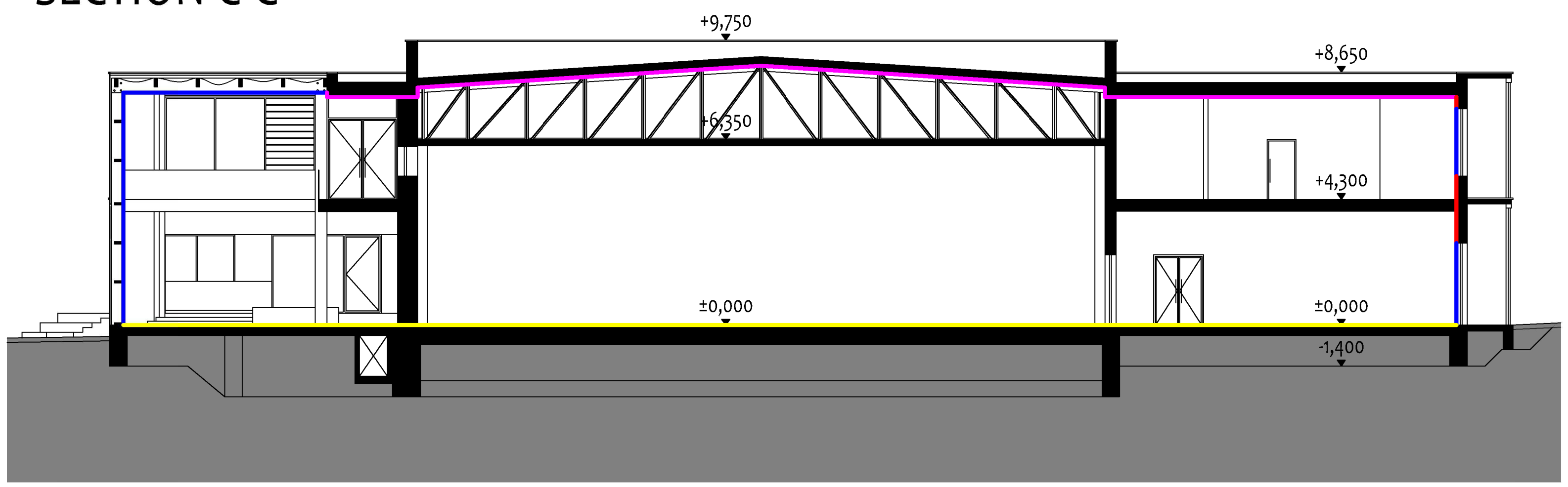
SECTION A-A



SECTION B-B



SECTION C-C



LEGEND OF THE ELEMENTS:

- POSITION OF THE MAIN AIR SEALING LAYER
- EXTERNAL WALLS $U_{real} \leq U_{pas,20}$ = 0,18 W/m2K
- EXTERNAL WALLS ADJACENT TO THE GROUND $U_{real} \leq U_{pas,20}$ = 0,22 W/m2K
- FLOOR ADJACENT TO THE GROUND $U_{real} \leq U_{pas,20}$ = 0,22 W/m2K
- ROOF $U_{real} \leq U_{pas,20}$ = 0,15 W/m2K
- WINDOWS $U_{real} \leq U_{pas,20}$ = 0,8 W/m2K

NOTES:

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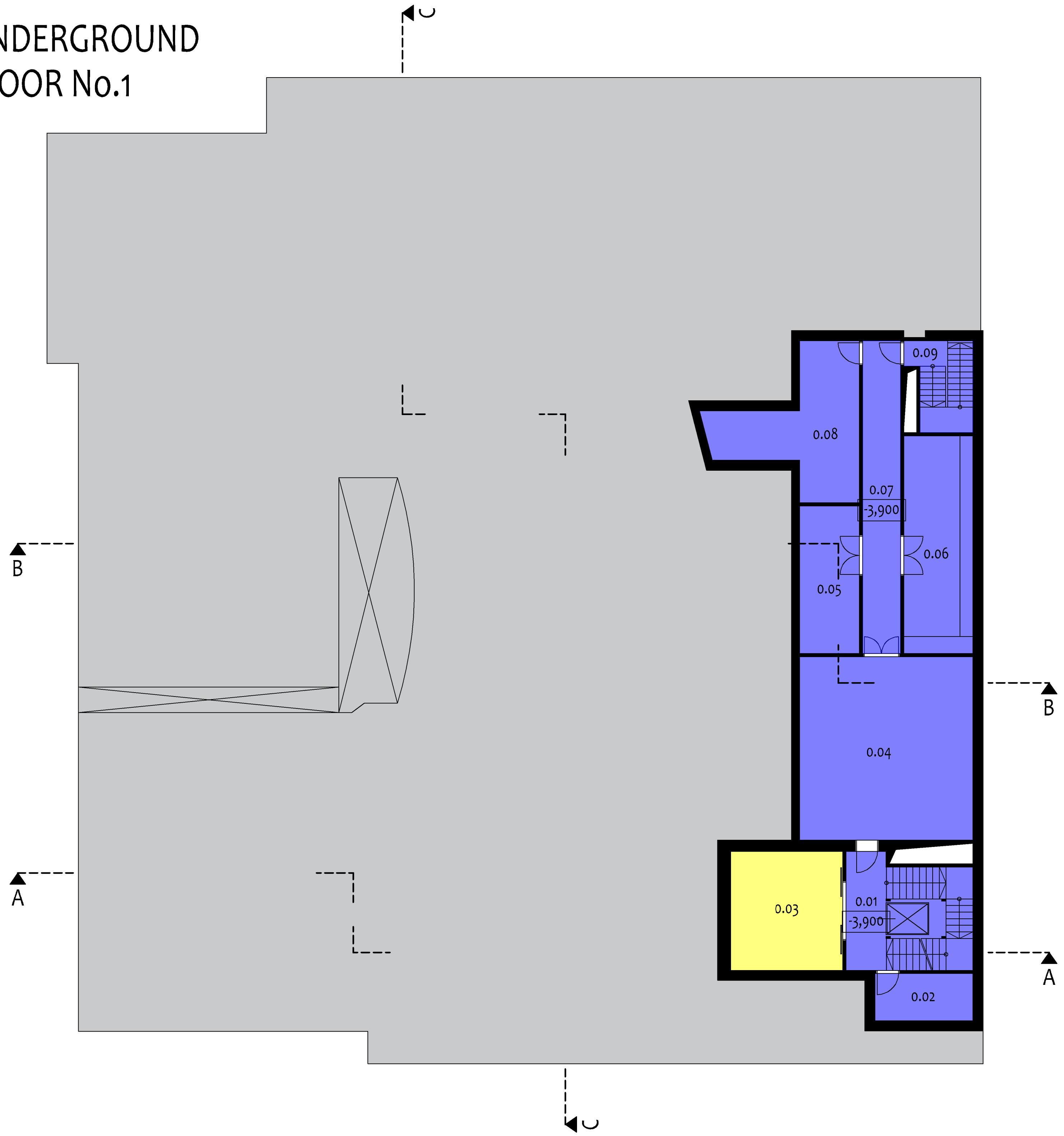
±0,000 = 401,5 m.s.l. (B.p.v.)

0 1 2 3 4 5 10 15m

AUTHOR	Bc. Tadeáš Petřík	CTU Prague Faculty of Civil Engineering	
SUPERVISOR	Ing. Kamil Staněk, Ph.D.		
CONSULTANT	Professor Climent Molins Borrell		
TYPE OF THESIS	Master's Thesis		
YEAR	2022/2023	FORMAT	2 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	INITIAL RESEARCH AND ANALYSIS	SCALE	NO.
CONTENT	VALUES OF THE HEAT TRANSFER COEF. - SECTIONS	1:250	H-04

UNDERGROUND FLOOR No.1



LEGEND OF THE ACOUSTIC SOLUTIONS:

SPACE WITH HIGHEST ACOUSTIC LOAD
- noise transmission and noise protection will be addressed within the design of the structural system

SPACES WITHOUT NOISE PROTECTION
- no acoustic modifications to the constructions are required

NOISE-PROTECTED SPACES
- requirements for structures in contact with:

LIBRARIES, CLUBROOMS, ETC.

CEILINGS	R'w ≥ 53 dB
	L'n,w ≤ 55 dB
INT. WALLS	R'w ≥ 47 dB
DOORS	R'w ≥ 37 dB

COMMON AREAS, CORRIDORS, STAIRCASES

CEILINGS	R'w ≥ 53 dB
	L'n,w ≤ 58 dB
INT. WALLS	R'w ≥ 47 dB
DOORS	R'w ≥ 32 dB

NOISY AREAS (CAFÉS, PLAYROOMS, ETC.)

CEILINGS	R'w ≥ 55 dB
	L'n,w ≤ 48 dB
INT. WALLS	R'w ≥ 52 dB
DOORS	R'w ≥ - dB

VERY NOISY AREAS (THEATRES, ETC.)

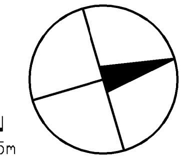
CEILINGS	R'w ≥ 60 dB
	L'n,w ≤ 48 dB
INT. WALLS	R'w ≥ 57 dB
DOORS	R'w ≥ - dB

Community centre - Vodňany - UG FL No.1

NO.	ROOM	AREA [m²]
0.01	CORRIDOR	30,4
0.02	STORAGE	10,2
0.03	REHEARSAL ROOM	29,5
0.04	UTILITY ROOM	70,3
0.05	STORAGE	19,5
0.06	WORKSHOP	33,3
0.07	CORRIDOR	26,5
0.08	STORAGE	31,6
0.09	CORRIDOR	11,7
	TOTAL	263,0

NOTES:

- the project documentation can be used only as DSP and in case of any questions it is necessary to contact the responsible designer

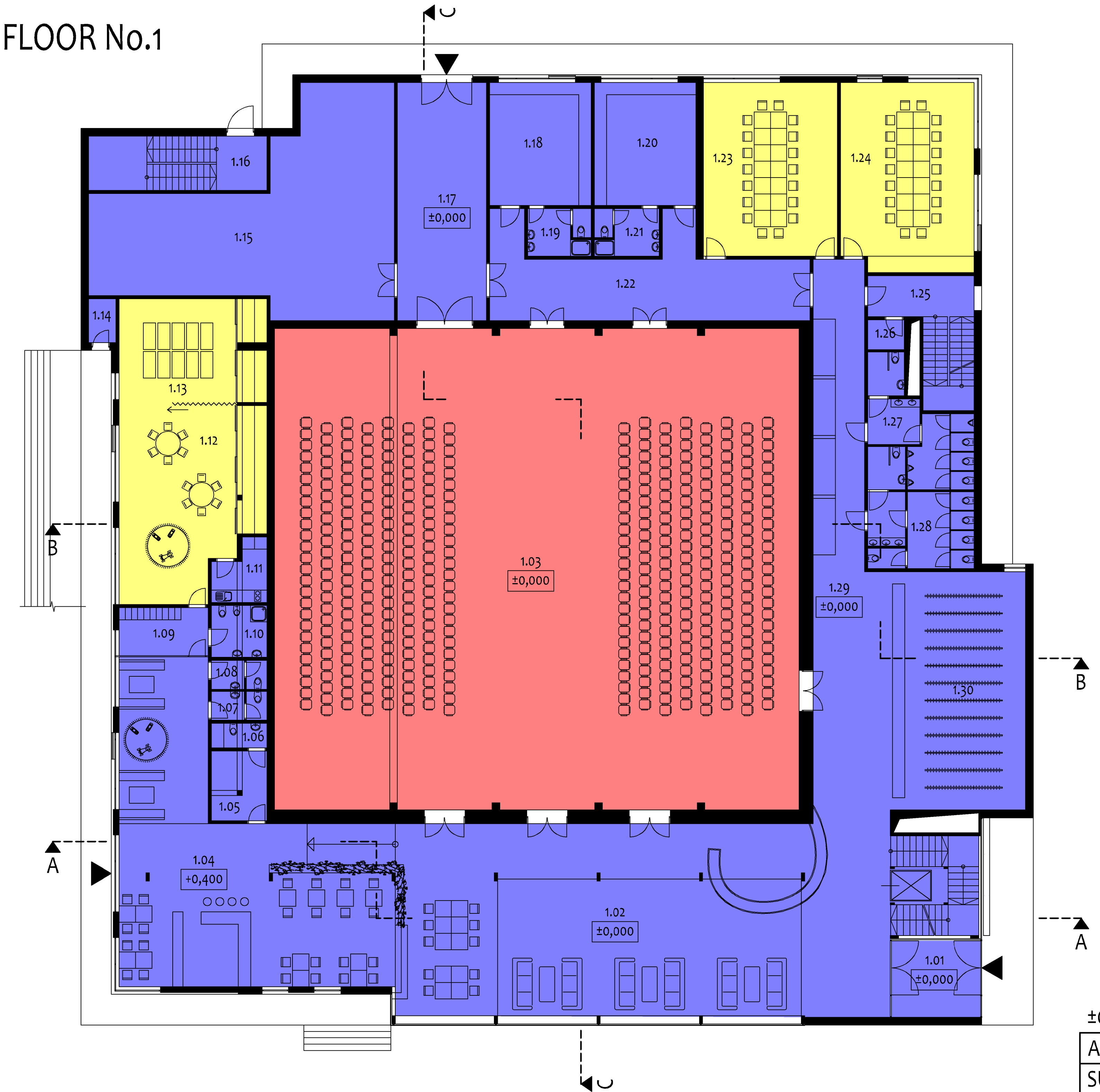


±0,000 = 401,5 m.s.l. (B.p.v.)

0 1 2 3 4 5 10 15m

AUTHOR	Bc. Tadeáš Petřík	CTU Prague Faculty of Civil Engineering	
SUPERVISOR	Ing. Kamil Staněk, Ph.D.		
CONSULTANT	Professor Climent Molins Borrell		
TYPE OF THESIS	Master's Thesis		
YEAR	2022/2023	FORMAT	2 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	INITIAL RESEARCH AND ANALYSIS	SCALE	NO.
CONTENT	VALUES OF MIN. AIRBORNE SOUND INSULATION AND MAX. IMPACT SOUND - UG FL No.1	1:250	S-01

FLOOR No.1



LEGEND OF THE ACOUSTIC SOLUTIONS:

SPACE WITH HIGHEST ACOUSTIC LOAD (red)
- noise transmission and noise protection will be addressed within the design of the structural system

SPACES WITHOUT NOISE PROTECTION (blue)
- no acoustic modifications to the constructions are required

NOISE-PROTECTED SPACES (yellow)
- requirements for structures in contact with: LIBRARIES, CLUBROOMS, ETC.

CEILINGS	R'w ≥ 53 dB
	L'n,w ≤ 55 dB
INT. WALLS	R'w ≥ 47 dB
DOORS	R'w ≥ 37 dB

COMMON AREAS, CORRIDORS, STAIRCASES

CEILINGS	R'w ≥ 53 dB
	L'n,w ≤ 58 dB
INT. WALLS	R'w ≥ 47 dB
DOORS	R'w ≥ 32 dB

NOISY AREAS (CAFÉS, PLAYROOMS, ETC.)

CEILINGS	R'w ≥ 55 dB
	L'n,w ≤ 48 dB
INT. WALLS	R'w ≥ 52 dB
DOORS	R'w ≥ - dB

VERY NOISY AREAS (THEATRES, ETC.)

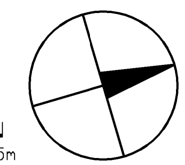
CEILINGS	R'w ≥ 60 dB
	L'n,w ≤ 48 dB
INT. WALLS	R'w ≥ 57 dB
DOORS	R'w ≥ - dB

NOTES:

- the project documentation can be used only as DSP and in case of any questions it is necessary to contact the responsible designer

Community centre - Vodňany - FL No.1

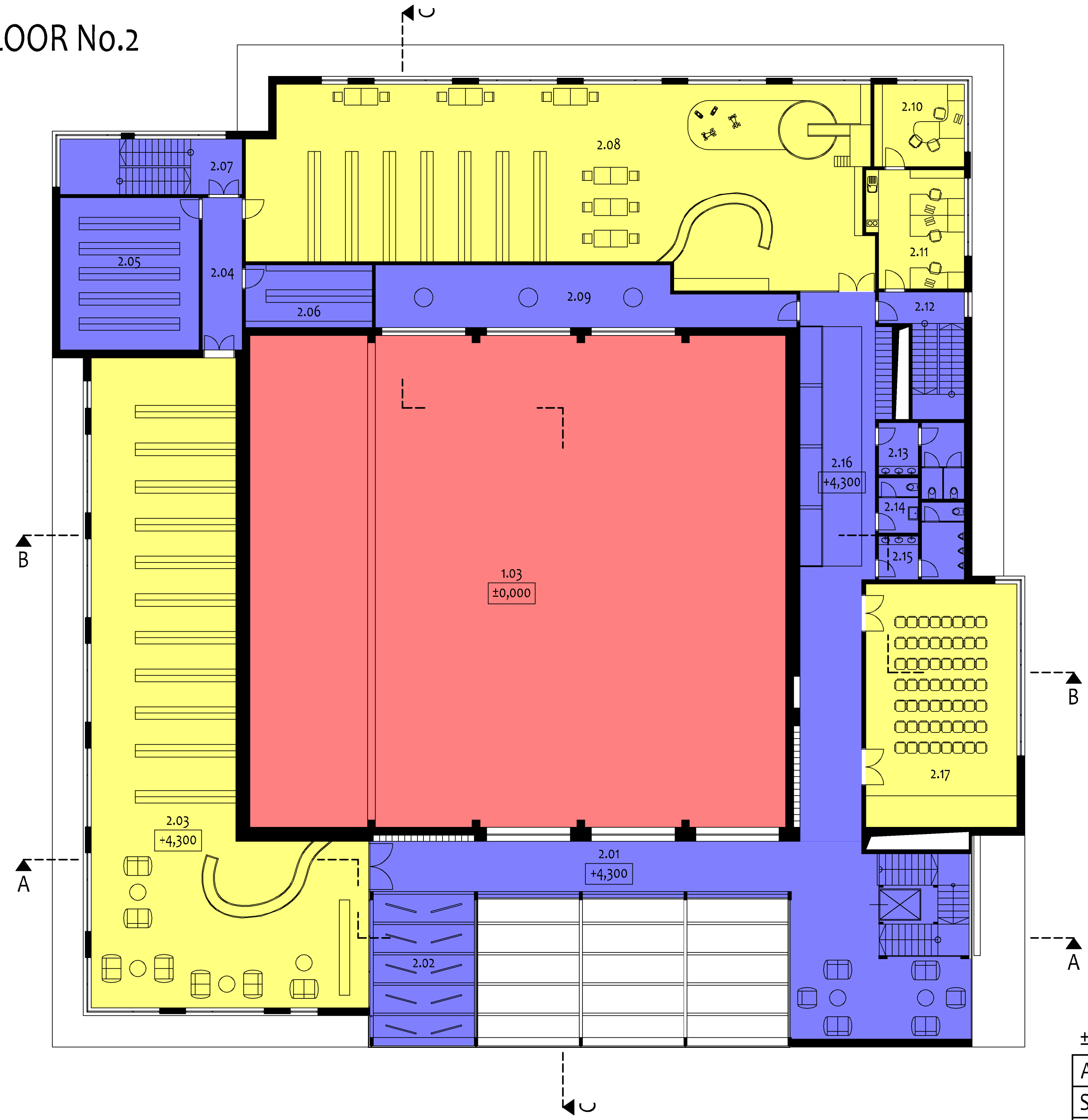
NO.	ROOM	AREA [m²]
1.01	VESTIBULE	16,3
1.02	FOYER + STAIRCASE	252,4
1.03	BLACK BOX THEATRE	601,1
1.04	CAFÉ	142,5
1.05	STORAGE + CLEANING ROOM	9,2
1.06	WC EMPLOYEES	3,2
1.07	WC WOMEN	3,7
1.08	WC MEN	3,7
1.09	CLOAKROOM	10,2
1.10	WC CHILDREN	6,8
1.11	KITCHEN	6,8
1.12	PLAYROOM	61,8
1.13	BEDROOM	36,0
1.14	TOY STORAGE	2,9
1.15	STORAGE	110,9
1.16	CORRIDOR	23,1
1.17	VESTIBULE	50,6
1.18	DRESSING ROOM MEN	29,7
1.19	WC MEN	7,0
1.20	DRESSING ROOM WOMEN	29,7
1.21	WC WOMEN	7,1
1.22	CORRIDOR	55,2
1.23	CLUBROOM	55,5
1.24	CLUBROOM	59,4
1.25	CORRIDOR	21,9
1.26	CLEANING ROOM	2,6
1.27	WC MEN	20,5
1.28	WC WOMEN	22,8
1.29	CORRIDOR	68,9
1.30	CLOAKROOM	92,1
	TOTAL	1814,1



±0,000 = 401,5 m.s.l. (B.p.v.)

AUTHOR	Bc. Tadeáš Petřík	CTU Prague Faculty of Civil Engineering	
SUPERVISOR	Ing. Kamil Staněk, Ph.D.		
CONSULTANT	Professor Climent Molins Borrell		
TYPE OF THESIS	Master's Thesis		
YEAR	2022/2023	FORMAT	2 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	INITIAL RESEARCH AND ANALYSIS	SCALE	NO.
CONTENT	VALUES OF MIN. AIRBORNE SOUND INSULATION AND MAX. IMPACT SOUND - FL No.1	1:250	S-02

FLOOR No.2



LEGEND OF THE ACOUSTIC SOLUTIONS:

SPACE WITH HIGHEST ACOUSTIC LOAD
- noise transmission and noise protection will be addressed within the design of the structural system

SPACES WITHOUT NOISE PROTECTION
- no acoustic modifications to the constructions are required

NOISE-PROTECTED SPACES
- requirements for structures in contact with:

LIBRARIES, CLUBROOMS, ETC.

CEILINGS	R'w ≥ 53 dB
	L'n,w ≤ 55 dB
INT. WALLS	R'w ≥ 47 dB
DOORS	R'w ≥ 37 dB

COMMON AREAS, CORRIDORS, STAIRCASES

CEILINGS	R'w ≥ 53 dB
	L'n,w ≤ 58 dB
INT. WALLS	R'w ≥ 47 dB
DOORS	R'w ≥ 32 dB

NOISY AREAS (CAFÉS, PLAYROOMS, ETC.)

CEILINGS	R'w ≥ 55 dB
	L'n,w ≤ 48 dB
INT. WALLS	R'w ≥ 52 dB
DOORS	R'w ≥ - dB

VERY NOISY AREAS (THEATRES, ETC.)

CEILINGS	R'w ≥ 60 dB
	L'n,w ≤ 48 dB
INT. WALLS	R'w ≥ 57 dB
DOORS	R'w ≥ - dB

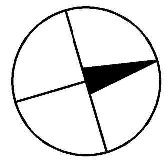
Community centre - Vodňany - FL No.2

NO.	ROOM	AREA [m²]
2.01	FOYER	109,7
2.02	EXHIBITION SPACE	37,3
2.03	LIBRARY	264,8
2.04	CORRIDOR	13,8
2.05	DEPOSITORY	48,5
2.06	DEPOSITORY	18,2
2.07	CORRIDOR	6,5
2.08	CHILDREN'S LIBRARY	262,1
2.09	TECHNICAL FACILITIES	52,0
2.10	OFFICE	17,0
2.11	OFFICE + KITCHEN	25,1
2.12	CORRIDOR	6,2
2.13	WC WOMEN	12,2
2.14	WC EMPLOYEES	5,0
2.15	WC MEN	11,5
2.16	CORRIDOR	89,9
2.17	LECTURE ROOM	83,7
	TOTAL	1063,5

1.03	BLACK BOX THEATRE	601,1

NOTES:

- the project documentation can be used only as DSP and in case of any questions it is necessary to contact the responsible designer



0 1 2 3 4 5 10 15m

±0,000 = 401,5 m.s.l. (B.p.v.)

AUTHOR	Bc. Tadeáš Petřík	CTU Prague Faculty of Civil Engineering	
SUPERVISOR	Ing. Kamil Staněk, Ph.D.		
CONSULTANT	Professor Climent Molins Borrell		
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SUBDIVISION	INITIAL RESEARCH AND ANALYSIS	SCALE	NO.
CONTENT	VALUES OF MIN. AIRBORNE SOUND INSULATION AND MAX. IMPACT SOUND - FL No.2	1:250	S-03