CZECH TECHNICAL UNIVERSITY IN PRAGUE
FACULTY OF CIVIL ENGINEERING

D.1.2 STRUCTURAL DESIGN

11/2022

Table of Content

<table>
<tr><td>AUTHOR</td><td>Bc. Tadeáš Petřík</td><td colspan="2" rowspan="4">CTU Prague
Faculty of Civil
Engineering</td></tr>
<tr><td>SUPERVISOR</td><td>Ing. Kamil Staněk, Ph.D.</td></tr>
<tr><td>CONSULTANT</td><td>Professor Climent Molins Borrell</td></tr>
<tr><td>TYPE OF THESIS</td><td>Master’s Thesis</td></tr>
<tr><td>YEAR</td><td>2022/2023</td><td>FORMAT</td><td>A4</td></tr>
<tr><td>LOCATION</td><td>Czech Republic – Vodňany</td><td>DATE</td><td>11/2022</td></tr>
<tr><td>BUILDING’S NAME</td><td>Community centre – Vodňany</td><td>LVL OF PD</td><td>DSP</td></tr>
<tr><td>SUBDIVISION</td><td>D.1.2 STRUCTURAL DESIGN</td><td rowspan="2">SCALE
-</td><td rowspan="2">NO.
-</td></tr>
<tr><td>CONTENT</td><td>Technical report</td></tr>
</table>

11/2022

Table of Content

1. Basic information about the project

1.1. General description of the building

The subject of the project documentation is a design of 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, with

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].

The building will be connected to the utilities, which are led under the adjacent roads in Zeyerovy Sady and Elektrárenská streets. The construction will not affect any surrounding existing buildings.

2. Basic characteristic of the building and structural design

2.1. Urban, architectural and layout design of the building

The subject of the project documentation is a design of a community centre in a Czech town called Vodňany. The building is square in shape, with area of 46,1 x 45,9 m. It has two floors above ground and one underground floor. The height of the building is 9,5 m above ±0,000 or 9,8 m above ground (modified terrain). Structural floor height is 3,9 m for the underground floor, 4,4 m for the first floor and 4,3 m for the second floor.

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.

2.2. Technical design of the building

The load-bearing system varies in different parts of the building. In the underground floor, the load-bearing system is designed as monolithic reinforced concrete walls supplemented by reinforced concrete beams and one-way floor slabs. On the above-ground floors, another load-bearing system is used for the black box theatre, where again monolithic reinforced concrete walls are used, now in combination with wooden truss beams. In the rest of the building, the load-bearing system is designed as a combination of wooden wall panels and wooden columns, supplemented by wooden beams and wooden one-way floor slabs.

The foundation structures are designed as a combination of strips and footings made of plain concrete, between which a base plain concrete slab will be made.

The staircases on the underground floor are designed as prefabricated reinforced concrete, half landing or two-quarter landing. The staircases on the above-ground floors are designed as wooden staircases, placed on wooden staircase beams, again half landing or two-quarter landing.

The building has sufficient spatial rigidity due to the large number of load-bearing walls perpendicular to each other in combination with woodem beams and rigid floor slabs.

2.3. Material solution of the building

Load-bearing structures in the underground floor are made as reinforced concrete monolithic, in the black box theatre as reinforced concrete monolithic in combination with wooden elements, and in the rest of the building the load-bearing structures are made of wood. The foundations are made of plain concrete.

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

Partitions

- Knauf W111, thickness 100 mm
- Knauf W112, thickness 100 mm
- YTONG Klasik 100, thickness 100 mm

3. Load on the structures

In the static calculations, the characteristic load values are always specified first. In order to obtain the design load values, it is necessary to multiply the characteristic values by the appropriate partial safety coefficients. A safety coefficient value of 1,35 was considered for dead loads and a safety coefficient value of 1,5 for live loads.

3.1. Dead load

Density of reinforced concrete structures is considered as 25 kN/m3.

The self-weight of the floors is considered as uniform average value of 1,4 kN/m2 for floors in the ground and above underground floor, and 1,0 kN/m2 for floors in the rest of the building. For the calculation of these values, see *Preliminary static calculation 2.1.2 Floors*.

The building has two types of roofs. Both are flat green roofs accessible only for maintenance. One of the roofs is constructed over the black box theatre with a dead load of 1,43 kN/m2, the other roof is constructed over the rest of the building and has a load of 1,28 kN/m2.

Dropped ceiling dead load in considered as 0,30 kN/m2.

Self-weight of the envelope non-load-bearing structures can be neglected due to the small value of the thermal insulation self-weight and is not considered further.

The dead load of the partitions is considered as uniform average value of 0,7 kN/m2. For the calculation, see *Preliminary static calculation 2.1.6 Partitions*.

Dead load from the stair steps in considered as 2,23 kN/m2 for reinforced concrete staircases and 0,54 kN/m2 for wooden staircases.

The basement walls will be loaded with ground pressure from the backfilling non-freezing soil with characteristic bulk density of 19,5 kN/m3.

3.2. Live load

3.2.1. Imposed load

- category E1 — storages, technical facilities, etc.
  $q_k = 7{,}5\ kN/m^2$
- category A — bedrooms, playrooms, kitchens and sanitary facilities
  $q_k = 1{,}5\ kN/m^2$
- category C1 — cafés, reading rooms, receptions
  $q_k = 3{,}0\ kN/m^2$

- category C2 rooms with attached seats, e.g. theatres, lecture rooms, etc.
  q_k = 4,0 kN/m^2 (min. 3,0 kN/m^2)
- category C3 areas without obstacles to the movement of people, e.g. areas in museums, exhibition halls and access areas in public buildings
  q_k = 5,0 kN/m^2 (min. 3,0 kN/m^2)
- category H roofs except for routine maintenance and repairs
  q_k = 0,75 kN/m^2

3.2.2. Snow load

The building is located in the Czech town of Vodňany, snow area I. Due to the location of the building and the surrounding buildings, there will be no significant snow movements due to wind. The snow load value was calculated as 0,56 kN/m2. For calculation, see *Preliminary static calculation 2.2.2 Snow load*.

3.2.3. Wind load

The object is located in the Czech town of Vodňany, wind area II, in an area built up with buildings of approximately the same height as the object in question, terrain category III. In terms of load, the main role is played by the simultaneous wind pressure on the windward side and the wind suction on the leeward side of the building. The value of the wind load was claculated as 0,62 kN/m2 for walls and 1,12 kN/m2 for roofs both in the transverse direction and the longitudinal direction.

3.3. Additional load

No other types of loads were considered for the building.

4. Load on the structures

4.1. Results of the geological survey

A geological survey under the building and in its surroundings revealed simple foundation conditions. The type of soil under and around the building does not change significantly, the layers are almost horizontal and of approximately the same thickness.

The terrain around the building is flat to slightly sloping. The thickness of the arable land is 100 mm. This is followed by a layer of clay sand S4 with a thickness of 0,65 m, and then a layer of gravelly clay F1 up to a depth of 21 m, followed only by a rock base R3. The groundwater level is stable, recorded at 16,4 m below ground level. The top edge of the building foundations will be 0,2 m below ±0.000, or

0,1 m above the modified terrain (the foundations will have to reach a depth of at least 0,8 m below the modified terrain in order to achieve a minimum frost depth), in the basement part of the building the top edge will be 4,1 m below ±0,000, or 3,8 m below the modified terrain. Therefore, the entire building will be founded on the gravelly clay F1 and will not be affected by the groundwater level.

4.2. Earthworks

The soils located under the building and in its surroundings have the mining class I and II according to the standard ČSN 73 6133. The excavations will be marked out by an authorised surveyor who will mark out the reference points of the object. The object will then be marked out using benches, which will be placed in such a way that they cannot be damaged during the earthworks.

First, topsoil 0,1 m thick will be stored on the site and used for final landscaping. Part of the soil excavated during the excavation works will be taken off-site and part will be stored on-site for use in the landscaping.

The groundwater level is below the level of the foundation joint. Drainage of the construction pit will be accomplished by using drainage channels to sumps with sump pumps, and the water will be directed to the adjacent storm sewer.

4.3. Foundations

All vertical load-bearing structures in the underground floor will be placed on plain concrete foundation strips 0,4 m wide and 0,6 m high, their foundation joint will be at a depth of 4,7 m below ±0.000. In the first storey, the load-bearing walls will be placed on plain concrete strips with a width of 0,4 m and a height of 1 m, and load-bearing columns on footings with dimensions of 0,6x0,6 m and a height of 1 m, the foundation joint of these foundations will be at a depth of 1,2 m below ±0.000. This height is determined primarily to maintain a safe frost depth. A base plain concrete slab with thickness of 150 mm will be made between all the foundations.

5. Load-bearing system

5.1. Vertical load-bearing structures

Monolithic reinforced concrete walls of uniform thickness of 200 mm will be made in the underground floor. In the above-ground floors, the load-bearing walls will be constructed in two ways. In the black box theatre, the walls will again be monolithic reinforced concrete walls of 200 mm thickness, in the rest of the building the walls will be made of NOVATOP SOLID wooden panels of uniform thickness 124 mm, supplemented by load-bearing wooden columns with dimensions 200x200 mm.

5.2. Horizontal load-bearing structures

In the underground floor, the floor slabs are made as one-way, monolithic, from reinforced concrete, designed in a uniform thickness of 250 mm. On this floor there are also monolithic reinforced concrete beams with a width of 200 mm and a height of 500 mm.

There will be openings in the reinforced concrete floor slabs, from which the reinforcement will be summarised outside the opening to the edges of the slab, the edges of the slab at the openings will be further edged with reinforcement.

On the above-ground floors, the floor slabs are designed as one-way wooden slabs NOVATOP ELEMENT, supplemented by wooden beams with a width of 180 mm and a height of 300 mm.

5.3. Vertical communication elements

in the underground floor the staircases will be made as prefabricated, from reinforced concrete, in the above-ground floors straicases will be made out of wood, supported by the staircase wooden beams. All staircase connections to load bearing structures will need to be made in such a way to eliminate the distribution of the impact sound as much as possible.

5.4. Spatial rigidity of the building

The supporting system of the above-ground floors of the building consists of two systems. The first system is the load-bearing reinforced concrete walls and wooden truss beams in the black box theatre, the second system is in the rest of the building, where the load-bearing system consists of wooden wall panels, wooden columns, and wooden floor slabs. The load-bearing walls are laid in both directions throughout the building, providing spatial rigidity. Spatial rigidity of the building is sufficient, direct assessment and verification is not required.

5.5. Work safety and health protection

All measures and legal regulations to ensure occupational safety and health protection on the construction site must be strictly observed by all construction workers throughout the construction activity and in the phase of its preparatory work (Act No. 183/2006 Coll., Government Regulation No. 591/2006 Coll., on more detailed minimum requirements for occupational safety and health protection on construction sites, Government Regulation No. 494/2001 Coll. and No. 495/2001 Coll.).

6. Software used

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

7. List of references

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

- NOVATOP [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/]
- CEMIX [online], LB Cemix, s.r.o., [cit. 2023-01-08], [https://www.cemix.cz/]
- 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., [c. 2023-01-08], [https://www.vytahy-voto.cz/]

- TZB-info [online], Topinfo s.r.o., [cit. 2023-01-08], [https://www.tzb-info.cz/]

8. 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 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

- 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

In Barcelona 11/2022

Author: Bc. Tadeáš Petřík

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	A4
LOCATION	Czech Republic – Vodňany	DATE	11/2022
BUILDING’S NAME	Community centre – Vodňany	LVL OF PD	DSP
SUBDIVISION	D.1.2 STRUCTURAL DESIGN	SCALE	NO.
CONTENT	Preliminary static calculation	-	-

Table of Content

1. Scheme and description of the construction

1.1. Structural system

For drawings of the structural system, see annexes *D.1.2-1 to D.1.2-3*.

1.2. Description of the construction of individual floors

<u>Underground floor No.1 – UG FL No.1</u>

- Structural floor height: 3,900 mm
- Floor use: rehearsal room, storages, tech. facilities, workshop
- Horizontal load-bearing struc.: monolithic reinforced concrete one-way floor slabs, monolithic reinforced concrete beams
- Vertical load-bearing struc.: monolithic reinforced concrete walls, monolithic reinforced concrete columns
- Staircases: half landing staircase, prefab. reinforced concrete two-quarter landing staircase, prefab. reinf. concrete

<u>Floor No.1 – FL No.1</u>

- Structural floor height: 4,400 mm
- Floor use: black box theatre, café, clubrooms, playroom
- Horizontal load-bearing struc.: black box theatre – steel of wooden truss beams rest of the building – wooden one-way floor slabs, wooden beams
- Vertical load-bearing struc.: black box theatre – monolithic reinf. concrete walls rest of the building – wooden walls, wooden columns
- Staircases: half landing staircases, wood two-quarter landing staircase, wood

<u>Floor No.2 – FL No.2</u>

- Structural floor height: 4,300 mm
- Floor use: libraries, exhibition space, lecture room
- Horizontal load-bearing struc.: black box theatre – steel of wooden truss beams rest of the building – wooden one-way floor slabs, wooden beams
- Vertical load-bearing struc.: black box theatre – monolithic reinf. concrete walls rest of the building – wooden walls, wooden columns

1.3. 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

Partitions

- Knauf W111, thickness 100 mm
- Knauf W112, thickness 100 mm
- YTONG Klasik 100, thickness 100 mm

2. Load overview

2.1. Dead load

2.1.1. Load-bearing structures

The self-weight of the individual load-bearing structures is specified in chapter *3. Preliminary design and assessment of load-bearing structures*.

2.1.2. Floors

Due to the similarity of the dead load values of the individual floors, a uniform average dead load of the floors will be considered, one value will be determined for the floors on the reinforced concrete ceiling structure, another value for the floors on the above-ground floors on the wooden ceiling structure. Below are typical examples of used floors with the highest load.

Floors on reinforced concrete ceiling (underground floor or adjacent to the ground):

F01 – Floor of the heated space adjacent to the ground (epoxy)					
Description	thick. [mm]	unit. wt. [kN/m³]	g_k [kN/m²]	γ_f	g_d [kN/m²]
epoxy coating	1	-	0,01	1,35	0,01
self-leveling floor compound	4	-	0,02	1,35	0,03
concrete screed + reinforcing mesh	55	23	1,27	1,35	1,71
separation PE foil	0,2	-	0,01	1,35	0,01
TI PIR panel Puren FAL	140	0,35	0,05	1,35	0,07
total			1,36		1,83

F03 – Floor of the heated space adjacent to the ground (laminate)					
Description	thick. [mm]	unit. wt. [kN/m³]	g_k [kN/m²]	γ_f	g_d [kN/m²]
laminate	8	-	0,03	1,35	0,04
dispersion adhesive for carpets and PVC	2	-	0,01	1,35	0,01
concrete screed + reinforcing mesh	50	23	1,15	1,35	1,55
separation PE foil	0,2	-	0,01	1,35	0,01
TI PIR panel Puren FAL	140	0,35	0,05	1,35	0,07
total			1,25		1,68

F04 – Floor of the heated space adjacent to the ground (ceramic tiles)					
Description	thick. [mm]	unit. wt. [kN/m³]	g_k [kN/m²]	γ_f	g_d [kN/m²]
ceramic tiles	8	22	0,18	1,35	0,24
adhesive for ceramic tiles	2	-	0,03	1,35	0,04
concrete screed + reinforcing mesh	50	23	1,15	1,35	1,55
separation PE foil	0,2	-	0,01	1,35	0,01
TI PIR panel Puren FAL	140	0,35	0,05	1,35	0,07
total			1,42		1,91

Note: Same as (F05), (F06), (F07)

Floors on wooden ceiling (above-ground floors):

F09 – Floor without temperature difference or up to 10 °C max. (laminate)					
Description	thick. [mm]	unit. wt. [kN/m³]	g_k [kN/m²]	γ_f	g_d [kN/m²]
laminate	8	-	0,03	1,35	0,04
dispersion adhesive for carpets and PVC	2	-	0,01	1,35	0,01
gypsum fibreboard	20	11,5	0,23	1,35	0,31
SI fibreboard	40	1,9	0,08	1,35	0,11
sub-base with honeycomb	140	-	0,45	1,35	0,61
total			0,80		1,08

F10 – Floor without temperature difference or up to 10 °C max. (ceramic tiles)					
Description	thick. [mm]	unit. wt. [kN/m^3]	g_k [kN/m^2]	γ_f	g_d [kN/m^2]
ceramic tiles	8	22	0,18	1,35	0,24
adhesive for ceramic tiles	2	-	0,03	1,35	0,04
gypsum fibreboard	20	11,5	0,23	1,35	0,31
SI fibreboard	40	1,9	0,08	1,35	0,11
sub-base with honeycomb	140	-	0,45	1,35	0,61
total			0,97		1,31

Note: Same as (F11)

<u>Summary of floor loads:</u>

Floors on reinforced concrete ceiling (underground floor or adjacent to the ground):

- Average char. value of floor dead load: g_k = (1,36+1,25+1,42)/3 = 1,34 kN/m^2
- Considered value of uniform fl. dead load: **g_k = 1,4 kN/m^2**

  g_d = 1,4*1,35 = 1,90 kN/m^2

Floors on wooden ceiling (above-ground floors):

- Average char. value of floor dead load: g_k = (0,8+0,97)/2 = 0,89 kN/m^2
- Considered value of uniform fl. dead load: **g_k = 1,0 kN/m^2**

  g_d = 1,0*1,35 = 1,35 kN/m^2

2.1.3. Roofs

R01 – Roof of the heated space (black box theatre)					
Description	thick. [mm]	unit. wt. [kN/m^3]	g_k [kN/m^2]	γ_f	g_d [kN/m^2]
extensive greenery	-	-	-	-	-
roof substrate	100	10	1,00	1,35	1,35
geotextile	-	-	0,01	1,35	0,01
perforated stud membrane	20	-	0,01	1,35	0,01
PVC-P foil	2	13,1	0,03	1,35	0,04
separation geotextile	-	-	0,01	1,35	0,01
TI EPS	270	0,3	0,08	1,35	0,11
asphalt strip (melted)	4	-	0,05	1,35	0,07
asphalt strip (self-adhesive)	3	-	0,04	1,35	0,05
board EGGER OSB 3	30	6	0,18	1,35	0,24
wooden slatted grate 40/60 (à 625 mm)	40	6	(0,02)	1,35	0,03
total			**1,43**		**1,92**

R02 – Roof of the heated space (rest of the building)					
Description	thick. [mm]	unit. wt. [kN/m^3]	g_k [kN/m^2]	γ_f	g_d [kN/m^2]
extensive greenery	-	-	-	-	-
roof substrate	100	10	1,00	1,35	1,35
geotextile	-	-	0,01	1,35	0,01
perforated stud membrane	20	-	0,01	1,35	0,01
TI XPS	200	0,3	0,06	1,35	0,08
separation geotextile	-	-	0,01	1,35	0,01
PVC-P foil	2	13,1	0,03	1,35	0,04
separation geotextile	-	-	0,01	1,35	0,01
TI EPS (average value closer to the max.)	200	0,3	0,06	1,35	0,08
asphalt strip (melted)	4	-	0,05	1,35	0,07
asphalt strip (self-adhesive)	3	-	0,04	1,35	0,05
total			**1,28**		**1,71**

2.1.4. Dropped ceilings

Knauf D11 dropped ceilings are used throughout the whole building.

Dropped ceiling dead load:

- Characteristic value of dropped ceiling dead load: $\mathbf{g_k = 0,30\ kN/m^2}$
- Design value of dropped ceiling dead load: $\mathbf{g_d = 0,3*1,35 = 0,40\ kN/m^2}$

2.1.5. Exterior walls

The load-bearing layer of the exterior walls in the underground floor will consist of a reinforced concrete with a thickness of 200 mm, the load-bearing layer of the exterior walls in the above-ground floors will consist of CLT panels NOVATOP SOLID with a thickness of 124 mm. For the self-weight of the reinforced concrete walls and wooden panels, see chapter *3. Preliminary design and assessment of load-bearing structures.*

XPS Isover STYRODUR 3000 CS with thickness of 200 mm was used as thermal insulation for the exterior walls on the underground floor and fibreboard STEICO Therm with thickness of 240 mm was used on the above-ground floors.

Self-weight of thermal insulations:

- XPS Isover STYRODUR 3000 CS $g_{0,k} = t*\gamma*\gamma_f = 0,2*0,3 = 0,06$ kN/m^2

  $g_{0,d} = t*\gamma*\gamma_f = 0,2*0,3*1,35 = 0,08$ kN/m^2
- fibreboard STEICO Therm $g_{0,k} = t*\gamma*\gamma_f = 0,24*1,6 = 0,38$ kN/m^2

  $g_{0,d} = t*\gamma*\gamma_f = 0,24*1,6*1,35 = 0,52$ kN/m^2

Due to the small value of the thermal insulation self-weight, it can be neglected and is not considered further.

2.1.6. Partitions

There are three types of partitions in the building, YTONG partitions on the underground floor and Knauf W11 partitions (specifically Knauf W111 and W112) on the upper floors.

Types of partitions:

- YTONG Klasik 100:
  - thickness: 100 mm
  - density: 500 kg/m^3
  - areal weight: 50 kg/m^2
  - self-weight: g_k = 0,50 kN/m^2
  - g_d = 0,50*1,35 = 0,68 kN/m^2

- Knauf W111:
  - thickness: 100 mm
  - areal weight: 39 kg/m^2
  - self-weight: g_k = 0,39 kN/m^2
  - g_d = 0,39*1,35 = 0,53 kN/m^2

- Knauf W112:
  - thickness: 100 mm
  - areal weight: 75 kg/m^2
  - self-weight: g_k = 0,75 kN/m^2
  - g_d = 0,75*1,35 = 1,01 kN/m^2

Due to the different location of the individual partitions in the building, a uniform average substitute area load will be considered, which value will be increased due to the possible higher concentration of partitions in some places of the building:

g_k = (0,50+0,39+0,75)/3 = 0,55 kN/m^2 => **g_k = 0,7 kN/m^2**

g_d = 0,7*1,35 = 0,95 kN/m^2

2.1.7. Staircases and stair steps

Two-quarter landing staircase UG FL No.1

- Floor height from floor to floor: 3,900 mm
- Number of steps per floor: 22 (7+6+9)
- Width of one step: 300 mm
- Height of one step: 177,3 mm (16*177+6*178)
- Material: reinforced concrete
- Density (unit weight): 2500 kg/m3 (25 kN/m3)

Substitute UDL from stair steps: $\mathbf{g_k = 1/2*0,178*25 = 2,23\ kN/m^2}$

Half landing staircase UG FL No.1

- Floor height from floor to floor: 3,900 mm
- Number of steps per floor: 22 (10+12)
- Width of one step: 270 mm
- Height of one step: 177,3 mm (16*177+6*178)
- Material: reinforced concrete
- Density (unit weight): 2500 kg/m3 (25 kN/m3)

Substitute UDL from stair steps: $\mathbf{g_k = 1/2*0,178*25 = 2,23\ kN/m^2}$

Two-quarter landing staircase FL No.1

- Floor height from floor to floor: 4,300 mm
- Number of steps per floor: 24 (9+6+9)
- Width of one step: 300 mm
- Height of one step: 179,2 mm (20*179+4*180)
- Material: wood
- Density (unit weight): 600 kg/m3 (6 kN/m3)

Substitute UDL from stair steps: $\mathbf{g_k = 1/2*0,180*6 = 0,54\ kN/m^2}$

Half landing staircase FL No.1

- Floor height from floor to floor: 4,300 mm
- Number of steps per floor: 24 (12+12)
- Width of one step: 270 mm
- Height of one step: 179,2 mm (20*179+4*180)
- Material: wood
- Density (unit weight): 600 kg/m3 (60 kN/m3)

Substitute UDL from stair steps: **g_k = 1/2*0,180*6 = 0,54 kN/m^2**

Note: UDL – uniformly distributed load

2.1.8. Ground pressure

The backfilling of the underground part of the building will be made with non-freezing soil with the following properties:

- the characteristic bulk density of the soil: $\gamma_{zem,k}$ = 19,5 kN/m^3
- design effective angle of internal friction: φ_d = 32°
- imposed load on the ground: $q_{0,k}$ = 5 kN/m^2
- coefficient of ground pressure at rest: $K_0 = 1-\sin\varphi_d = 1-\sin 32 = 0,47$

Characteristic ground pressure:

$$\sigma_{i,k} = K_0*(q_{0,k}+\gamma_{zem,k}*h_i) = 0,47*(5+19,5*h_i)$$

The groundwater level was found at a depth of 16,4 m during the hydrogeological survey. Therefore, it has no influence on the designed building and is therefore not considered further.

2.2. Live load

2.2.1. Imposed load

- category E1 storages, technical facilities, etc.
  q_k = 7,5 kN/m^2

- category A bedrooms, playrooms, kitchens and sanitary facilities
  q_k = 1,5 kN/m^2

- category C1 cafés, reading rooms, receptions
  q_k = 3,0 kN/m^2

- category C2 rooms with attached seats, e.g. theatres, lecture rooms, etc.
  q_k = 4,0 kN/m^2 (min. 3,0 kN/m^2)

- category C3 areas without obstacles to the movement of people, e.g. areas in museums, exhibition halls and access areas in public buildings
  q_k = 5,0 kN/m^2 (min. 3,0 kN/m^2)

- category H roofs except for routine maintenance and repairs
  q_k = 0,75 kN/m^2

2.2.2. Snow load

- Flat roof: $\alpha < 30°$ => shafe coefficient $\mu = 0{,}8$
- Exposure coefficient: $C_e = 1$
- Heat coefficient: $C_t = 1$
- Snow area: Vodňany – snow area I => char. snow load s_k = 0,7 kN/m^2

Average snow load: $s = \mu * C_e * C_t * s_k = 0{,}8*1*1*0{,}7 = 0{,}56$ kN/m^2

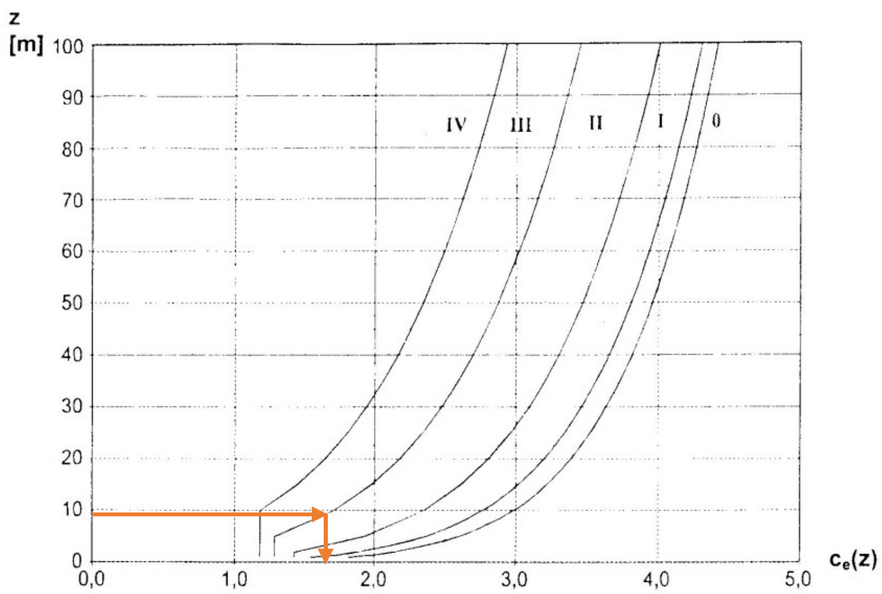
The value of the roof live load will be considered as the greater of:

- Roof imposed load: q_k = 0,75 kN/m^2
- Snow load: q_k = 0,56 kN/m^2

Roof live load: **$q_{stř,k}$ = 0,75 kN/m^2**

2.2.3. Wind load

- Wind area: Vodňany – wind area II => v_b = 25,0 m/s
- Terrain category: III
- Roof parapet height above the ground: h = 9,80 m
- Roof parapet height: h_{rp} = 1,0 m
- Air density: ρ = 1,25 kg/m^3
- Basic wind pressure: $q_b = 1/2*\rho*v_b^2 = 1/2*1,25*25^2 = 0,39$ kN/m^2



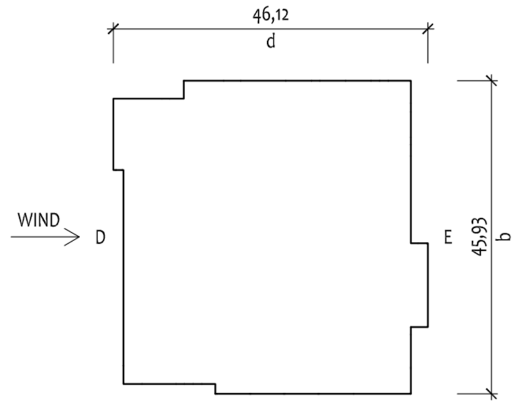
Fgure: Exposure coefficient graph

[fsv.cvut.cz]

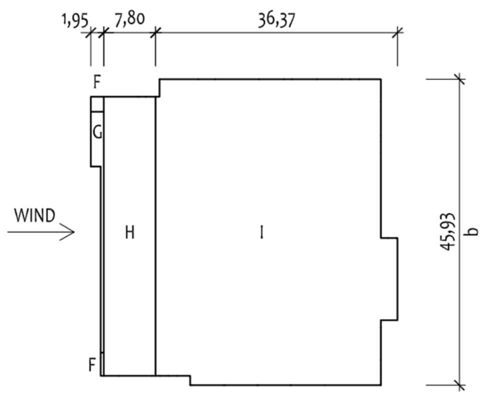
- Exposure coefficient: $C_e(z) = 1,6$
- Max. dynamic pressure: $q_p = c_e(z)*q_b(z) = 1,6*0,39 = 0,62$ kN/m^2

Transverse direction:

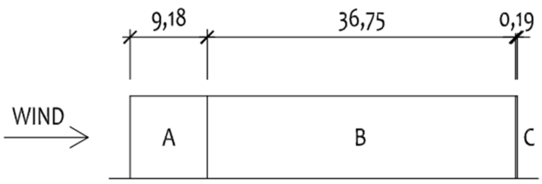
Layout



Roof

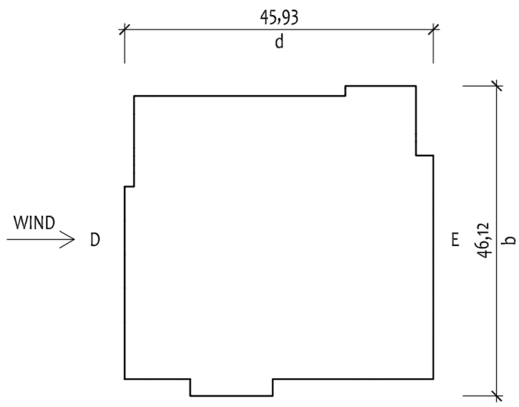


View

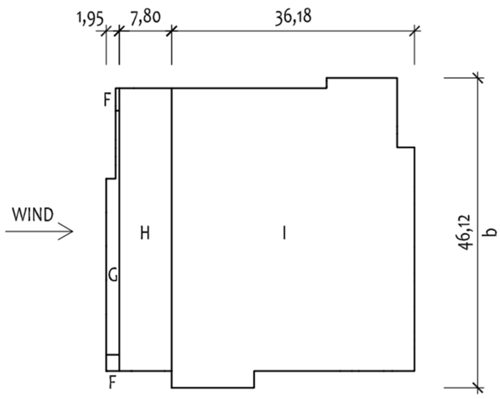


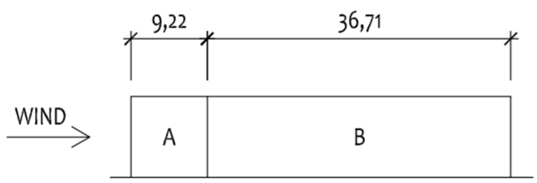
Longitudinal direction:

Layout



View





External pressure coefficient $c_{pe,1}$:

DIRECTION	AREA					
	D	E	F	G	H	I
transverse	0,7	-0,3	-	-0,9	-0,7	±0,2
longitudinal	0,7	-0,3	-	-0,9	-0,7	±0,2

Notes: The external pressure coefficient c_{pe} can be considered as the sum of its absolute values from areas D and E for walls, and from areas G, H and I for roofs, because the simultaneous wind pressure on the windward side of the building and the wind suction on the leeward side of the building play a decisive role.

Area F was neglected due to its very low value.

Transverse direction: walls $c_{pe} = 0{,}7+0{,}3 = 1{,}00$

roof $c_{pe} = 0{,}9+0{,}7+0{,}2 = 1{,}80$

Longitudinal direction: walls $c_{pe} = 0{,}7+0{,}3 = 1{,}00$

roof $c_{pe} = 0{,}9+0{,}7+0{,}2 = 1{,}80$

Characteristic value of wind load:

- transverse direction **walls** $\mathbf{w_{k,walls} = q_p * c_{pe} = 0{,}62*1{,}00 = 0{,}62\ kN/m^2}$

  roof $\mathbf{w_{k,roof} = q_p * c_{pe} = 0{,}62*1{,}80 = 1{,}12\ kN/m^2}$
- longitudinal direction **walls** $\mathbf{w_{k,walls} = q_p * c_{pe} = 0{,}62*1{,}00 = 0{,}62\ kN/m^2}$

  roof $\mathbf{w_{k,roof} = q_p * c_{pe} = 0{,}62*1{,}80 = 1{,}12\ kN/m^2}$

3. Preliminary design and assessment of load-bearing elements

3.1. Horizontal load-bearing structures

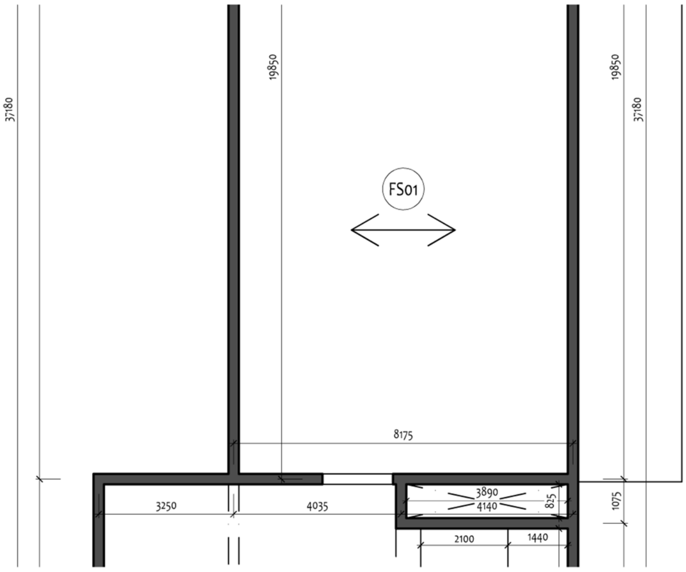
3.1.1. FS01 – one-way floor slab, reinforced concrete, monolithic (underground floor)

The floor slabs in the entire underground floor will be made as monolithic, from reinforced concrete. The floor slabs will be designed in a uniform thickness according to the floor slab with the largest span and load.

Description:

- concrete C30/37 XC1 (CZ) – Cl 0,2 – Dmax 16 – S3 $f_{cd} = f_{ck}/\gamma_c = 30/1{,}5 = 20$ MPa
- steel B 500 B

Scheme:



Empirical design of the floor slab:

- one-way floor slab

  L_{fs} = 8,2 m = 8200 mm

  $h_{fs1} \geq L_{fs}/35 \sim L_{fs}/30 = 8200/35 \sim 8200/30 = 235 \sim 275$ mm

  Design: h_{fs1} = 240 mm

Design based on fulfilment of the bending slenderness condition of the floor slab:

$\lambda = L/d \leq \lambda_d = \kappa_{c1}*\kappa_{c2}*\kappa_{c3}*\lambda_{d,tab}$ => $d \geq L/\lambda_d$

$\kappa_{c1} = 1,0$

$\kappa_{c2} = 7/L = 7/8,2 = 0,85$

$\kappa_{c3} = 1,5$ estimation of tensile reinforcement stress coefficient

assumed degree of reinforcement of the plates: ρ = 0,5 %

expected reinforcement profile: Ø = 12 mm

assumed reinforcement covering: c_{nom} = 25 mm

floor slab designed height $h_{fs2} = d + Ø/2 + c_{nom}$

SUPPORT TYPE	L_{fs} [m]	$\lambda_{d,tab}$	λ_d	d [mm]	h_{fs2} [mm]
one-way, fixed	8,2	30,8	39,3	209	250

Design: h_{fs2} = 250 mm

<u>Verification of the floor slab in terms of bending capacity:</u>

FS01 – one-way floor slab, reinforced concrete, monolithic (underground floor)				
description	calculation	f_k [kN/m^2]	γ_f	f_d [kN/m^2]
RC floor slab (self weight)	25,0*0,25	6,25	1,35	8,44
floor		1,40	1,35	1,89
partitions		0,70	1,35	0,95
imposed load		3,00	1,5	4,50
total		11,35		15,78

Maximum bending moment on the floor slab: $m_{Ed,max} = 1/10*f_d*l^2 = 1/10*15{,}78*8{,}2^2 = 106{,}10$ kNm

<u>Verification of the rel. height of the pressed area ξ and the degree of reinf. by the bending reinf. ρ:</u>

- relative bending moment: $\mu = \frac{m_{Ed,max}}{b*d^2*f_{cd}}$
- lever arm of internal forces: from the table
- relative height of the pressed area ξ: from the table
- required reinforcement area: $A_{s,req} = \frac{M_{Ed}}{\zeta*d*f_{yd}}$
- indicative degree of reinforcement: $\rho = \frac{A_{s,req}}{b*d}$

FLOOR SLAB	h_{fs} [mm]	d [mm]	$m_{Ed,max}$ [kNm/m‘]	μ [-]	ζ [-]	ξ [-]	$A_{s,req}$ [mm^2]	ρ_d [-]
FS01	250	219	99,72	0,111	0,941	0,147	1184	0,005

- assumption used in the calc.: ρ = 0,5% = 0,005 ≥ ρ_d = 0,005 => FULFILLED
- assumption: ξ_{opt} = (0,1 - 0,15) ≥ ξ_d = 0,147 => FULFILLED

Final design: h_{fs} = 250 mm, Ø 12 à 95 mm; $A_{s,prof}$ = 1191 mm^2

Note: The floor slab meets the bending slenderness condition, direct assessment is not necessary.

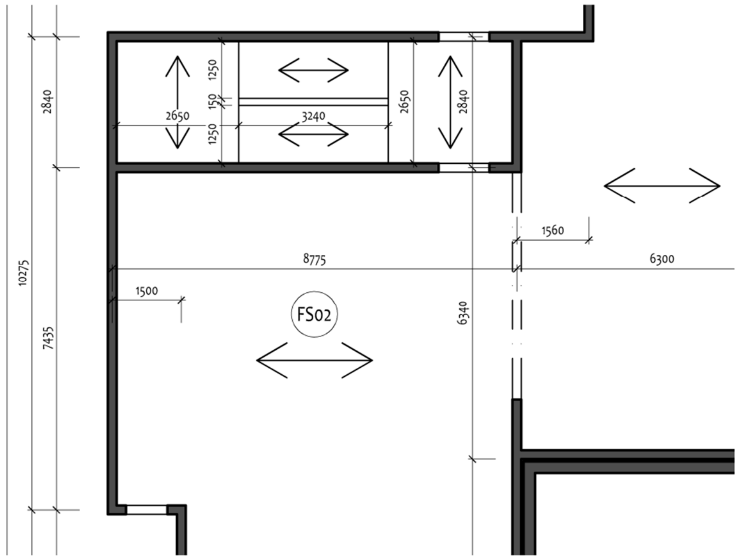
The designed uniform thickness of the floor slabs h_{fs} = 250 mm fulfils the requirements.

3.1.2. FS02 – one-way floor slab, wood (rest of the building)

The floor slabs in the rest of the building (except black box theatre) will be made as SWP or SWP + BSH GL32h wooden panels NOVATOP ELEMENT. The floor slabs will be designed in a uniform thickness according to the floor slab with the largest span and load.

Note: Software *Agrop Nova – Novatop Elements* created by the manufacturer of the NOVATOP ELEMENT panels will be used for the design.
[https://novatop-system.cz/ke-stazeni/sw-element/]

Scheme:



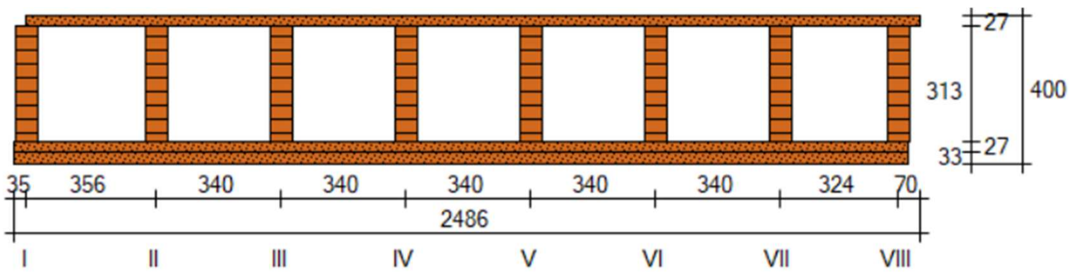
Description:

- wood SWP or SWP + BSH GL32h
- one-way floor slab
- L_d = 8,8 m

Considered load on the structure:

- self-weight included in the software automatically
- floors g_k = 1,00 kN/m^2
- dropped ceiling g_k = 0,30 kN/m^2
- partitions g_k = 0,70 kN/m^2
- imposed load q_k = 3,0 kN/m^2

Calculation:



element height: 400 mm

element width: 2485,5 mm

top belt material: SWP 9/9/9

bottom belt material: SWP 9/9/9

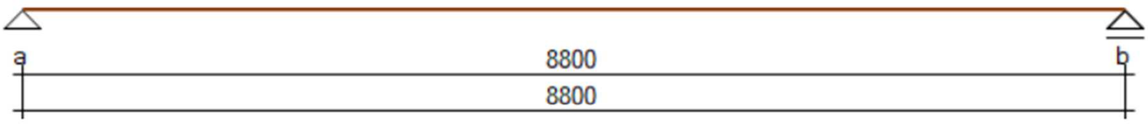
2nd bottom belt material: SWP 9/9/9

class of application / KLED: 1 / medium

psi_0 / psi_2: 0,70 / 0,60

rib	material	overhang OG [mm]	overhang UG [mm]	span of ribs [mm]
I	Gl32h, b = 60 mm	0,0	35,0	356,5
II	Gl32h, b = 60 mm	-	-	340,0
III	Gl32h, b = 60 mm	-	-	340,0
IV	Gl32h, b = 60 mm	-	-	340,0
V	Gl32h, b = 60 mm	-	-	340,0
VI	Gl32h, b = 60 mm	-	-	340,0
VII	Gl32h, b = 60 mm	-	-	324,0
VIII	Gl32h, b = 60 mm	70,0	35,0	-

static scheme and load: Ceiling element, Element pitch 0°



	ℓ [mm]	g_k [kN/m²]	q_k [kN/m²]	G_k [kN/m]	x_G [mm]	Q_k [kN/m]	x_Q [mm]
field 1	8800	3,13	3,00	0,00	0	0,00	0

the table contains the following loads: dead weight 0,73 kN/m2, filling 40 kg/m2, added partition wall 0,00 kN/m2

evaluation - serviceability limit state:

	u_{inst} [mm]	u_{fin} [mm]	$u_{net,fin}$ [mm]
field 1	19,7 (ℓ/447)	29,2 (ℓ/302)	29,2 (ℓ/302)

recommended bend limit values are observed.

Figure: Extract from the calculation of FS02 – one-way floor slab, wood (rest of the building)

Note: Software Agrop Nova – Novatop Elements was used for the calculation.

[https://novatop-system.cz/ke-stazeni/sw-element/]

Note: For the whole calculation, see annex *FS02 – one-way floor slab, wood (rest of the building).*

Recap of the designed uniform values:	**floor slab**	**one-way**
	h_d	**400 mm (27+313+27+33)**
	top belt	**SWP, thickness 27 mm**
	bottom belts	**SWP, thickness 27+33 mm**
	ribs	**BSH GL32h, thickness 60 mm**

The designed uniform wooden floor slab fulfils the requirements.

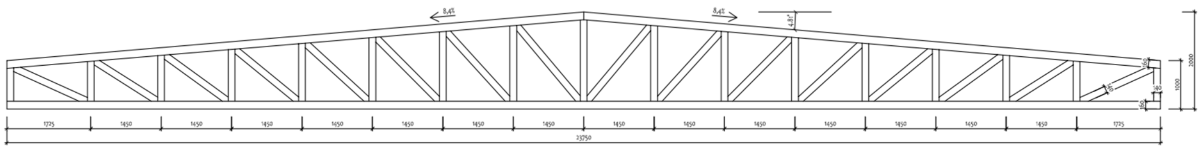
3.1.3. RS01 – truss beams, wood (black box theatre)

Only the shape of the truss was designed as part of the preliminary calculation. After the detailed calculation, the dimensions of the individual elements and possibly the height of the beam may change, but the shape of the truss should remain the same.

The assumed thickness of the truss is 120 mm, the height of the beam is 2000 mm, the height of the top and bottom part is 160 mm, and the width of the vertical and diagonal elements is 140 mm.

The truss will be made of KVH/DUO C24 (S4S) timber.

<u>Scheme (design):</u>

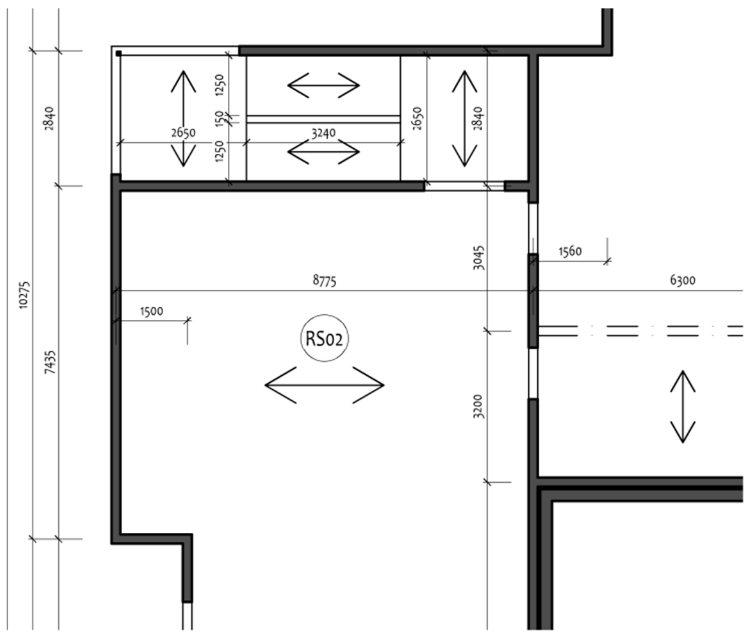


3.1.4. RS02 – one-way roof slab, wood (rest of the building)

The roof slabs in the rest of the building (except black box theatre and lecture room) will be made as SWP or SWP + BSH GL32h wooden panels NOVATOP ELEMENT. The roof slabs will be designed in a uniform thickness according to the roof slab with the largest span and load.

Note: Software *Agrop Nova – Novatop Elements* created by the manufacturer of the NOVATOP ELEMENT panels will be used for the design. [https://novatop-system.cz/ke-stazeni/sw-element/]

<u>Scheme:</u>



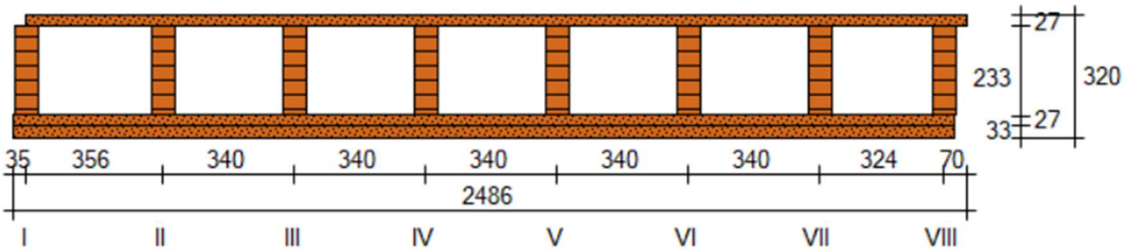
Description:

- wood SWP or SWP + BSH GL32h
- one-way roof slab
- L_d = 8,8 m
- slope approx. 2°

Considered load on the structure:

- self-weight — included in the software automatically
- roof — g_k = 1,28 kN/m^2 (originally 1,19 kN/m^2, no further recalculated in the calculation due to the minimum difference)
- dropped ceiling — g_k = 0,30 kN/m^2
- imposed (or snow) load — q_k = 0,75 kN/m^2
- wind load — q_k = 1,12 kN/m^2

Calculation:



element height: 320 mm

element width: 2485,5 mm

top belt material: SWP 9/9/9

bottom belt material: SWP 9/9/9

2nd bottom belt material: SWP 9/9/9

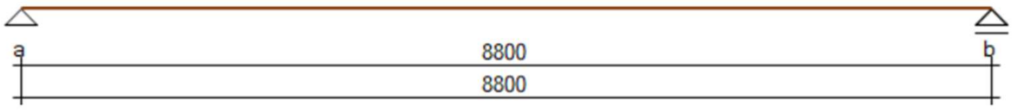
class of application / KLED: 1 / medium

psi_0_s / psi_2_s: 0,50 / 0,00

psi_0_w / psi_2_w: 0,60 / 0,00

rib	material	overhang OG [mm]	overhang UG [mm]	span of ribs [mm]
I	Gl32h, b = 60 mm	0,0	35,0	356,5
II	Gl32h, b = 60 mm	-	-	340,0
III	Gl32h, b = 60 mm	-	-	340,0
IV	Gl32h, b = 60 mm	-	-	340,0
V	Gl32h, b = 60 mm	-	-	340,0
VI	Gl32h, b = 60 mm	-	-	340,0
VII	Gl32h, b = 60 mm	-	-	324,0
VIII	Gl32h, b = 60 mm	70,0	35,0	-

static scheme and load: Roof element, Element pitch 2°



Warning: The specified lengths of the fields are lengths designed to the ground plan.

	ℓ [mm]	g_k [kN/m²]	s [kN/m²] *	w_k [kN/m²]	G_k [kN/m]	x_G [mm]
field 1	8800	2,14	0,75	1,12	0,00	0

the table contains the following loads: dead weight 0,65 kN/m2, filling 0 kg/m2

** Snow load s includes the roof shape coefficient.*

evaluation - serviceability limit state:

	u_{inst} [mm]	u_{fin} [mm]	$u_{net,fin}$ [mm]
field 1	20,9 (ℓ/421)	28,3 (ℓ/311)	28,3 (ℓ/311)

recommended bend limit values are observed.

Figure: Extract from the calculation of RS02 – one-way roof slab, wood (rest of the building)

Note: Software Agrop Nova – Novatop Elements was used for the calculation.

[https://novatop-system.cz/ke-stazeni/sw-element/]

Note: For the whole calculation, see annex *RS02 – one-way roof slab, wood (rest of the building).*

Recap of the designed uniform values:	**roof slab**	**one-way**
	h_d	**320 mm (27+233+27+33)**
	top belt	**SWP, thickness 27 mm**
	bottom belts	**SWP, thickness 27+33 mm**
	ribs	**BSH GL32h, thickness 60 mm**

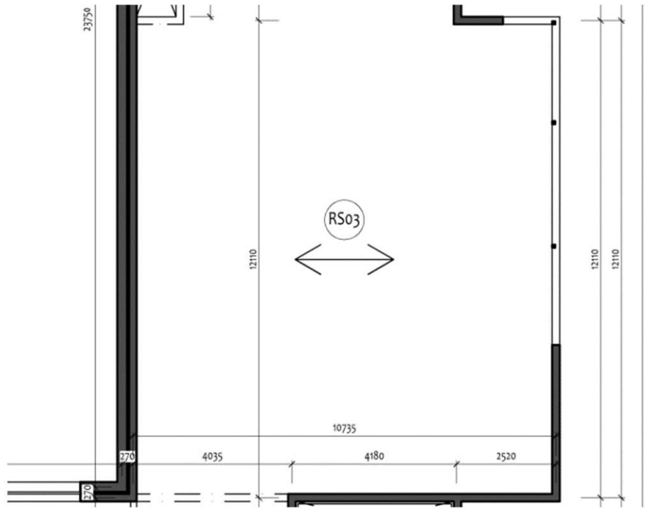
The designed uniform wooden roof slab fulfils the requirements.

3.1.5. RS03 – one-way roof slab, wood (lecture room)

The roof panel over rooms 2.17 Lecture room and 2.16 Corridor has a span of 11,0 m and would not meet the requirements using the same design as the roof panel RS02. Therefore, an additional design must be made for this specific panel.

Note: Software *Agrop Nova – Novatop Elements* created by the manufacturer of the NOVATOP ELEMENT panels will be used for the design.
[https://novatop-system.cz/ke-stazeni/sw-element/]

Scheme:



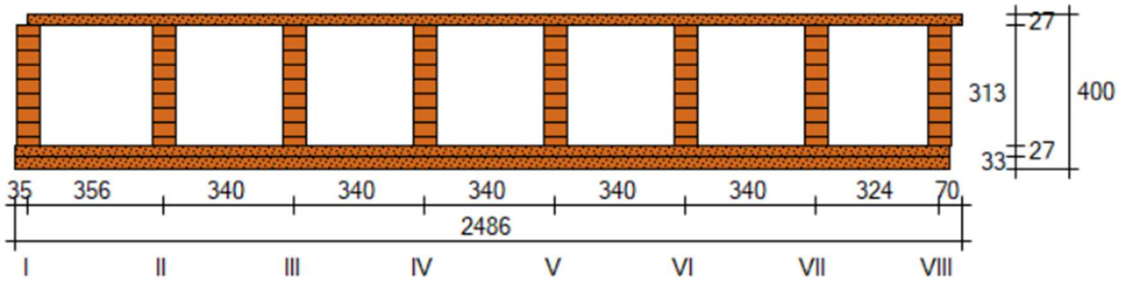
Description:

- wood SWP or SWP + BSH GL32h
- one-way roof slab
- L_d = 11,0 m
- slope approx. 2°

Considered load on the structure:

- self-weight — included in the software automatically
- roof — g_k = 1,28 kN/m^2 (originally 1,19 kN/m^2, no further recalculated in the calculation due to the minimum difference)
- dropped ceiling — g_k = 0,30 kN/m^2
- imposed (or snow) load — q_k = 0,75 kN/m^2
- wind load — q_k = 1,12 kN/m^2

Calculation:



element height: 400 mm

element width: 2485,5 mm

top belt material: SWP 9/9/9

bottom belt material: SWP 9/9/9

2nd bottom belt material: SWP 9/9/9

class of application / KLED: 1 / medium

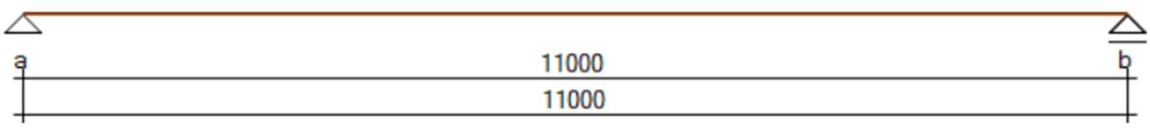
psi_0_s / psi_2_s: 0,50 / 0,00

psi_0_w / psi_2_w: 0,60 / 0,00

rib	material	overhang OG [mm]	overhang UG [mm]	span of ribs [mm]
I	Gl32h, b = 60 mm	0,0	35,0	356,5
II	Gl32h, b = 60 mm	-	-	340,0
III	Gl32h, b = 60 mm	-	-	340,0
IV	Gl32h, b = 60 mm	-	-	340,0
V	Gl32h, b = 60 mm	-	-	340,0
VI	Gl32h, b = 60 mm	-	-	340,0
VII	Gl32h, b = 60 mm	-	-	324,0
VIII	Gl32h, b = 60 mm	70,0	35,0	-

The dimensions in the table are measured on the axis

static scheme and load: Roof element, Element pitch 2°



Warning: The specified lengths of the fields are lengths designed to the ground plan.

	ℓ [mm]	g_k [kN/m²]	s [kN/m²] *	w_k [kN/m²]	G_k [kN/m]	x_G [mm]
field 1	11000	2,22	0,75	1,12	0,00	0

the table contains the following loads: dead weight 0,73 kN/m2, filling 0 kg/m2

** Snow load s includes the roof shape coefficient.*

evaluation - serviceability limit state:

	u_{inst} [mm]	u_{fin} [mm]	$u_{net,fin}$ [mm]
field 1	28,4 (ℓ/387)	38,6 (ℓ/285)	38,6 (ℓ/285)

recommended bend limit values are observed.

Figure: Extract from the calculation of RS03 – one-way roof slab, wood (lecture room)

Note: Software Agrop Nova – Novatop Elements was used for the calculation.

[https://novatop-system.cz/ke-stazeni/sw-element/]

Note: For the whole calculation, see annex *RS03 – one-way roof slab, wood (lecture room).*

Recap of the designed uniform values:

roof slab	**one-way**
h_d	**400 mm (27+313+27+33)**
top belt	**SWP, thickness 27 mm**
bottom belts	**SWP, thickness 27+33 mm**
ribs	**BSH GL32h, thickness 60 mm**

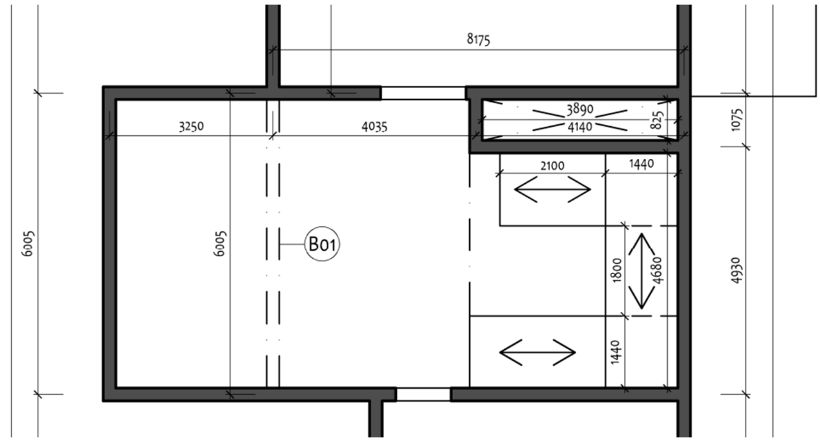
The designed uniform wooden roof slab fulfils the requirements.

3.1.6. B01 – beam, reinforced concrete, monolithic (undergorund floor)

In the room 0.03 Rehearsal room is a reinforced concrete beam supporting a wooden column on the upper floor. The beam will be monolithically connected to the reinforced concrete basement walls.

- concrete C30/37 XC1 (CZ) – Cl 0,2 – Dmax 16 – S3 $f_{cd} = f_{ck}/\gamma_c = 30/1,5 = 20$ MPa
- steel B 500 B

Scheme:



Empirical design of the beam:

- $L_b = 6,0$ m = 6000 mm

  $h_b \geq L_b/12 \sim L_b/10 = 6000/12 \sim 6000/10 = 500 \sim 600$ mm => $h_b = 500$ mm

  $b_b \geq h_b/3 \sim h_b/2 = 500/3 \sim 500/2 = 167 \sim 250$ mm => $b_b = 200$ mm

  Design: $h_{b1} = 500$ mm, $b_{b1} = 200$ mm

Design based on fulfilment of the bending slenderness condition of the beam:

$\lambda = L/d \leq \lambda_d = \kappa_{c1} * \kappa_{c2} * \kappa_{c3} * \lambda_{d,tab}$ => $d \geq L/\lambda_d$

$\kappa_{c1} = 0,8$

$\kappa_{c2} = 1,0$

$\kappa_{c3} = 1,2$ estimation of tensile reinforcement stress coefficient

assumed degree of reinforcement of the beam: $\rho = 0,5$ %

expected reinforcement profile: $\emptyset = 12$ mm

assumed reinforcement covering: $c_{nom} = 25$ mm

floor slab designed height $h_{d2} = d + \emptyset/2 + c_{nom}$

SUPPORT TYPE	L_d [m]	$\lambda_{d,tab}$	λ_d	d [mm]	h_{d2} [mm]
one-way, fixed	6,0	30,8	29,6	203	234

Design: h_{b2} = 300 mm, b_{b2} = 200 mm

<u>Verification of beam stiffness against the floor slab:</u>

$h_b \geq 2{,}5 * h_{fs}$

$h_b \geq 2{,}5 * 250$

$h_p \geq 500$ mm

Final design: h_b = 500 mm, b_b = 200 mm

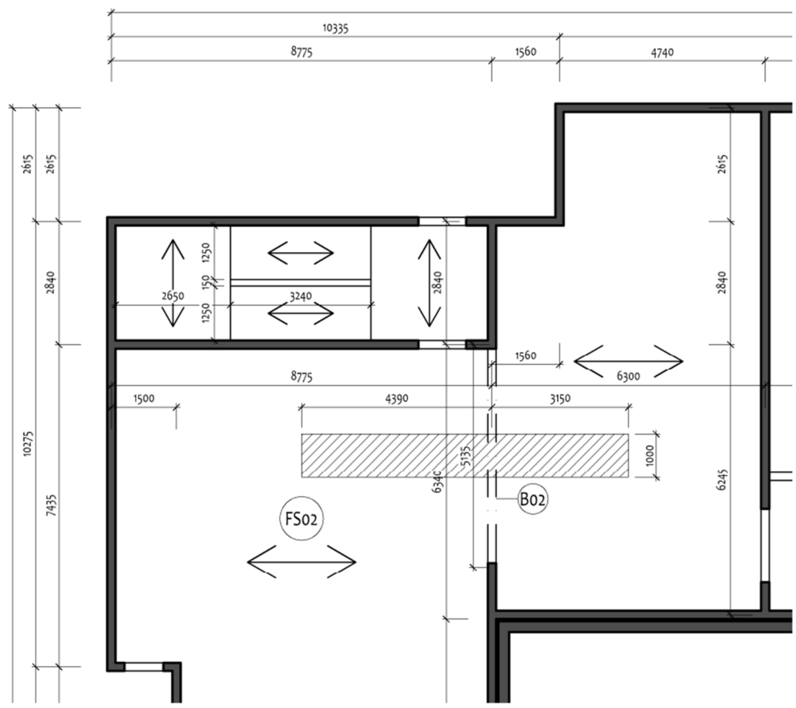
Note: Within the scope of the preliminary calculation, we can safely assume that the beam can support the wooden column given its dimensions.

3.1.7. B02 – beam, wood (rest of the building)

On the first floor in the room 1.15 Storage is a beam with the largest load area and the highest load. This beam will therefore be used to determine the largest wooden beam dimensions that will be designed in the building. All other wooden beams on the above-ground floors will either have the same dimensions or smaller dimensions. In the case of a detailed structural calculation, the beams would be designed individually.

Note: *Designed in software Scia Engineer (student licence)*

<u>Scheme:</u>



Description:

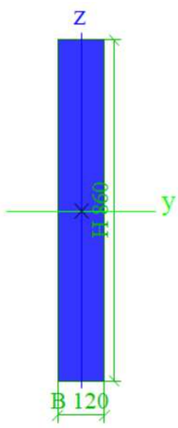
- wood BSH GL30
- L_b = 5,2 m
- load area 1,0 x 7,55 m

Considered load on the structure:

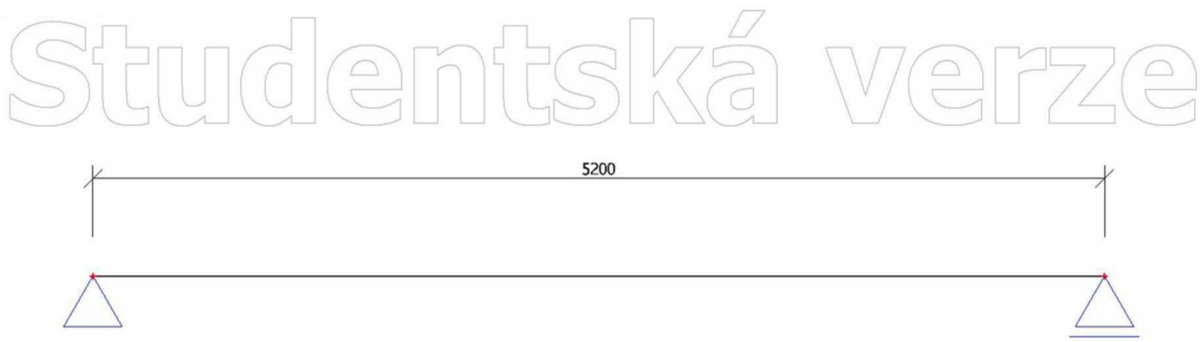
B02 – beam, wood (rest of the building)				
description	calculation	f_k [kN/m‘]	γ_f	f_d [kN/m‘]
wooden beam (self weight)		in Scia	1,35	in Scia
wooden floor slab	1,13*7,55*1,0	8,53	1,35	11,52
floor	1,0*7,55*1,0	7,55	1,35	10,19
wooden roof slab	0,65*7,55*1,0	4,91	1,35	6,63
roof	1,28*7,55*1,0	9,66	1,35	13,04
2x dropped ceiling	2*0,3*7,55*1,0	4,53	1,35	6,12
load-bearing wooden wall	6,0*0,124*4,0*1,0	2,98	1,35	4,02
partitions	0,7*7,55*1,0	5,29	1,35	7,14
total dead load		43,45		58,66
imposed load – floor	3,0*7,55*1,0	22,65	1,5	33,98
imposed load – roof	0,75*7,55*1,0	5,66	1,5	8,49
total live load		28,31		42,47
total		71,76		101,13

Calculation:

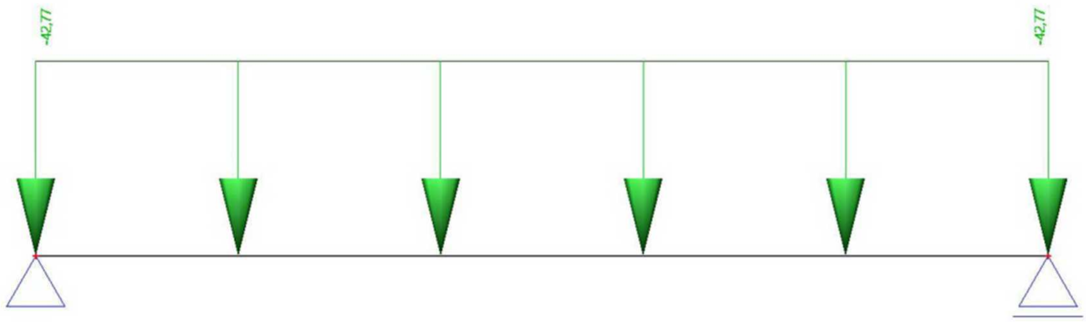
- wood BSH GL30h (BSH GL30)
- L_b = 5,2 m
- h_b = TBD (860 mm)
- b_b = 120 mm (to align with the thickness 124 mm of the designed walls NOVATOP SOLID in the building)



Model of the beam:

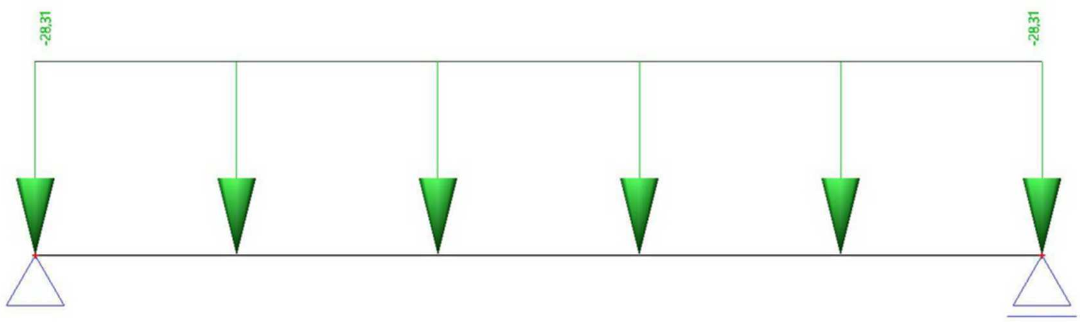


Dead load:

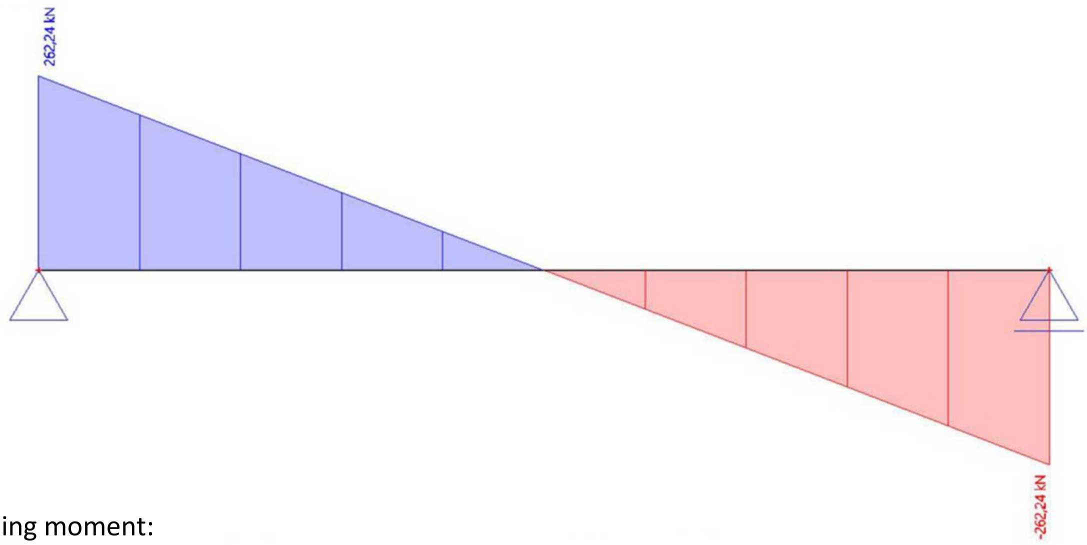


Note: The original design of the roof structure R01 contained PE foil, but the newer design contains asphalt strips which caused a load difference of 0,68 kN/m‘, the dead load was changed in the table above, but the structure was no further recalculated due to the negligible difference.

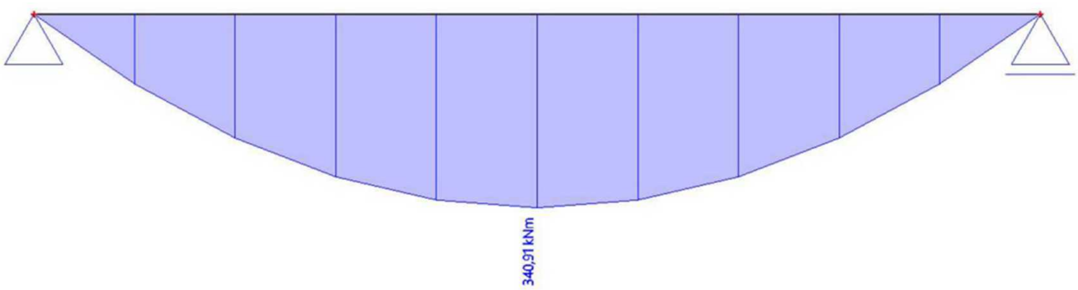
Live load:



Shear force:



Bending moment:



Maximum beam deflection:

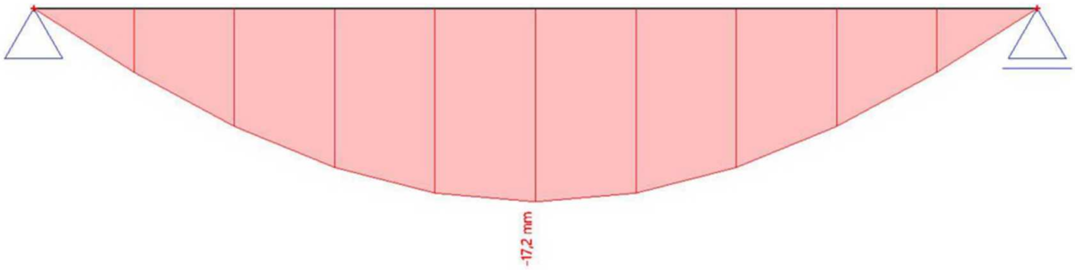


Figure: Original calculation B02 – beam, wood (rest of the building)

Note: Software Scia Engineer was used for the calculation.

[https://www.scia.net/en]

<u>Condition:</u>

Max. beam deflection ≤ L_b/300 = 5200/300 = 17,3 mm

17,2 mm ≤ 17,3 mm => FULFILLED

<u>Conclusion:</u>

As we can see from the Scia Engineer calculation results, in the original design the beam would have to be approximately 700 mm high in order not to exceed the maximum allowable deflection.

For this reason, several changes had to be made in the design. In order to keep the height of the beam within reason, I had to change the width of the beam from 120 mm to 180 mm (to achieve a lower height), and I also had to add a wooden column in the middle of the beam span to reduce the span from 5,2m to 2,6 m and therefore reduce the deflection. I also had to add two columns to both ends of the beam, as a 180 mm wide beam would not be able to fit longitudinally on a 124 mm wide load-bearing wall. These end columns will be fully hidden in the wall compostion.

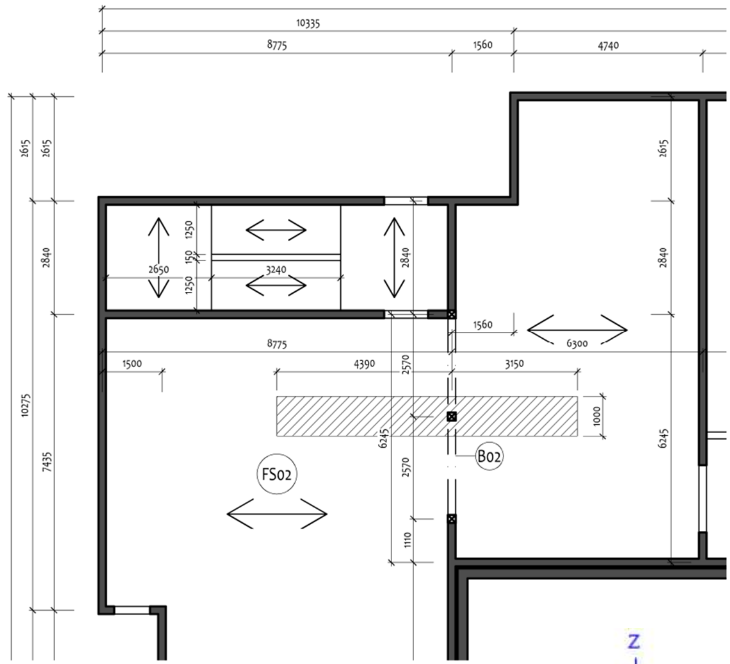
There should be no restriction of operations in the room 1.15 Storage by the addition of the wooden column due to the still sufficient clear width between the column and the walls.

See new calculation below.

<u>New description:</u>

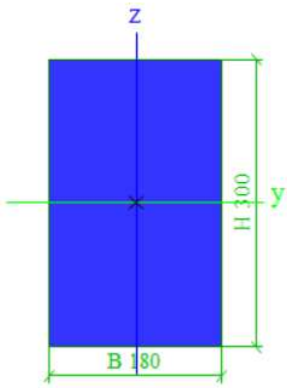
- wood BSH GL30
- L_b = 2,6 m + 2,6 m
- load area 1,0 x 7,55 m

<u>New scheme:</u>

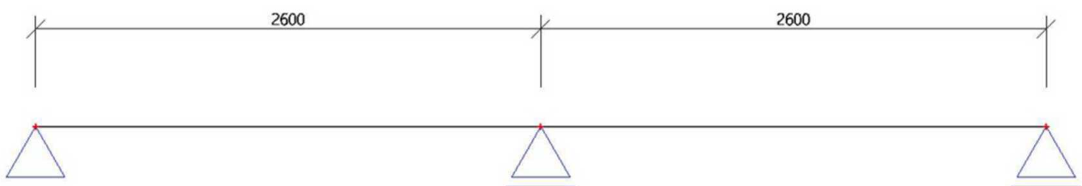


<u>New calculation:</u>

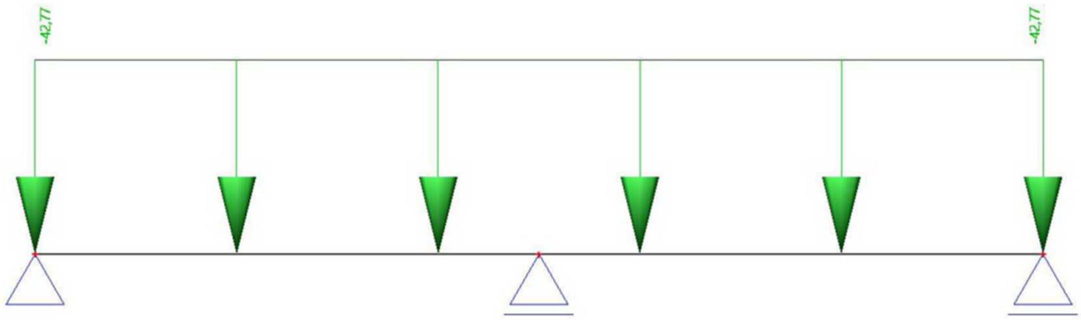
- wood BSH GL30h (BSH GL30)
- L_b = 2,6 + 2,6 m
- h_b = 300 mm
- b_b = 180 mm



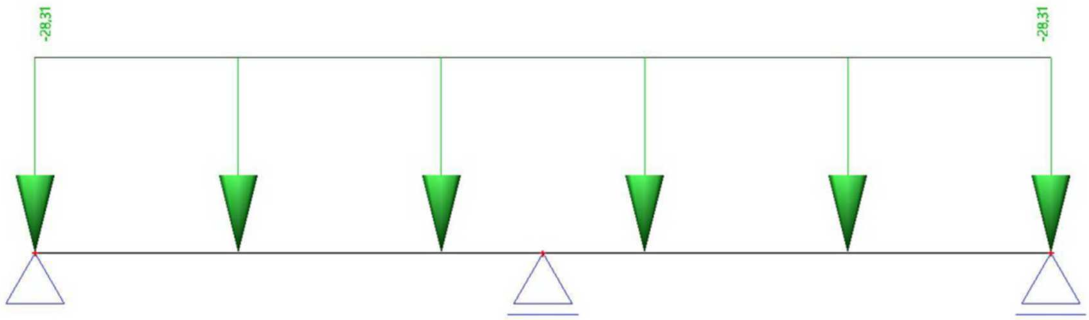
Model of the beam:



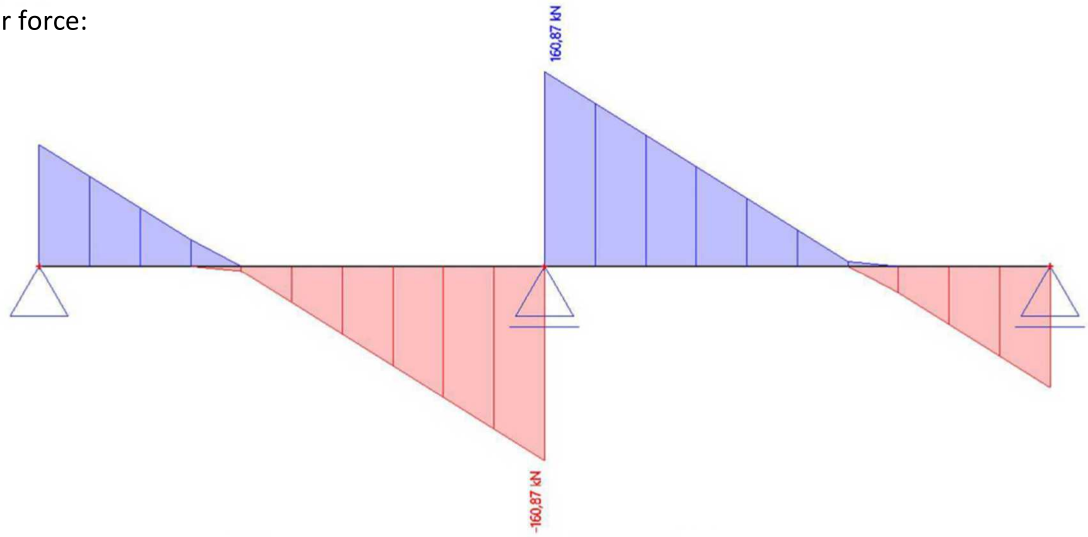
Dead load:



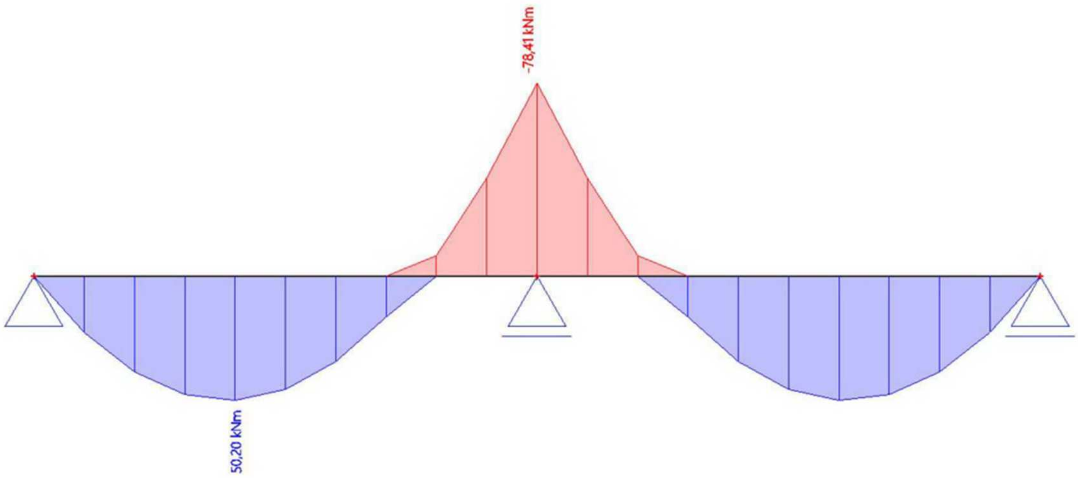
Live load:



Shear force:



Bending moment:



Maximum beam deflection:

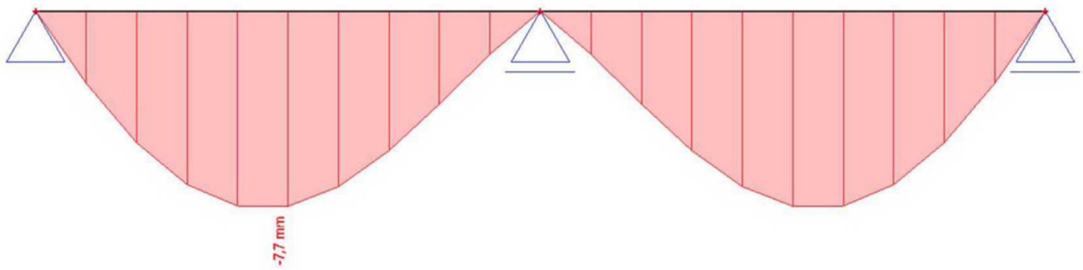


Figure: New calculation B02 – beam, wood (rest of the building)

Note: Software Scia Engineer was used for the calculation.

[https://www.scia.net/en]

<u>Condition:</u>

Max. beam deflection ≤ $L_b/300$ = 2600/300 = 8,7 mm

7,7 mm ≤ 8,7 mm => FULFILLED

<u>Conclusion:</u>

The newly designed beam has much more reasonable dimensions and also less deflection, so I will consider this design as final.

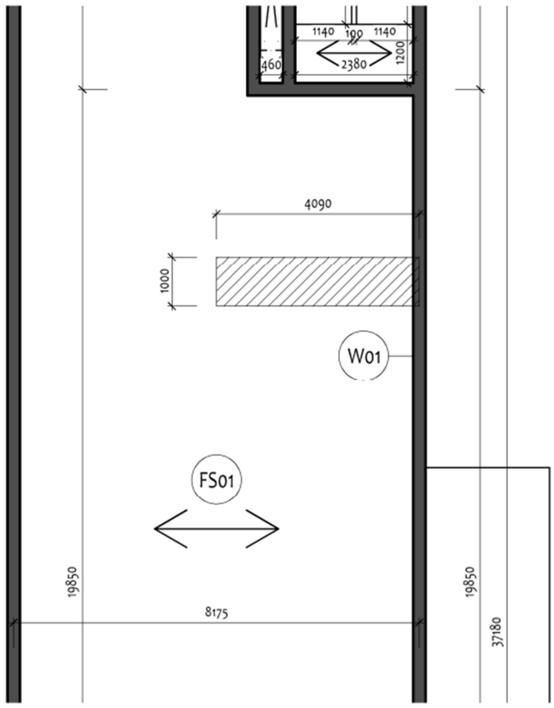
Final design: h_b = 300, b_b = 180 mm

3.2. Vertical load-bearing structures

3.2.1. W01 – exterior wall, reinforced concrete, monolithic (underground floor)

Basement walls are designed as reinforced concrete monolithic. The backfilling of the underground part will be made with non-freezing soil. The groundwater level was found to be 16,4 m deep during the hydrogeological survey. Therefore, it has no influence on the object under consideration and is therefore not considered further.

Scheme:



Description:

- concrete C30/37 XC2 (CZ) – Cl 0,2 – Dmax 16 – S3 $f_{cd} = f_{ck}/\gamma_c = 30/1{,}5 = 20$ MPa
- steel B 500 B
- hw = 3,65 m
- load area 1,0 x 4,1 m
- characteristic bulk density of soil $\gamma_{zem,k} = 19{,}5$ kN/m^3
- design effective angle of internal friction $\varphi_d = 32°$

Design: t_w = 200 mm

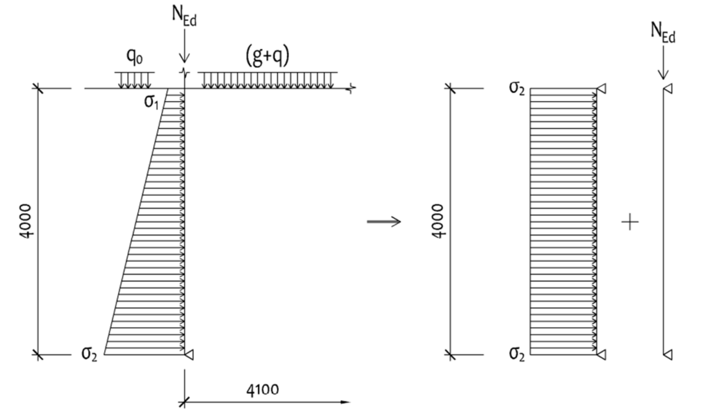
<u>Considered load on the structure:</u>

Ground pressure load:

- imposed load on the ground $q_{0,k} = 5\ kN/m^2$
  coefficient of ground pressure at rest $K_0 = 1 - \sin\varphi_d = 1 - \sin 32 = 0{,}47$
  design ground pressure at ground level $\sigma_{1,d} = K_0 * \gamma_Q * q_{0,k} = 0{,}47*1{,}5*5 = 3{,}53\ kN/m^2$
  design ground p. at the base of the b. wall $\sigma_{2,d} = K_0 * (\gamma_Q * q_{0,k} + \gamma_G * \gamma_{zem,k} * h_i)$
  $\sigma_{2,d} = 0{,}47*(1{,}5*5 + 1{,}35*19{,}5*3{,}65)$
  $\sigma_{2,d} = 48{,}69\ m^2$
  load length $L_{load} = 1{,}0\ m$
  $\sigma_1 = \sigma_{1,d} * L_{load} = 3{,}53*1{,}0 = 3{,}53\ kN/m'$
  $\sigma_2 = \sigma_{2,d} * L_{load} = 48{,}69*1{,}0 = 48{,}69\ kN/m'$

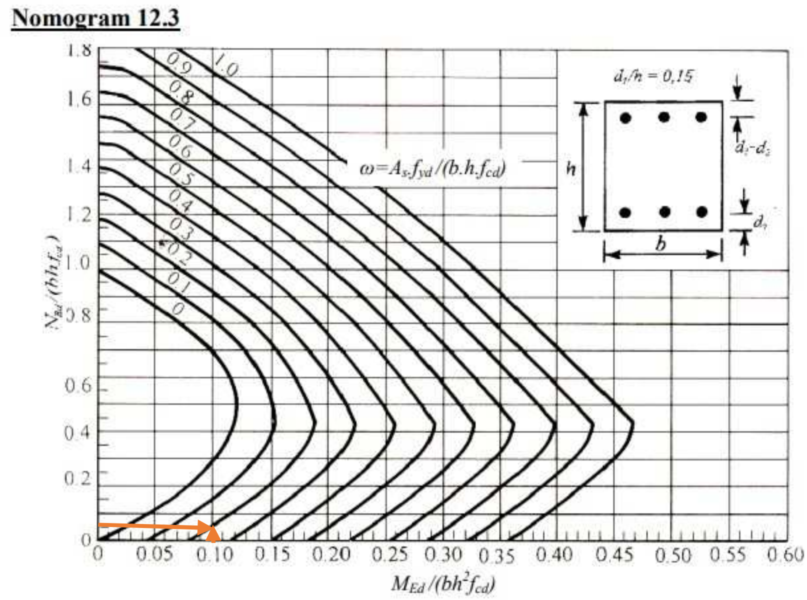
W01 – exterior wall, reinforced concrete, monolithic (underground floor)				
description	calculation	f_k [kN/m‘]	γ_f	f_d [kN/m‘]
RC load-b. wall (self weight)	25,0*0,2*3,65*1,0	18,25	1,35	24,64
RC floor slab	25,0*0,25*4,1*1,0	25,63	1,35	34,60
wooden floor slab	1,13*4,1*1,0	4,63	1,35	6,25
2x floor	2*1,0*4,1*1,0	8,20	1,35	11,07
wooden roof slab	0,65*4,1*1,0	2,67	1,35	3,60
roof	1,28*4,1*1,0	5,25	1,35	7,09
2x dropped ceiling	2*0,3*4,1*1,0	2,46	1,35	3,32
2x load-bearing wooden wall	2*6,0*0,124*4,0*1,0	5,95	1,35	8,03
2x partitions	2*0,7*4,1*1,0	5,74	1,35	7,75
total dead load		78,78		106,35
2x imposed load – floor	2*3,0*4,1*1,0	24,6	1,5	36,9
imposed load – roof	0,75*4,1*1,0	3,08	1,5	4,62
total live load		27,68		41,52
total		106,46		147,87

<u>Static model:</u>



- bending moment $M_{Ed} = 1/8 * f_d * L^2 = 1/8*48{,}69*3{,}65^2 = 81{,}08\ kNm$

Verification of the possibility of reinforcement using a nomogram:



ν = $\frac{N_{Ed}}{b*t*f_{cd}} = \frac{147{,}87*10^3}{1000*200*20}$ = 0,037

μ = $\frac{M_{Ed}}{b*t^2*f_{cd}} = \frac{81{,}08*10^6}{1000*200^2*20}$ = 0,101

ω = 0,2 => $\omega = \frac{A_{s,req}*f_{yd}}{b*h*f_{cd}}$ => $A_{s,req} = \frac{\omega*b*h*f_{cd}}{f_{yd}} = \frac{0{,}2*1000*200*20}{435} = 1839\ mm^2$

Final design: t_w = 200 mm, Ø 16 à 100 mm; $A_{s,prof}$ = 2011 mm^2

3.2.2. W02 – interior wall, reinforced concrete, monolithic (black box theatre)

The interior reinforced concrete load-bearing wall in the black box theatre will be designed in the same thickness as the basement reinforced concrete wall. Verification will be done only on the basement wall due to the fact that it will be more loaded (it has a smaller load area but a much larger load).

For verification of the load-bearing capacity of reinforced concrete walls, see above *3.2.1 W01 – exterior wall, reinforced concrete, monolithic (underground floor)*.

Final design: t_w = 200 mm

3.2.3. W03 – exterior wall, wood (rest of the building)

All wooden exterior load-bearing walls will be designed in the same system (NOVATOP SOLID) and thickness as the wooden interior load-bearing walls. The load-bearing capacity will therefore only be verified for the interior load-bearing walls, which will be more loaded. If these interior walls meet the load-bearing capacity, the perimeter walls will also meet the load-bearing capacity.

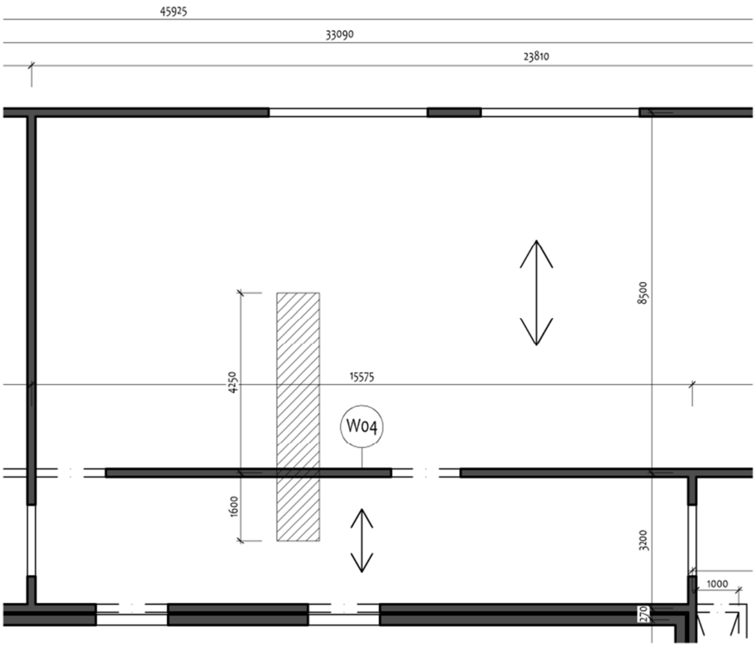
For verification of load capacity, see *3.2.4 W04 – interior wall, wood (rest of the building)* below.

Design: t_w = 124 mm (NOVATOP SOLID)

3.2.4. W04 – interior wall, wood (rest of the building)

The interior load-bearing walls in the above-ground floors will be designed in the NOVATOP SOLID system. The procedure from the NOVATOP SOLID technical documentation will be used for the calculation.

<u>Scheme:</u>



<u>Description:</u>

- wood CLT C24
- h_w = 4,0 m
- load area 1,0 x 5,85 m
- E_{eff}, $E_{0,mean}$, $f_{c,0,k}$, k_{mod}, γ_m from the NOVATOP SOLID technical documentation
- A_{eff} = 4x9 = 36 mm (4 load-bearing narrow C24 panels in NOVATOP SOLID panel)

Considered load on the structure:

W04 – interior wall, wood (rest of the building)				
description	calculation	f_k [kN/m‘]	γ_f	f_d [kN/m‘]
load-b. w. wall (self weight)	6,0*0,124*4,0*1,0	2,98	1,35	4,02
wooden floor slab	1,13*5,85*1,0	6,61	1,35	8,92
floor	1,0*5,85*1,0	5,85	1,35	7,90
wooden roof slab	0,65*5,85*1,0	3,80	1,35	5,13
roof	1,28*5,85*1,0	7,49	1,35	10,11
2x dropped ceiling	2*0,3*5,85*1,0	3,51	1,35	4,74
load-bearing wooden wall	6,0*0,124*4,0*1,0	2,98	1,35	4,02
partitions	0,7*5,85*1,0	4,10	1,35	5,54
total dead load		37,32		50,38
imposed load – floor	3,0*5,85*1,0	17,55	1,5	26,33
imposed load – roof	0,75*5,85*1,0	4,39	1,5	6,59
total live load		21,94		32,92
total		59,26		83,30

Load-bearing capacity assessment:

N_d = 83,30 kN/m‘

$$M_d = \frac{w_d * h_w^2}{8} + N_d * e = \frac{0*4^2}{8} + 83,30 * 0 = 0\ kNm$$

$$V_d = \frac{w_d * l}{2} = \frac{0*4}{2} = 0\ kN/m'$$

$$z_s = \frac{h}{2} = \frac{124}{2} = 62\ mm$$

$$W = \frac{EI_{eff}}{E_{0,mean} * z_s} = \frac{6,30*10^{11}}{11600*62} = 8,76 * 10^5\ mm$$

$$i = \sqrt{\frac{EI_{eff}}{E_{0,mean} * A_{eff}}} = \sqrt{\frac{6,30*10^{11}}{11600*4*9*1000}} = 38,84\ mm$$

$$\lambda_{rel,y} = \frac{l_{eff}}{\pi * i} * \sqrt{\frac{f_{c,0,k}}{E_{0;0,05}}} = \frac{4000}{\pi*38,84} * \sqrt{\frac{24}{\frac{5}{6}*11600}} = 1,633$$

β_c = 0,1 (for CLT)

$k_y = 1/2*(1 + \beta_c*(\lambda_{rel,y} - 0,3) + \lambda_{rel,y}^2) = 1/2*(1 + 0,1*(1,633 - 0,3) + 1,633^2) = 1,900$

$$k_{c,y} = \frac{1}{k_y + \sqrt{k_y^2 - \lambda_{rel,y}^2}} = \frac{1}{1,9 + \sqrt{1,9^2 - 1,633^2}} = 0,348$$

$$\sigma_{c,0,d} = \frac{N_d}{A_{eff}} = \frac{83,30*1000}{4*9*1000} = 2,31\ N/mm^2$$

$\sigma_{m,d} = \frac{M_d}{W} = \frac{0}{8,76*10^5} = 0\ N/mm^2$

$f_{c,0,d} = \frac{f_{c,0,k}*k_{mod}}{\gamma_m} = \frac{24*0,8}{1,3} = 14,77\ N/mm^2$

$f_{m,d} = \frac{f_{m,k}*k_{mod}}{\gamma_m} = \frac{24*0,8}{1,3} = 14,77\ N/mm^2$

$\frac{\sigma_{c,0,d}}{k_{c,y}*f_{c,0,d}} + \frac{\sigma_{m,d}}{f_{m,d}} = \frac{2,31}{0,348*14,77} + \frac{0}{14,77} = 0,45 \leq 1,0$ => FULFILLED

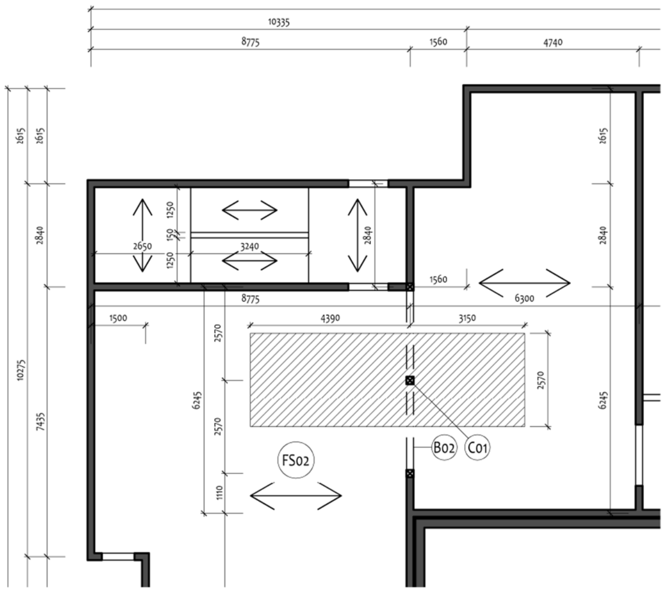
The proposed wall dimensions meet the conditions of the assessment.

Final design: t_w = 124 mm (NOVATOP SOLID)

3.2.5. C01 – column, wood

The most heavily loaded wooden column is located on the first floor below the most heavily loaded beam. All other wooden columns in the building will be designed based on the design of this column.

Scheme:



Description:

- wood KVH C24
- h_w = 4,0 m
- load area 2,60 x 7,55 m
- A_{eff} = 200x200 = 40000 mm
- $E_{0,05}$ = 7400 MPa
- $f_{c,0,k}$ = 21 MPa
- k_{mod} = 0,8
- γ_m = 1,3

Considered load on the structure:

C01 – column, wood				
description	calculation	f_k [kN]	γ_f	f_d [kN]
column (self weight)	6,0*4,0*0,2*0,2	0,96	1,35	1,30
wooden floor slab	1,13*2,6*7,55	22,18	1,35	29,94
floor	1,0*2,6*7,55	19,63	1,35	26,50
wooden roof slab	0,65*2,6*7,55	12,76	1,35	17,23
roof	1,28*2,6*7,55	25,13	1,35	33,93
2x dropped ceiling	2*0,3*2,6*7,55	11,78	1,35	15,90
load-bearing wooden wall	6,0*4,0*2,6*0,124	7,74	1,35	10,45
partitions	0,7*2,6*7,55	13,74	1,35	18,55
total dead load		113,92		153,80
imposed load – floor	3,0*2,6*7,55	58,89	1,5	88,34
imposed load – roof	0,75*2,6*7,55	14,72	1,5	22,08
total live load		73,61		110,42
total		187,53		264,22

Load-bearing capacity assessment:

N_d = 264,22 kN

$$f_{c,0,d} = \frac{f_{c,0,k} * k_{mod}}{\gamma_m} = \frac{21*0,8}{1,3} = 12,92\ MPa$$

$I_y = I_z = 1/12*200*200^3 = 1,3*10^8\ mm^4$

$$i_y = i_z = \sqrt{\frac{I_y}{A_{eff}}} = \sqrt{\frac{1,3*10^8}{40000}} = 57,74\ mm$$

$$\lambda_y = \lambda_z = \frac{l_y}{i_y} = 69,28$$

$$\sigma_{c,crit,y} = \pi^2 * \frac{E_{0,05}}{\lambda_y^2} = \pi^2 * \frac{7400}{69,28^2} = 15,22\ MPa$$

$$\lambda_{rel,y} = \lambda_{rel,z} = \sqrt{\frac{f_{c,0,k}}{\sigma_{c,crit,y}}} = \sqrt{\frac{21}{15,22}} = 1,170$$

β_c = 0,2 (for C24)

$k_y = 1/2*(1 + \beta_c*(\lambda_{rel,y} - 0,5) + \lambda_{rel,y}^2) = 1/2*(1 + 0,2*(1,17 - 0,5) + 1,17^2) = 1,260$

$$k_{c,y} = \frac{1}{k_y + \sqrt{k_y^2 - \lambda_{rel,y}^2}} = \frac{1}{1,260 + \sqrt{1,260^2 - 1,170^2}} = 0,590$$

$\sigma_{c,0,d} = \frac{N_d}{A_{eff}} = \frac{264{,}22*10^3}{40000} = 6{,}61\ MPa$

$\frac{\sigma_{c,0,d}}{k_{c,y}*f_{c,0,d}} = \frac{6{,}61}{0{,}590*12{,}92} = 0{,}87 \leq 1{,}0$ => FULFILLED

The proposed column dimensions meet the conditions of the assessment.

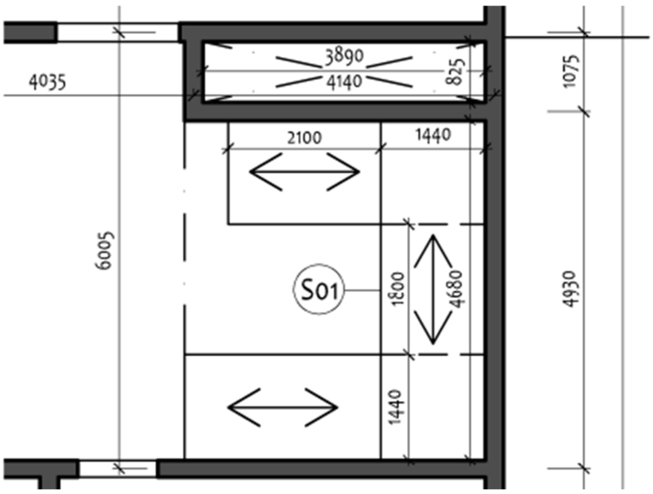
Final design: 200x200 mm, wood KVH C24

3.3. Staircases

3.3.1. S01 – two-quarter landing staircase, reinforced concrete, prefabricated (underground floor)

Staircase flights will be supported by the staircase landings, the landings will be supported by the load-bearing walls, and will be installed in soundproof boxes that will be placed in the walls.

Scheme:



Description:

- concrete C30/37 XC1 (CZ) – Cl 0,2 – Dmax 16 – S3 $f_{cd} = f_{ck}/\gamma_c = 30/1{,}5 = 20$ MPa
- steel B 500 B
- structural floor height: 3900 mm
- floor height from floor to floor: 3900 mm
- dimensions of landings: 1450x1450 mm
- total run: 2100 mm, 1800 mm, 2700 mm
- number of steps per floor: 22 (first flight 7, second flight 6, third flight 9)
- step width (tread): 300 mm
- step height (riser): 177,3 mm (16*177+6*178)
- angle of incline: 30,6°

Empirical design of landings and flights:

$$h_l = \left(\frac{1}{30} \sim \frac{1}{25}\right) * L_l = \left(\frac{1}{30} \sim \frac{1}{25}\right) * 1450 = 48 \sim 58\,mm$$

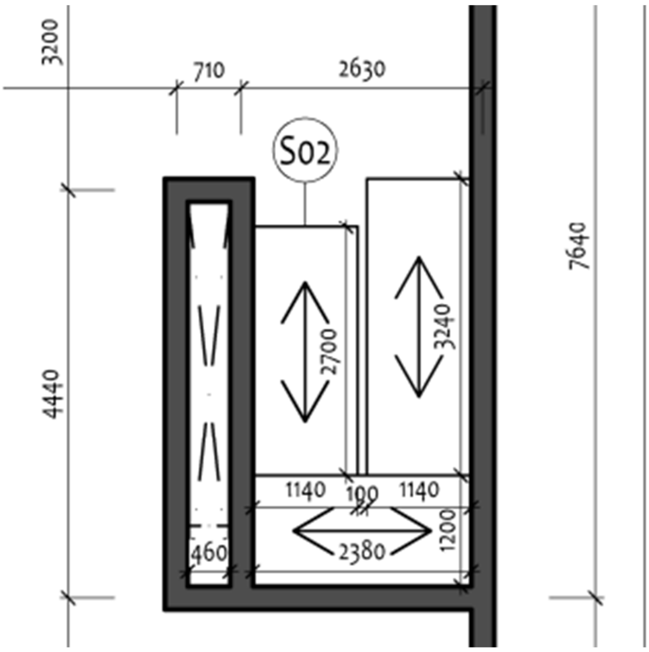
$$h_f = \left(\frac{1}{30} \sim \frac{1}{25}\right) * L_f = \left(\frac{1}{30} \sim \frac{1}{25}\right) * 2700 = 90 \sim 108\,mm$$

Final design: **h_l = 150 mm, h_f = 150 mm (due to the minimum covering layer of reinforcement)**

3.3.2. S02 – half landing staircase, reinforced concrete, prefabricated (underground floor)

Staircase flights will be supported by the staircase landing, the landing will be supported by the load-bearing walls, and will be installed in soundproof boxes that will be placed in the walls.

Scheme:



Description:

- concrete C30/37 XC1 (CZ) – Cl 0,2 – Dmax 16 – S3 $f_{cd} = f_{ck}/\gamma_c$ = 30/1,5 = 20 MPa
- steel B 500 B
- structural floor height: 3900 mm
- floor height from floor to floor: 3900 mm
- lenght of landing: 2400 mm
- total run: 2700 mm, 3240 mm
- number of steps per floor: 22 (first flight 10, second flight 12)
- step width (tread): 270 mm
- step height (riser): 177,3 mm (16*177+6*178)
- angle of incline: 33,3°

<u>Empirical design of landings and flights:</u>

$$h_l = \left(\frac{1}{30} \sim \frac{1}{25}\right) * L_l = \left(\frac{1}{30} \sim \frac{1}{25}\right) * 2400 = 80 \sim 96\ mm$$

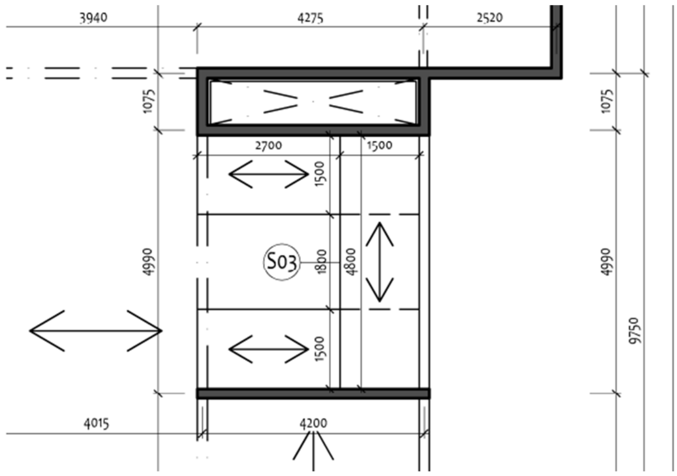
$$h_f = \left(\frac{1}{30} \sim \frac{1}{25}\right) * L_f = \left(\frac{1}{30} \sim \frac{1}{25}\right) * 3240 = 108 \sim 130\ mm$$

Final design: h_l = 150 mm, h_f = 150 mm (due to the minimum covering layer of reinforcement)

3.3.3. S03 – two-quarter landing staircase, wood (rest of the building)

Staircase flights will be supported by the staircase landings, the landings will be supported by the load-bearing walls, and will be installed in such a way to minimize the transmission of impact sound.

<u>Scheme:</u>



<u>Description:</u>

- wood KVH C24
- structural floor height: 4400 mm
- floor height from floor to floor: 4300 mm
- dimensions of landings: 1500x1500 mm
- total run: 2700 mm, 1800 mm, 2700 mm
- number of steps per floor: 24 (first flight 9, second flight 6, third flight 9)
- step width (tread): 300 mm
- step height (riser): 179,2 mm (20*179+4*180)
- angle of incline: 30,9°

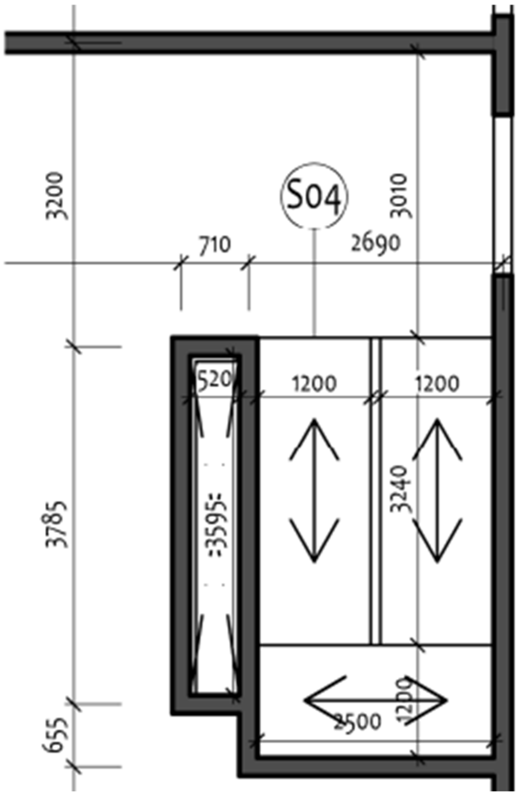
The design of the domensions of the staircase beams will not be further verified in the preliminary structural calculation due to the fact that very low loads are placed on the wooden staircase beams (permanent load 0,54 kN/m2 and imposed load 3,0 kN/m2).

Final design of staircase beams: 160x60 mm

3.3.4. S04 – half landing staircase, wood (rest of the building)

Staircase flights will be supported by the staircase landings, the landings will be supported by the load-bearing walls, and will be installed in such a way to minimize the transmission of impact sound.

<u>Scheme:</u>



<u>Description:</u>

- wood KVH C24
- structural floor height: 4400 mm
- floor height from floor to floor: 4300 mm
- lenght of landing: 2500 mm
- total run: 3240 mm, 3240 mm
- number of steps per floor: 24 (first flight 12, second flight 12)
- step width (tread): 270 mm
- step height (riser): 179,2 mm (20*179+4*180)
- angle of incline: 33,6°

The design of the domensions of the staircase beams will not be further verified in the preliminary structural calculation due to the fact that very low loads are placed on the wooden staircase beams (permanent load 0,54 kN/m2 and imposed load 3,0 kN/m2).

Final design of staircase beams: 160x60 mm

3.4. Foundations

A geological survey under the building and in its surroundings revealed simple foundation conditions. The type of soil under and around the building does not change significantly, the layers are almost horizontal and of approximately the same thickness.

The terrain around the building is flat to slightly sloping. The thickness of the arable land is 100 mm. This is followed by a layer of clay sand S4 with a thickness of 0,65 m, and then a layer of gravelly clay F1 up to a depth of 21 m, followed only by a rock base R3. The groundwater level is stable, recorded at 16,4 m below ground level. The top edge of the building foundations will be 0,2 m below ±0.000, or 0,1 m above the modified terrain (the foundations will have to reach a depth of at least 0,8 m below the modified terrain in order to achieve a minimum frost depth), in the basement part of the building the top edge will be 4,1 m below ±0,000, or 3,8 m below the modified terrain. Therefore, the entire building will be founded on the gravelly clay F1 and will not be affected by the groundwater level.

The building will be based on a combination of strip foundations and footings made of plain concrete, with 150 mm thick base layer of plain concrete between them.

3.4.1. F01 – foundation footings, plain concrete, monolithic (under Floor No.1)

The footings will be made of plain concrete. The calculation is made for the most heavily loaded footing (under column C01, for the load on the column and its self-weight, see *3.2.5 C01 – column, wood*).

<u>Decription:</u>

- concrete C25/30 XC2 – Cl 0,2 – D_{max} 16 – S3 $f_{cd} = f_{ck}/\gamma_c = 25/1,5 = 16,67$ MPa
- foundation conditions: simple
- coplexity of building: moderate
- soil class: F1
- groundwater level: no presence of groundwater
- 2. geotechnical category

<u>MSÚ assessment:</u>

Design approach 2 (NP2): K2 = A2+M2+R1 (coefficients according to ČSN EN 1997-1-Eurocode 7)

- Soil: F1 (solid)
- cohesion c‘: 16 kPa
- angle φ‘: 30°
- bulk density γ‘: 19,0 kN/m^3
- load at the base of C01: Vgk = 113,92 kN
  Vqk = 73,61 kN
- depth of the found. joint: D = 0,9 m

Design of footings dimensions: h = 1,0 m B = 0,6 m L = 0,6 m

Note: The height of the footings could be lower in terms of load-bearing capacity, but it is necessary to maintain a minimum frost depth, so I choose a footing height of 1,0 m.

<u>Vertical load capacity:</u>

$V_d = V_{g,k} * \gamma_g + V_{q,k} * \gamma_q$ = 209,61 kN

$G_p = B * L * h * \gamma_g * \gamma_{bet}$ = 9,00 kN

$G_z = B * L * (D - h) * \gamma_g * \gamma'$ = -0,68 kN

$\sigma_d = \frac{V_d + G_p + G_z}{B' * L'}$ = 605,36 kPa

<u>Load capacity coefficients:</u>

$N_c = (N_d - 1) * \tan^{-1} \varphi'_d$ = 20,42

$N_d = \tan(45 + 0{,}5 * \varphi'_d)^2 * e^{\pi * \tan(\varphi'_d)}$ = 10,43

$N_b = 1{,}5 * (N_d - 1) * \tan \varphi'_d$ = 6,53

<u>Shape coefficients:</u>

$S_c = 1 + 0{,}2 * \frac{B'}{L'}$ = 1,20

$S_d = 1 + \frac{B'}{L'} * \sin \varphi'_d$ = 1,42

$S_b = 1 - 0{,}3 * \frac{B'}{L'}$ = 0,70

<u>Depth coefficients:</u>

$d_c = 1 + 0{,}1 * \sqrt{\frac{D}{B}} = 1{,}12$

$d_d = 1 + 0{,}1 * \sqrt{\frac{D}{B}\sin(2 * \varphi'_d)} = 1{,}11$

$d_b = 1{,}00$

<u>Load slope coefficients:</u>

$i_c = i_d = i_b = 1{,}00$

<u>Load-bearing capacity of the soil:</u>

$\frac{R}{A'} = c_d * N_c * s_c * d_c * i_c + \gamma' * D * N_d * s_c * d_d * i_d + 0{,}5 * \gamma' * B' * N_b * s_b * d_b * i_b$

$\frac{R}{A'} = 658{,}32$ kPa

<u>Verification of the load-bearing capacity:</u>

$\sigma_d \leq \frac{R}{A'}$

605,36 kPa ≤ 658,32 kPa => FULFILLED

The design of foundation footings dimensions of 1,0 x 0,6 x 0,6 m are suitable in terms of vertical load-bearing capacity.

<u>Horizontal load-bearing capacity:</u>

Not assessed.

<u>Settling of the foundation footings:</u>

Foundation footings settlement calculation is attached at the end of the preliminary structural calculation (see annexes).

3.4.2. F02 – foundation strips, plain concrete, monolithic (under Floor No.1)

The strips will be made of plain concrete. The calculation is made for the most heavily loaded strip (under interior wall W04, for the load on the wall and its self-weight, see *3.2.4 W04 – interior wall, wood (rest of the building)*).

Decription:

- concrete C25/30 XC2 – Cl 0,2 – D_{max} 16 – S3 $f_{cd} = f_{ck}/\gamma_c$ = 25/1,5 = 16,67 MPa
- foundation conditions: simple
- coplexity of building: moderate
- soil class: F1
- groundwater level: no presence of groundwater
- 2. geotechnical category

MSÚ assessment:

Design approach 2 (NP2): K2 = A2+M2+R1 (coefficients according to ČSN EN 1997-1-Eurocode 7)

- Soil: F1 (solid)
- cohesion c‘: 16 kPa
- angle φ‘: 30°
- bulk density γ‘: 19,0 kN/m^3
- load at the base of W04: Vgk = 37,32 kN/m‘
  Vqk = 21,94 kN/m‘
- depth of the found. joint: D = 0,9 m

Design of strips dimensions: h = 1,0 m B = 0,4 m L = 1,0 m‘

Vertical load capacity:

$V_d = V_{g,k} * \gamma_g + V_{q,k} * \gamma_q$ = 65,84 kN

$G_p = B * L * h * \gamma_g * \gamma_{bet}$ = 10,00 kN

$G_z = B * L * (D - h) * \gamma_g * \gamma'$ = -0,76 kN

$\sigma_d = \frac{V_d + G_p + G_z}{B' * L'}$ = 187,71 kPa

Load capacity coefficients:

$N_c = (N_d - 1) * \tan^{-1} \varphi'_d = 20{,}42$

$N_d = \tan(45 + 0{,}5 * \varphi'_d)^2 * e^{\pi * \tan(\varphi'_d)} = 10{,}43$

$N_b = 1{,}5 * (N_d - 1) * \tan \varphi'_d = 6{,}53$

Shape coefficients:

$S_c = 1 + 0{,}2 * \frac{B'}{L'} = 1{,}08$

$S_d = 1 + \frac{B'}{L'} * \sin \varphi'_d = 1{,}17$

$S_b = 1 - 0{,}3 * \frac{B'}{L'} = 0{,}88$

Depth coefficients:

$d_c = 1 + 0{,}1 * \sqrt{\frac{D}{B}} = 1{,}15$

$d_d = 1 + 0{,}1 * \sqrt{\frac{D}{B} \sin(2 * \varphi'_d)} = 1{,}13$

$d_b = 1{,}00$

Load slope coefficients:

$i_c = i_d = i_b = 1{,}00$

Load-bearing capacity of the soil:

$\frac{R}{A'} = c_d * N_c * s_c * d_c * i_c + \gamma' * D * N_d * s_c * d_d * i_d + 0{,}5 * \gamma' * B' * N_b * s_b * d_b * i_b$

$\frac{R}{A'} = 581{,}99$ kPa

Verification of the load-bearing capacity:

$\sigma_d \leq \frac{R}{A'}$

187,71 kPa ≤ 581,99 kPa => FULFILLED

The design of foundation strips dimensions of 1,0 x 0,4 m (x 1,0 m‘) are suitable in terms of vertical load-bearing capacity.

Horizontal load-bearing capacity:

Not assessed.

Settling of the foundation strips:

Foundation strips settlement calculation is attached at the end of the preliminary structural calculation (see annexes).

3.4.3. F03 – foundation strips, plain concrete, monolithic (under Underground floor No.1)

The strips will be made of plain concrete. The calculation is made for the most heavily loaded strip (under interior wall W04, for the load on the wall and its self-weight, see *3.2.1 W01 – exterior wall, reinforced concrete, monolithic (underground floor)*).

Decription:

- concrete C25/30 XC2 – Cl 0,2 – D_{max} 16 – S3 $f_{cd} = f_{ck}/\gamma_c = 25/1,5 = 16,67$ MPa
- foundation conditions: simple
- coplexity of building: moderate
- soil class: F1
- groundwater level: no presence of groundwater
- 2. geotechnical category

MSÚ assessment:

Design approach 2 (NP2): K2 = A2+M2+R1 (coefficients according to ČSN EN 1997-1-Eurocode 7)

- Soil: F1 (solid)
- cohesion c‘: 16 kPa
- angle φ‘: 30°
- bulk density γ‘: 19,0 kN/m^3
- load at the base of W04: Vgk = 78,78 kN/m‘
  Vqk = 27,68 kN/m‘
- depth of the found. joint: D = 4,4 m

Design of strips dimensions: h = 0,6 m B = 0,4 m L = 1,0 m‘

Vertical load capacity:

$V_d = V_{g,k} * \gamma_g + V_{q,k} * \gamma_q$ = 114,76 kN

$G_p = B * L * h * \gamma_g * \gamma_{bet}$ = 6,00 kN

$G_z = B * L * (D - h) * \gamma_g * \gamma'$ = 28,88 kN

$\sigma_d = \frac{V_d + G_p + G_z}{B' * L'}$ = 374,11 kPa

Load capacity coefficients:

$N_c = (N_d - 1) * \tan^{-1} \varphi'_d$ = 20,42

$N_d = \tan(45 + 0,5 * \varphi'_d)^2 * e^{\pi * \tan(\varphi'_d)}$ = 10,43

$N_b = 1,5 * (N_d - 1) * \tan \varphi'_d$ = 6,53

Shape coefficients:

$S_c = 1 + 0,2 * \frac{B'}{L'}$ = 1,08

$S_d = 1 + \frac{B'}{L'} * \sin \varphi'_d$ = 1,17

$S_b = 1 - 0,3 * \frac{B'}{L'}$ = 0,88

Depth coefficients:

$d_c = 1 + 0,1 * \sqrt{\frac{D}{B}}$ = 1,33

$d_d = 1 + 0,1 * \sqrt{\frac{D}{B} \sin(2 * \varphi'_d)}$ = 1,29

d_b = 1,00

Load slope coefficients:

$i_c = i_d = i_b$ = 1,00

Load-bearing capacity of the soil:

$\frac{R}{A'} = c_d * N_c * s_c * d_c * i_c + \gamma' * D * N_d * s_c * d_d * i_d + 0,5 * \gamma' * B' * N_b * s_b * d_b * i_b$

$\frac{R}{A'}$ = 1710,67 kPa

<u>Verification of the load-bearing capacity:</u>

$\sigma_d \leq \frac{R}{A'}$

374,11 kPa ≤ 1710,67 kPa => FULFILLED

The design of foundation strips dimensions of 0,6 x 0,4 m (x 1,0 m') are suitable in terms of vertical load-bearing capacity.

<u>Horizontal load-bearing capacity:</u>

Not assessed.

<u>Settling of the foundation strips:</u>

Foundation strips settlement calculation is attached at the end of the preliminary structural calculation (see annexes).

3.5. Spatial rigidity of the building

The supporting system of the above-ground floors of the building consists of two systems. The first system is the load-bearing reinforced concrete walls and wooden truss beams in the black box theatre, the second system is in the rest of the building, where the load-bearing system consists of wooden wall panels, wooden columns, and wooden floor slabs. The load-bearing walls are laid in both directions throughout the building, providing spatial rigidity.

Spatial rigidity of the building is sufficient, direct assessment and verification is not required.

In Barcelona 11/2022

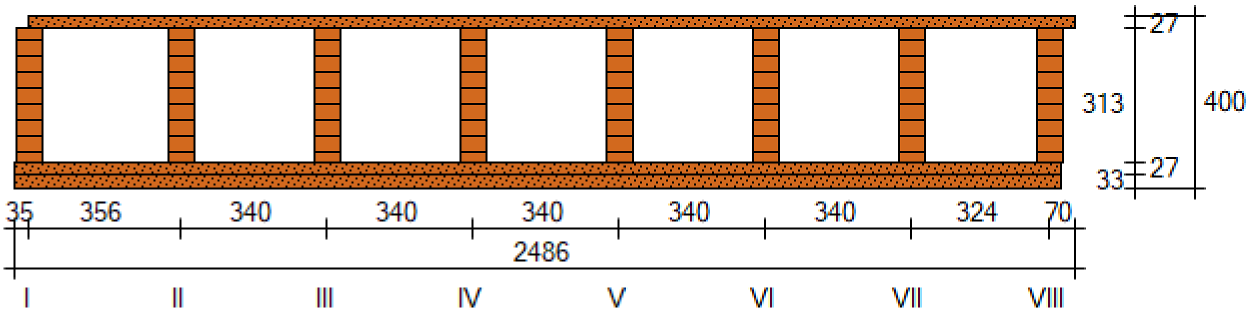
Author: Bc. Tadeáš Petřík

project: Master's Thesis - Tadeáš Petřík position:

assumptions for the computation:

- groundwork: ETA-11/0310, Eurocode 0/1/5 + National Annex Czech Republic
- with lengths of elements ℓ ≤ 6,0m the cover layers are not interrupted with a joint, with l > 6,0 m the cover layers are connected with an inlay joint
- strength and stiffness parameters according to EN 14080
- all butt joints between the individual elements of the panel are glued along the whole surface
- The cross joints are permitted only in the area of compression and bending.
- The data on load capacity limit state: proof and assessment of each individual partition. When assessing individual partitions (element strip), it is considered as an internal partition (full failure modes)
- assessment of serviceability limit state - deflection and vibration: assessment of the entire element, or the entire width of the element (only belt assessment with the belt of the element)

section:



element height: 400 mm

element width: 2485,5 mm

top belt material: SWP 9/9/9

bottom belt material: SWP 9/9/9

2nd bottom belt material: SWP 9/9/9

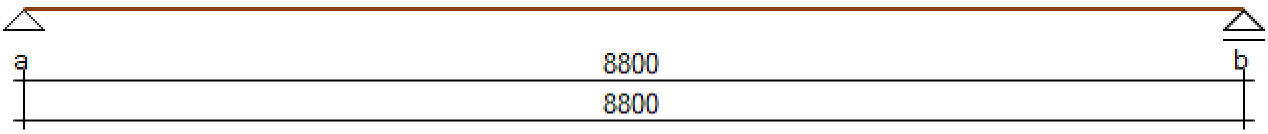
class of application / KLED: 1 / medium

psi_0 / psi_2: 0,70 / 0,60

rib	material	overhang OG [mm]	overhang UG [mm]	span of ribs [mm]
I	Gl32h, b = 60 mm	0,0	35,0	356,5
II	Gl32h, b = 60 mm	-	-	340,0
III	Gl32h, b = 60 mm	-	-	340,0
IV	Gl32h, b = 60 mm	-	-	340,0
V	Gl32h, b = 60 mm	-	-	340,0
VI	Gl32h, b = 60 mm	-	-	340,0
VII	Gl32h, b = 60 mm	-	-	324,0
VIII	Gl32h, b = 60 mm	70,0	35,0	-

The dimensions in the table are measured on the axis

static scheme and load: Ceiling element, Element pitch 0°



	ℓ [mm]	g_k [kN/m²]	q_k [kN/m²]	G_k [kN/m]	x_G [mm]	Q_k [kN/m]	x_Q [mm]
field 1	8800	3,13	3,00	0,00	0	0,00	0

the table contains the following loads: dead weight 0,73 kN/m2, filling 40 kg/m2, added partition wall 0,00 kN/m2

parameters of the load capacity and the load:

characteristic load capacity of the shear force at the negative/positive bending moment $-Q_{R,k}$ / $+Q_{R,k}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	15,36	28,27	28,39	28,39	28,39

	rib VI	rib VII	rib VIII
field 1	28,39	28,50	16,41

characteristic moment load capacity at the negative/positive bending moment $-M_{R,k}$ / $+M_{R,k}$ [kNm]

	rib I	rib II	rib III	rib IV	rib V
field 1	45,90 / 50,98	65,76 / 76,42	64,75 / 74,93	64,75 / 74,93	64,75 / 74,93

	rib VI	rib VII	rib VIII
field 1	64,75 / 74,93	63,77 / 73,48	49,76 / 50,52

effective bending stiffness at the negative/positive bending moment $-EI_{ef}$ / $+EI_{ef}$ [$\cdot 10^{11}$ Nmm²]

	rib I	rib II	rib III	rib IV	rib V
field 1	61,03	89,29	87,75	87,75	87,75

	rib VI	rib VII	rib VIII
field 1	87,75	86,25	63,36

governing internal forces:

nominal shear forces as a result of permanent load $-Q_{E,d(g)}$ / $+Q_{E,d(g)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-3,97 / 3,97	-6,48 / 6,48	-6,32 / 6,32	-6,32 / 6,32	-6,32 / 6,32

	rib VI	rib VII	rib VIII
field 1	-6,32 / 6,32	-6,33 / 6,33	-4,32 / 4,32

nominal shear forces as a result of permanent + variable load $-Q_{E,d(g+q)}$ / $+Q_{E,d(g+q)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-8,19 / 8,19	-13,37 / 13,37	-13,06 / 13,06	-13,06 / 13,06	-13,06 / 13,06

	rib VI	rib VII	rib VIII
field 1	-13,06 / 13,06	-13,07 / 13,07	-8,91 / 8,91

nominal moments as a result of permanent load $-M_{E,d(g)}$ / $+M_{E,d(g)}$ [kNm]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,00 / 8,73	0,00 / 14,25	0,00 / 13,91	0,00 / 13,91	0,00 / 13,91

	rib VI	rib VII	rib VIII
field 1	0,00 / 13,91	0,00 / 13,92	0,00 / 9,49

nominal moments as a result of permanent + variable load $-M_{E,d(g+q)}$ / $+M_{E,d(g+q)}$ [kNm]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,00 / 18,02	0,00 / 29,42	0,00 / 28,72	0,00 / 28,72	0,00 / 28,72

	rib VI	rib VII	rib VIII
field 1	0,00 / 28,72	0,00 / 28,75	0,00 / 19,60

evaluation of marginal load capacity:

degree of utilization under permanent load, k_{mod} = 0,60, max eta_Q / eta_M [-]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,56 / 0,37	0,50 / 0,40	0,48 / 0,40	0,48 / 0,40	0,48 / 0,40

	rib VI	rib VII	rib VIII
field 1	0,48 / 0,40	0,48 / 0,41	0,57 / 0,41

degree of utilization under permanent + variable load, k_{mod} = 0,80, max eta_Q / eta_M [-]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,87 / 0,57	0,77 / 0,63	0,75 / 0,62	0,75 / 0,62	0,75 / 0,62

	rib VI	rib VII	rib VIII
field 1	0,75 / 0,62	0,74 / 0,64	0,88 / 0,63

evaluation - serviceability limit state:

	u_{inst} [mm]	u_{fin} [mm]	$u_{net,fin}$ [mm]
field 1	19,7 (ℓ/447)	29,2 (ℓ/302)	29,2 (ℓ/302)

recommended bend limit values are observed.

evaluation - evaluation of vibration:

evaluation of vibration not performed.

reaction forces:

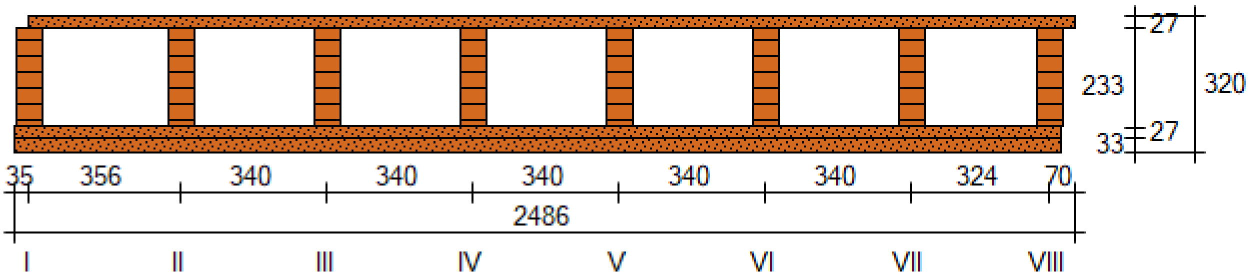
supports	g_k [kN/m]	min. q_k [kN/m]	max. q_k [kN/m]
a	13,83	0,00	13,24
b	13,83	0,00	13,24

project: Master's Thesis - Tadeáš Petřík position:

assumptions for the computation:

- groundwork: ETA-11/0310, Eurocode 0/1/5 + National Annex Czech Republic
- with lengths of elements ℓ ≤ 6,0m the cover layers are not interrupted with a joint, with l > 6,0 m the cover layers are connected with an inlay joint
- strength and stiffness parameters according to EN 14080
- all butt joints between the individual elements of the panel are glued along the whole surface
- The cross joints are permitted only in the area of compression and bending.
- The data on load capacity limit state: proof and assessment of each individual partition. When assessing individual partitions (element strip), it is considered as an internal partition (full failure modes)
- assessment of serviceability limit state - deflection and vibration: assessment of the entire element, or the entire width of the element (only belt assessment with the belt of the element)

section:



element height: 320 mm

element width: 2485,5 mm

top belt material: SWP 9/9/9

bottom belt material: SWP 9/9/9

2nd bottom belt material: SWP 9/9/9

class of application / KLED: 1 / medium

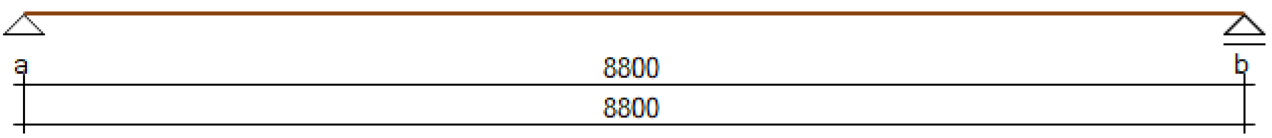
psi_0_s / psi_2_s: 0,50 / 0,00

psi_0_w / psi_2_w: 0,60 / 0,00

rib	material	overhang OG [mm]	overhang UG [mm]	span of ribs [mm]
I	Gl32h, b = 60 mm	0,0	35,0	356,5
II	Gl32h, b = 60 mm	-	-	340,0
III	Gl32h, b = 60 mm	-	-	340,0
IV	Gl32h, b = 60 mm	-	-	340,0
V	Gl32h, b = 60 mm	-	-	340,0
VI	Gl32h, b = 60 mm	-	-	340,0
VII	Gl32h, b = 60 mm	-	-	324,0
VIII	Gl32h, b = 60 mm	70,0	35,0	-

The dimensions in the table are measured on the axis

static scheme and load: Roof element, Element pitch 2°



Warning: The specified lengths of the fields are lengths designed to the ground plan.

	ℓ [mm]	g_k [kN/m²]	s [kN/m²] *	w_k [kN/m²]	G_k [kN/m]	x_G [mm]
field 1	8800	2,14	0,75	1,12	0,00	0

the table contains the following loads: dead weight 0,65 kN/m2, filling 0 kg/m2

** Snow load s includes the roof shape coefficient.*

parameters of the load capacity and the load:

characteristic load capacity of the shear force at the negative/positive bending moment $-Q_{R,k}$ / $+Q_{R,k}$ [kN] for N = 0 kN

	rib I	rib II	rib III	rib IV	rib V
field 1	10,84	20,73	20,78	20,78	20,78

	rib VI	rib VII	rib VIII
field 1	20,78	20,83	11,53

characteristic moment load capacity at the negative/positive bending moment $-M_{R,k}$ / $+M_{R,k}$ [kNm] for N = 0 kN

	rib I	rib II	rib III	rib IV	rib V
field 1	30,90 / 34,98	46,11 / 54,48	45,34 / 53,33	45,34 / 53,33	45,34 / 53,33

	rib VI	rib VII	rib VIII
field 1	45,34 / 53,33	44,60 / 52,22	34,06 / 34,62

effective bending stiffness at the negative/positive bending moment $-EI_{ef}$ / $+EI_{ef}$ [$\cdot 10^{11}$ Nmm²]

	rib I	rib II	rib III	rib IV	rib V
field 1	32,49	49,45	48,53	48,53	48,53

	rib VI	rib VII	rib VIII
field 1	48,53	47,63	34,01

governing internal forces:

nominal shear forces as a result of permanent load $-Q_{E,d(g)}$ / $+Q_{E,d(g)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-2,72 / 2,72	-4,44 / 4,44	-4,33 / 4,33	-4,33 / 4,33	-4,33 / 4,33

	rib VI	rib VII	rib VIII
field 1	-4,33 / 4,33	-4,33 / 4,33	-2,96 / 2,96

dimensioning transverse forces due to permanent load + snow load $-Q_{E,d(g+s)}$ / $+Q_{E,d(g+s)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-3,77 / 3,77	-6,16 / 6,16	-6,01 / 6,01	-6,01 / 6,01	-6,01 / 6,01

	rib VI	rib VII	rib VIII
field 1	-6,01 / 6,01	-6,02 / 6,02	-4,10 / 4,10

dimensioning transverse forces due to permanent load + wind load $-Q_{E,d(g+w)}$ / $+Q_{E,d(g+w)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-4,82 / 4,82	-7,87 / 7,87	-7,69 / 7,69	-7,69 / 7,69	-7,69 / 7,69

	rib VI	rib VII	rib VIII
field 1	-7,69 / 7,69	-7,69 / 7,69	-5,25 / 5,25

nominal moments as a result of permanent load $-M_{E,d(g)}$ / $+M_{E,d(g)}$ [kNm]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,00 / 5,98	0,00 / 9,77	0,00 / 9,53	0,00 / 9,53	0,00 / 9,53

	rib VI	rib VII	rib VIII
field 1	0,00 / 9,53	0,00 / 9,54	0,00 / 6,51

dimensioning moments due to permanent load + snow load $-M_{E,d(g+s)}$ / $+M_{E,d(g+s)}$ [kNm]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,00 / 8,30	0,00 / 13,56	0,00 / 13,24	0,00 / 13,24	0,00 / 13,24

	rib VI	rib VII	rib VIII
field 1	0,00 / 13,24	0,00 / 13,25	0,00 / 9,03

dimensioning moments due to permanent load + wind load $-M_{E,d(g+w)}$ / $+M_{E,d(g+w)}$ [kNm]

	rib I	rib II	rib III	rib IV	rib V

field 1	0,00 / 10,61	0,00 / 17,33	0,00 / 16,92	0,00 / 16,92	0,00 / 16,92

	rib VI	rib VII	rib VIII
field 1	0,00 / 16,92	0,00 / 16,93	0,00 / 11,55

dimensioning regular forces due to permanent load $-N_{E,d(g)}$ / $+N_{E,d(g)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-0,10 / 0,09	-0,16 / 0,15	-0,15 / 0,15	-0,15 / 0,15	-0,15 / 0,15

	rib VI	rib VII	rib VIII
field 1	-0,15 / 0,15	-0,15 / 0,15	-0,10 / 0,10

dimensioning regular forces of the permanent load + snow load $-N_{E,d(g+s)}$ / $+N_{E,d(g+s)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-0,13 / 0,13	-0,22 / 0,21	-0,21 / 0,20	-0,21 / 0,20	-0,21 / 0,20

	rib VI	rib VII	rib VIII
field 1	-0,21 / 0,20	-0,21 / 0,21	-0,14 / 0,14

dimensioning regular forces of the permanent load + wind load $-N_{E,d(g+w)}$ / $+N_{E,d(g+w)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-0,10 / 0,16	-0,17 / 0,27	-0,16 / 0,26	-0,16 / 0,26	-0,16 / 0,26

	rib VI	rib VII	rib VIII
field 1	-0,16 / 0,26	-0,16 / 0,26	-0,11 / 0,18

<u>evaluation of marginal load capacity:</u>

degree of utilization under permanent load, k_{mod} = 0,60, max eta_Q / eta_M [-]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,54 / 0,37	0,46 / 0,39	0,45 / 0,39	0,45 / 0,39	0,45 / 0,39

	rib VI	rib VII	rib VIII
field 1	0,45 / 0,39	0,45 / 0,40	0,56 / 0,41

utilization rates under permanent load + snow load, k_{mod} = 0,90, max eta_Q / eta_M [-]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,50 / 0,34	0,43 / 0,36	0,42 / 0,36	0,42 / 0,36	0,42 / 0,36

	rib VI	rib VII	rib VIII
field 1	0,42 / 0,36	0,42 / 0,37	0,51 / 0,38

utilization rates under permanent load + wind load, k_{mod} = 0,90, max eta_Q / eta_M [-]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,64 / 0,44	0,55 / 0,46	0,53 / 0,46	0,53 / 0,46	0,53 / 0,46

	rib VI	rib VII	rib VIII
field 1	0,53 / 0,46	0,53 / 0,47	0,66 / 0,48

evaluation - serviceability limit state:

	u_{inst} [mm]	u_{fin} [mm]	$u_{net,fin}$ [mm]
field 1	20,9 (ℓ/421)	28,3 (ℓ/311)	28,3 (ℓ/311)

recommended bend limit values are observed.

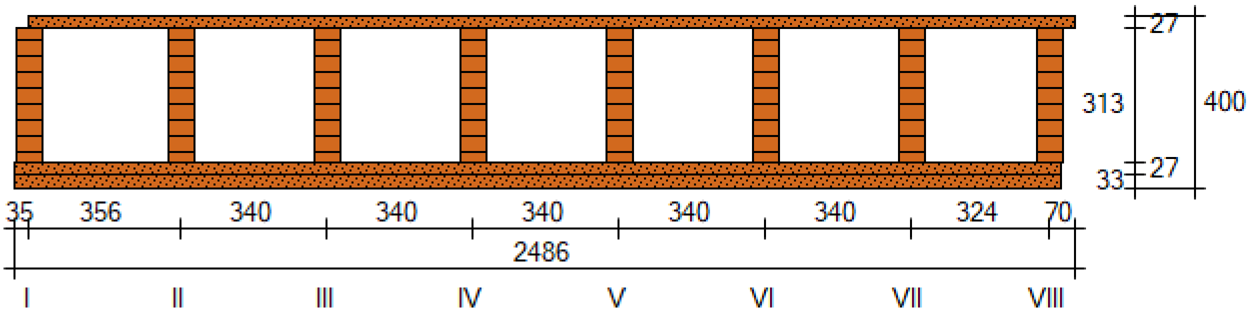
reaction forces:

supports	g_k [kN/m]	s [kN/m]	$w_{k,min}$ [kN/m]	$w_{k,max}$ [kN/m]
a	9,47	3,31	4,94	0,35
b	9,47	3,31	4,95	0,00

assumptions for the computation:

- groundwork: ETA-11/0310, Eurocode 0/1/5 + National Annex Czech Republic
- with lengths of elements ℓ ≤ 6,0m the cover layers are not interrupted with a joint, with l > 6,0 m the cover layers are connected with an inlay joint
- strength and stiffness parameters according to EN 14080
- all butt joints between the individual elements of the panel are glued along the whole surface
- The cross joints are permitted only in the area of compression and bending.
- The data on load capacity limit state: proof and assessment of each individual partition. When assessing individual partitions (element strip), it is considered as an internal partition (full failure modes)
- assessment of serviceability limit state - deflection and vibration: assessment of the entire element, or the entire width of the element (only belt assessment with the belt of the element)

section:



element height: 400 mm

element width: 2485,5 mm

top belt material: SWP 9/9/9

bottom belt material: SWP 9/9/9

2nd bottom belt material: SWP 9/9/9

class of application / KLED: 1 / medium

psi_0_s / psi_2_s: 0,50 / 0,00

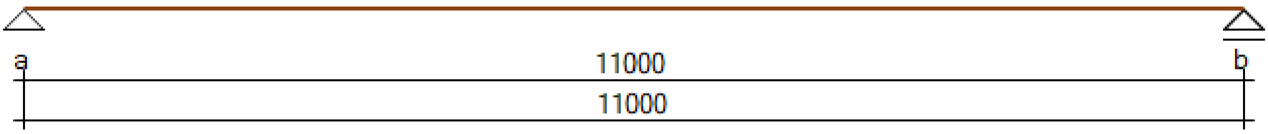
psi_0_w / psi_2_w: 0,60 / 0,00

rib	material	overhang OG [mm]	overhang UG [mm]	span of ribs [mm]
I	Gl32h, b = 60 mm	0,0	35,0	356,5
II	Gl32h, b = 60 mm	-	-	340,0
III	Gl32h, b = 60 mm	-	-	340,0
IV	Gl32h, b = 60 mm	-	-	340,0
V	Gl32h, b = 60 mm	-	-	340,0
VI	Gl32h, b = 60 mm	-	-	340,0
VII	Gl32h, b = 60 mm	-	-	324,0

VIII	Gl32h, b = 60 mm	70,0	35,0	-

The dimensions in the table are measured on the axis

<u>static scheme and load: Roof element, Element pitch 2°</u>



Warning: The specified lengths of the fields are lengths designed to the ground plan.

	ℓ [mm]	g_k [kN/m²]	s [kN/m²] *	w_k [kN/m²]	G_k [kN/m]	x_G [mm]
field 1	11000	2,22	0,75	1,12	0,00	0

the table contains the following loads: dead weight 0,73 kN/m2, filling 0 kg/m2

** Snow load s includes the roof shape coefficient.*

<u>parameters of the load capacity and the load:</u>

characteristic load capacity of the shear force at the negative/positive bending moment $-Q_{R,k}$ / $+Q_{R,k}$ [kN] for N = 0 kN

	rib I	rib II	rib III	rib IV	rib V
field 1	15,36	28,27	28,39	28,39	28,39

	rib VI	rib VII	rib VIII
field 1	28,39	28,50	16,41

characteristic moment load capacity at the negative/positive bending moment $-M_{R,k}$ / $+M_{R,k}$ [kNm] for N = 0 kN

	rib I	rib II	rib III	rib IV	rib V
field 1	45,90 / 50,98	65,76 / 76,42	64,75 / 74,93	64,75 / 74,93	64,75 / 74,93

	rib VI	rib VII	rib VIII
field 1	64,75 / 74,93	63,77 / 73,48	49,76 / 50,52

effective bending stiffness at the negative/positive bending moment $-EI_{ef}$ / $+EI_{ef}$ [$\cdot 10^{11}$ Nmm²]

	rib I	rib II	rib III	rib IV	rib V
field 1	61,03	89,29	87,75	87,75	87,75

	rib VI	rib VII	rib VIII
field 1	87,75	86,25	63,36

governing internal forces:

nominal shear forces as a result of permanent load $-Q_{E,d(g)}$ / $+Q_{E,d(g)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-3,52 / 3,52	-5,74 / 5,74	-5,61 / 5,61	-5,61 / 5,61	-5,61 / 5,61

	rib VI	rib VII	rib VIII
field 1	-5,61 / 5,61	-5,61 / 5,61	-3,83 / 3,83

dimensioning transverse forces due to permanent load + snow load $-Q_{E,d(g+s)}$ / $+Q_{E,d(g+s)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-4,84 / 4,84	-7,90 / 7,90	-7,71 / 7,71	-7,71 / 7,71	-7,71 / 7,71

	rib VI	rib VII	rib VIII
field 1	-7,71 / 7,71	-7,72 / 7,72	-5,26 / 5,26

dimensioning transverse forces due to permanent load + wind load $-Q_{E,d(g+w)}$ / $+Q_{E,d(g+w)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-6,15 / 6,15	-10,04 / 10,04	-9,80 / 9,80	-9,80 / 9,80	-9,80 / 9,80

	rib VI	rib VII	rib VIII
field 1	-9,80 / 9,80	-9,81 / 9,81	-6,69 / 6,69

nominal moments as a result of permanent load $-M_{E,d(g)}$ / $+M_{E,d(g)}$ [kNm]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,00 / 9,68	0,00 / 15,81	0,00 / 15,43	0,00 / 15,43	0,00 / 15,43

	rib VI	rib VII	rib VIII
field 1	0,00 / 15,43	0,00 / 15,44	0,00 / 10,53

dimensioning moments due to permanent load + snow load $-M_{E,d(g+s)}$ / $+M_{E,d(g+s)}$ [kNm]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,00 / 13,31	0,00 / 21,73	0,00 / 21,22	0,00 / 21,22	0,00 / 21,22

	rib VI	rib VII	rib VIII
field 1	0,00 / 21,22	0,00 / 21,23	0,00 / 14,48

dimensioning moments due to permanent load + wind load $-M_{E,d(g+w)}$ / $+M_{E,d(g+w)}$ [kNm]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,00 / 16,92	0,00 / 27,63	0,00 / 26,98	0,00 / 26,98	0,00 / 26,98

	rib VI	rib VII	rib VIII
field 1	0,00 / 26,98	0,00 / 27,00	0,00 / 18,41

dimensioning regular forces due to permanent load $-N_{E,d(g)}$ / $+N_{E,d(g)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-0,13 / 0,13	-0,21 / 0,21	-0,20 / 0,20	-0,20 / 0,20	-0,20 / 0,20

	rib VI	rib VII	rib VIII
field 1	-0,20 / 0,20	-0,20 / 0,20	-0,14 / 0,14

dimensioning regular forces of the permanent load + snow load $-N_{E,d(g+s)}$ / $+N_{E,d(g+s)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-0,18 / 0,18	-0,29 / 0,29	-0,28 / 0,28	-0,28 / 0,28	-0,28 / 0,28

	rib VI	rib VII	rib VIII
field 1	-0,28 / 0,28	-0,28 / 0,28	-0,19 / 0,19

dimensioning regular forces of the permanent load + wind load $-N_{E,d(g+w)}$ / $+N_{E,d(g+w)}$ [kN]

	rib I	rib II	rib III	rib IV	rib V
field 1	-0,14 / 0,22	-0,22 / 0,37	-0,22 / 0,36	-0,22 / 0,36	-0,22 / 0,36

	rib VI	rib VII	rib VIII
field 1	-0,22 / 0,36	-0,22 / 0,36	-0,15 / 0,24

evaluation of marginal load capacity:

degree of utilization under permanent load, k_{mod} = 0,60, max eta_Q / eta_M [-]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,50 / 0,41	0,44 / 0,45	0,43 / 0,45	0,43 / 0,45	0,43 / 0,45

	rib VI	rib VII	rib VIII
field 1	0,43 / 0,45	0,43 / 0,46	0,51 / 0,45

utilization rates under permanent load + snow load, k_{mod} = 0,90, max eta_Q / eta_M [-]

	rib I	rib II	rib III	rib IV	rib V

field 1	0,46 / 0,38	0,40 / 0,41	0,39 / 0,41	0,39 / 0,41	0,39 / 0,41

	rib VI	rib VII	rib VIII
field 1	0,39 / 0,41	0,39 / 0,42	0,46 / 0,41

utilization rates under permanent load + wind load, k_{mod} = 0,90, max eta_Q / eta_M [-]

	rib I	rib II	rib III	rib IV	rib V
field 1	0,58 / 0,48	0,51 / 0,52	0,50 / 0,52	0,50 / 0,52	0,50 / 0,52

	rib VI	rib VII	rib VIII
field 1	0,50 / 0,52	0,50 / 0,53	0,59 / 0,53

evaluation - serviceability limit state:

	u_{inst} [mm]	u_{fin} [mm]	$u_{net,fin}$ [mm]
field 1	28,4 (ℓ/387)	38,6 (ℓ/285)	38,6 (ℓ/285)

recommended bend limit values are observed.

reaction forces:

supports	g_k [kN/m]	s [kN/m]	$w_{k,min}$ [kN/m]	$w_{k,max}$ [kN/m]
a	12,27	4,14	6,17	0,42
b	12,27	4,14	6,19	0,00

F01 - foundation footings, plain concrete, monolithic (under Floor No.1)

Calculation of soil (foundation) settlement:

B	0,6 m	soil	F1 (solid)
L	0,6 m	γ_1	19 kN/m^3
D	0,9 m	E_{def}	30 MPa
γ_1	19 kN/m^3	β	0,62 kN/m^3
V_k	187,5 kN		

L/B	1
σ_{ol}	503,817 kPa

z_{ic}	14,1 m

a) without influence of the foundation depth

i	h_i [m]	z_i [m]	γ_i [kN/m^3]	$E_{oed,i}$ [MPa]	m_i	$\sigma_{or,i}$ [kPa]	z_i/B	I_{CH}	σ_{zi} [kPa]	s_i [mm]
1	0,4	0,20	19	48,39	0,3	20,9	0,333	0,86	433,28	3,53
2	0,4	0,40	19	48,39	0,3	24,7	0,667	0,61	307,33	2,48
3	0,5	0,65	19	48,39	0,3	29,45	1,083	0,46	231,76	2,30
4	0,5	0,90	19	48,39	0,3	34,2	1,500	0,36	181,37	1,77
5	0,5	1,15	19	48,39	0,3	38,95	1,917	0,30	151,15	1,44
6	0,5	1,40	19	48,39	0,3	43,7	2,333	0,26	130,99	1,22
7	0,5	1,65	19	48,39	0,3	48,45	2,750	0,22	110,84	1,00
8	0,5	1,90	19	48,39	0,3	53,2	3,167	0,20	100,76	0,88
10	0,5	2,15	19	48,39	0,3	57,95	3,583	0,18	90,69	0,76
11	0,5	2,40	19	48,39	0,3	62,7	4,000	0,16	80,61	0,64
12	0,5	2,65	19	48,39	0,3	67,45	4,417	0,14	70,53	0,52
13	0,5	2,90	19	48,39	0,3	72,2	4,833	0,12	60,46	0,40
14	0,5	3,15	19	48,39	0,3	76,95	5,250	0,10	50,38	0,28
15	0,5	3,40	19	48,39	0,3	81,7	5,667	0,09	45,34	0,22
16	0,5	3,65	19	48,39	0,3	86,45	6,083	0,08	40,31	0,15
17	0,5	3,90	19	48,39	0,3	91,2	6,500	0,07	35,27	0,08
18	0,5	4,15	19	48,39	0,3	95,95	6,917	0,06	30,23	0,01
										17,67

b) with influence of the foundation depth

i	h_i	z_i [m]	γ_i [kN/m^3]	$E_{oed,i}$ [MPa]	m_i	$\sigma_{or,i}$ [kPa]	D/zi	κ1	z_{ic}/z_i	κ2	z_R/B	I_{CH}	σ_{zi} [kPa]	s_i [mm]
1	0,4	0,20	19	48,39	0,3	20,9	4,500	1,50	70,500	1,00	0,50	0,7	352,67	2,86
2	0,4	0,40	19	48,39	0,3	24,7	2,250	1,45	35,250	1,00	0,97	0,46	231,76	1,85
3	0,5	0,65	19	48,39	0,3	29,45	1,385	1,40	21,692	1,00	1,51	0,33	166,26	1,63
4	0,5	0,90	19	48,39	0,3	34,2	1,000	1,35	15,667	1,00	2,02	0,26	130,99	1,25
5	0,5	1,15	19	48,39	0,3	38,95	0,783	1,31	12,261	1,00	2,51	0,23	115,88	1,08
6	0,5	1,40	19	48,39	0,3	43,7	0,643	1,27	10,071	1,00	2,97	0,18	90,69	0,80
7	0,5	1,65	19	48,39	0,3	48,45	0,545	1,25	8,545	1,00	3,43	0,16	80,61	0,68
8	0,5	1,90	19	48,39	0,3	53,2	0,474	1,22	7,421	1,00	3,87	0,14	70,53	0,56
9	0,5	2,15	19	48,39	0,3	57,95	0,419	1,20	6,558	1,00	4,30	0,12	60,46	0,45
10	0,5	2,40	19	48,39	0,3	62,7	0,375	1,18	5,875	1,00	4,74	0,11	55,42	0,38
11	0,5	2,65	19	48,39	0,3	67,45	0,340	1,17	5,321	1,00	5,16	0,1	50,38	0,31
12	0,5	2,90	19	48,39	0,3	72,2	0,310	1,16	4,862	1,00	5,59	0,09	45,34	0,24
13	0,5	3,15	19	48,39	0,3	76,95	0,286	1,15	4,476	1,00	6,01	0,08	40,31	0,18
14	0,5	3,40	19	48,39	0,3	81,7	0,265	1,14	4,147	1,00	6,42	0,07	35,27	0,11
15	0,5	3,65	19	48,39	0,3	86,45	0,247	1,13	3,863	1,00	6,83	0,06	30,23	0,04
														12,43

F02 - foundation strips, plain concrete, monolithic (under Floor No.1)

Calculation of soil (foundation) settlement:

B	0,4	m
L	1	m
D	0,9	m
γ_1	19	kN/m^3
V_k	59,26	kN

soil	F1 (solid)	
γ_1	19	kN/m^3
E_{def}	30	MPa
β	0,62	kN/m^3

L/B	2,5	
σ_{ol}	131,050	kPa

z_{ic}	14,1	m

a) without influence of the foundation depth

i	h_i [m]	z_i [m]	γ_i [kN/m^3]	$E_{oed,i}$ [MPa]	m_i	$\sigma_{or,i}$ [kPa]	z_i/B	I_{CH}	σ_{zi} [kPa]	s_i [mm]
1	0,4	0,20	19	48,39	0,3	20,9	0,500	0,86	112,70	0,88
2	0,4	0,40	19	48,39	0,3	24,7	1,000	0,61	79,94	0,60
3	0,5	0,65	19	48,39	0,3	29,45	1,625	0,46	60,28	0,53
4	0,5	0,90	19	48,39	0,3	34,2	2,250	0,36	47,18	0,38
5	0,5	1,15	19	48,39	0,3	38,95	2,875	0,30	39,32	0,29
6	0,5	1,40	19	48,39	0,3	43,7	3,500	0,26	34,07	0,22
7	0,5	1,65	19	48,39	0,3	48,45	4,125	0,22	28,83	0,15
8	0,5	1,90	19	48,39	0,3	53,2	4,750	0,20	26,21	0,11
10	0,5	2,15	19	48,39	0,3	57,95	5,375	0,18	23,59	0,06
11	0,5	2,40	19	48,39	0,3	62,7	6,000	0,16	20,97	0,02
										3,23

b) with influence of the foundation depth

i	h_i	z_i [m]	γ_i [kN/m^3]	$E_{oed,i}$ [MPa]	m_i	$\sigma_{or,i}$ [kPa]	D/zi	κ1	z_{ic}/z_i	κ2	z_R/B	I_{CH}	σ_{zi} [kPa]	s_i [mm]
1	0,4	0,20	19	48,39	0,3	20,9	4,500	1,50	70,500	1,00	0,75	0,7	91,74	0,71
2	0,4	0,40	19	48,39	0,3	24,7	2,250	1,45	35,250	1,00	1,45	0,46	60,28	0,44
3	0,5	0,65	19	48,39	0,3	29,45	1,385	1,40	21,692	1,00	2,27	0,33	43,25	0,36
4	0,5	0,90	19	48,39	0,3	34,2	1,000	1,35	15,667	1,00	3,04	0,26	34,07	0,25
5	0,5	1,15	19	48,39	0,3	38,95	0,783	1,31	12,261	1,00	3,76	0,23	30,14	0,19
6	0,5	1,40	19	48,39	0,3	43,7	0,643	1,27	10,071	1,00	4,46	0,18	23,59	0,11
7	0,5	1,65	19	48,39	0,3	48,45	0,545	1,25	8,545	1,00	5,14	0,16	20,97	0,07
8	0,5	1,90	19	48,39	0,3	53,2	0,474	1,22	7,421	1,00	5,80	0,14	18,35	0,02
														2,14

F03 - foundation strips, plain concrete, monolithic (under Underground floor No.1)

Calculation of soil (foundation) settlement:

B	0,4	m
L	1	m
D	4,4	m
γ_1	19	kN/m^3
V_k	106,5	kN

soil	F1 (solid)	
γ_1	19	kN/m^3
E_{def}	30	MPa
β	0,62	kN/m^3

L/B	2,5	
σ_{ol}	182,550	kPa

z_{ic}	10,6	m

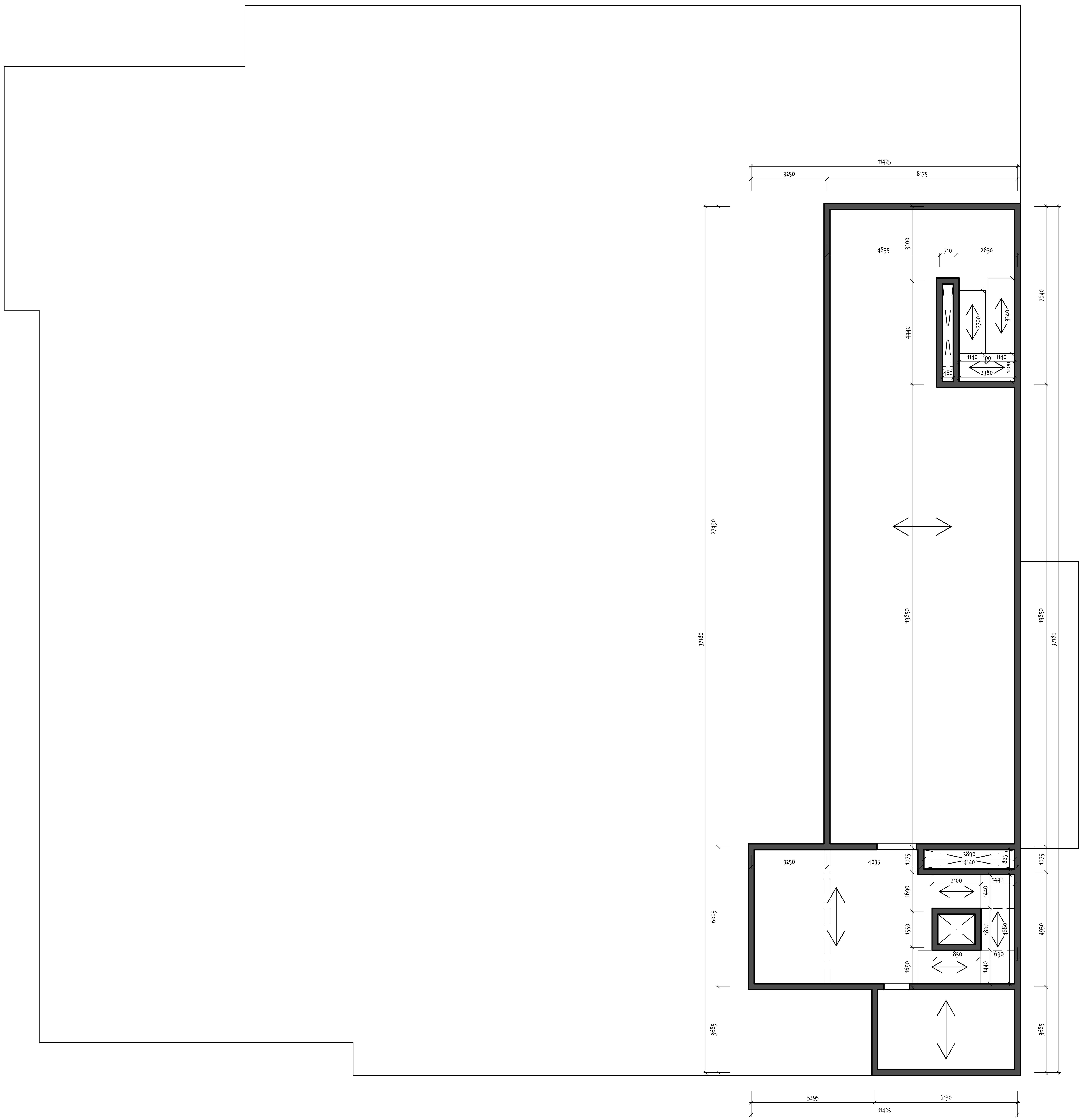
a) without influence of the foundation depth

i	h_i [m]	z_i [m]	γ_i [kN/m^3]	$E_{oed,i}$ [MPa]	m_i	$\sigma_{or,i}$ [kPa]	z_i/B	I_{CH}	σ_{zi} [kPa]	s_i [mm]
1	0,4	0,20	19	48,39	0,3	87,4	0,500	0,86	156,99	1,08
2	0,4	0,40	19	48,39	0,3	91,2	1,000	0,61	111,36	0,69
3	0,5	0,65	19	48,39	0,3	95,95	1,625	0,46	83,97	0,57
4	0,5	0,90	19	48,39	0,3	100,7	2,250	0,36	65,72	0,37
5	0,5	1,15	19	48,39	0,3	105,45	2,875	0,30	54,77	0,24
6	0,5	1,40	19	48,39	0,3	110,2	3,500	0,26	47,46	0,15
7	0,5	1,65	19	48,39	0,3	114,95	4,125	0,22	40,16	0,06
8	0,5	1,90	19	48,39	0,3	119,7	4,750	0,20	36,51	0,01
										3,17

b) with influence of the foundation depth

i	h_i	z_i [m]	γ_i [kN/m^3]	$E_{oed,i}$ [MPa]	m_i	$\sigma_{or,i}$ [kPa]	D/zi	κ1	z_{ic}/z_i	κ2	z_R/B	I_{CH}	σ_{zi} [kPa]	s_i [mm]
1	0,4	0,20	19	48,39	0,3	87,4	22,000	1,50	53,000	1,00	0,75	0,7	127,79	0,84
2	0,4	0,40	19	48,39	0,3	91,2	11,000	1,53	26,500	1,00	1,53	0,46	83,97	0,47
3	0,5	0,65	19	48,39	0,3	95,95	6,769	1,52	16,308	1,00	2,46	0,33	60,24	0,33
4	0,5	0,90	19	48,39	0,3	100,7	4,889	1,50	11,778	1,00	3,38	0,26	47,46	0,18
5	0,5	1,15	19	48,39	0,3	105,45	3,826	1,49	9,217	1,00	4,29	0,23	41,99	0,11
6	0,5	1,40	19	48,39	0,3	110,2	3,143	1,48	7,571	1,00	5,18	0,19	34,68	0,02
														1,93

UNDERGROUND FLOOR No.1



MATERIAL SOLUTION:

- LOAD-BEARING WALLS: (black box theatre) — reinforced concrete, monolithic, thickness TBD; C30/37 XC1 (CZ) - Cl 0,2 - D_{max} 16 - S3
- LOAD-BEARING WALLS: (underground floor) — reinforced concrete, 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) — reinforced concrete, 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) — reinforced concrete, 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) — reinforced concrete, 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 concrete, monolithic, dimensions TBD; C25/30 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3

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
  - 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)

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

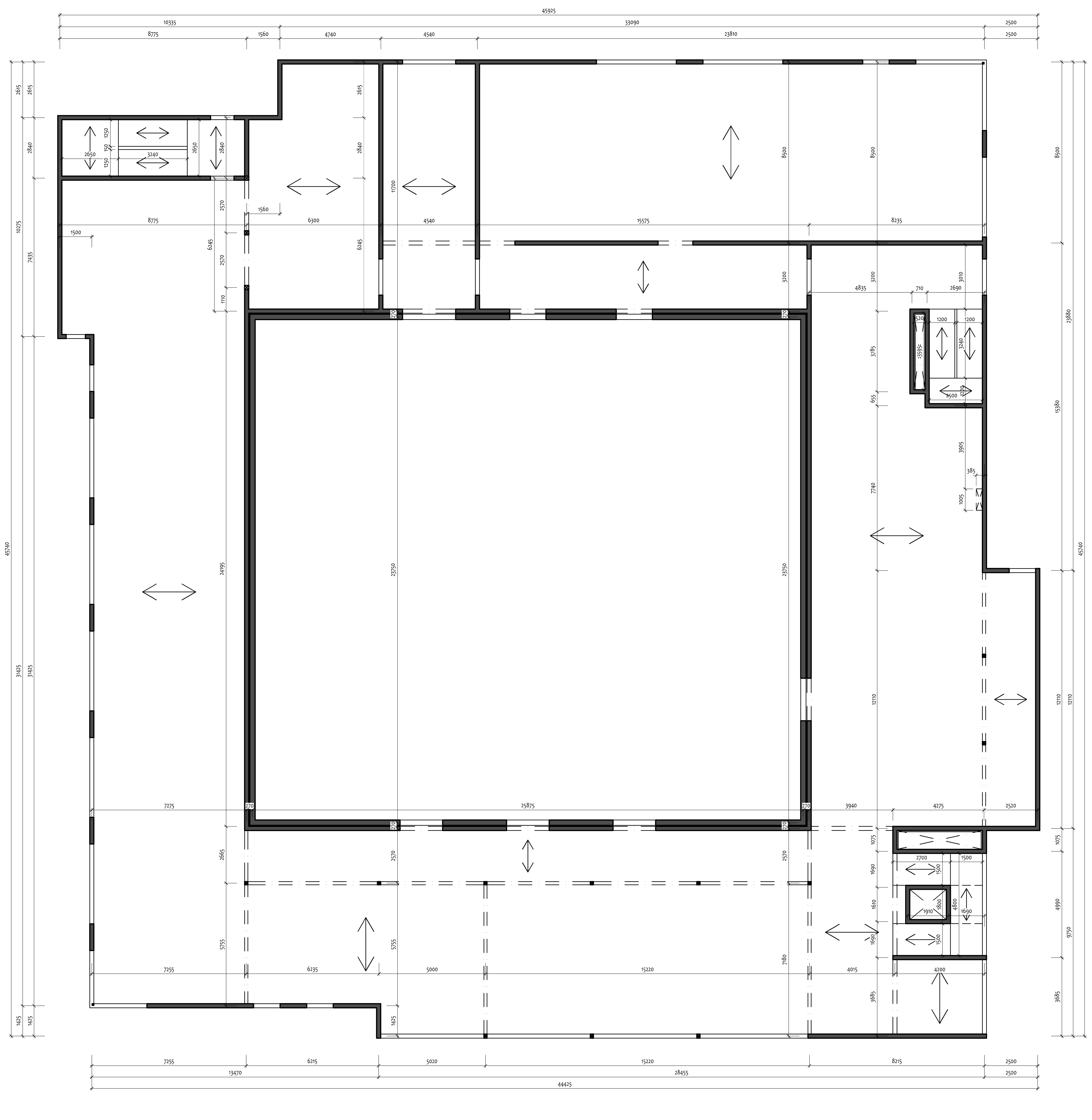
NOTES:

- The black box theatre space will be separated from the rest of the building to break the acoustic bridges. This applies to the walls, roof, floor and foundations, an air gap of at least 50 mm will be left between the walls of the black box theatre and the rest of the building..
- The thicknesses and dimensions of the individual structures will be specified in the preliminary static calculation.
- 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.
- 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.)

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	8 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	D.1.2 STRUCTURAL DESIGN	SCALE	NO.
CONTENT	STRUCTURAL SYSTEM - UG FL No.1	1:100	D.1.2-1

FLOOR No.1



MATERIAL SOLUTION:

- LOAD-BEARING WALLS: (black box theatre) — reinforced concrete, monolithic, thickness TBD; C30/37 XC1 (CZ) - Cl 0,2 - D_{max} 16 - S3
- LOAD-BEARING WALLS: (underground floor) — reinforced concrete, 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) — reinforced concrete, 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) — reinforced concrete, 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) — reinforced concrete, 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 concrete, monolithic, dimensions TBD; C25/30 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3

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
  - 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)

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

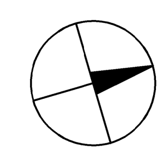
FOUNDATIONS:
- CONCRETE C25/30 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3

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

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

NOTES:

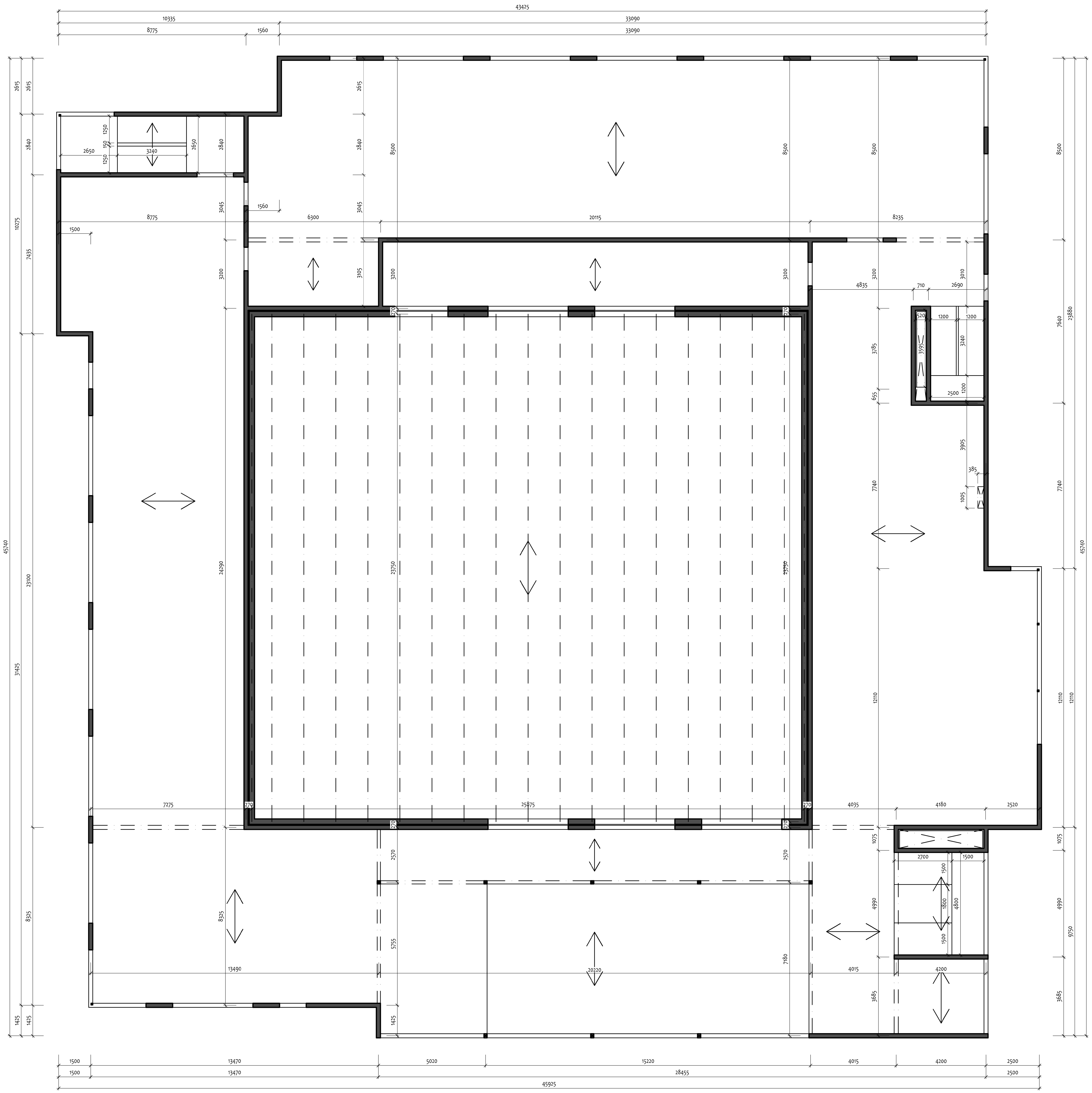
- The black box theatre space will be separated from the rest of the building to break the acoustic bridges. This applies to the walls, roof, floor and foundations, an air gap of at least 50 mm will be left between the walls of the black box theatre and the rest of the building..
- The thicknesses and dimensions of the individual structures will be specified in the preliminary static calculation.
- 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.
- 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.)

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	8 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	D.1.2 STRUCTURAL DESIGN	SCALE	NO.
CONTENT	STRUCTURAL SYSTEM - FL No.1	1:100	D.1.2-2

FLOOR No.2



MATERIAL SOLUTION:

- LOAD-BEARING WALLS: (black box theatre) — reinforced concrete, monolithic, thickness TBD; C30/37 XC1 (CZ) - Cl 0,2 - D_{max} 16 - S3
- LOAD-BEARING WALLS: (underground floor) — reinforced concrete, 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) — reinforced concrete, 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) — reinforced concrete, 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) — reinforced concrete, 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 concrete, monolithic, dimensions TBD; C25/30 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3

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
  - 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)

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

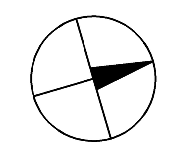
FOUNDATIONS:
- CONCRETE C25/30 XC2 (CZ) - Cl 0,2 - D_{max} 16 - S3

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

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

NOTES:

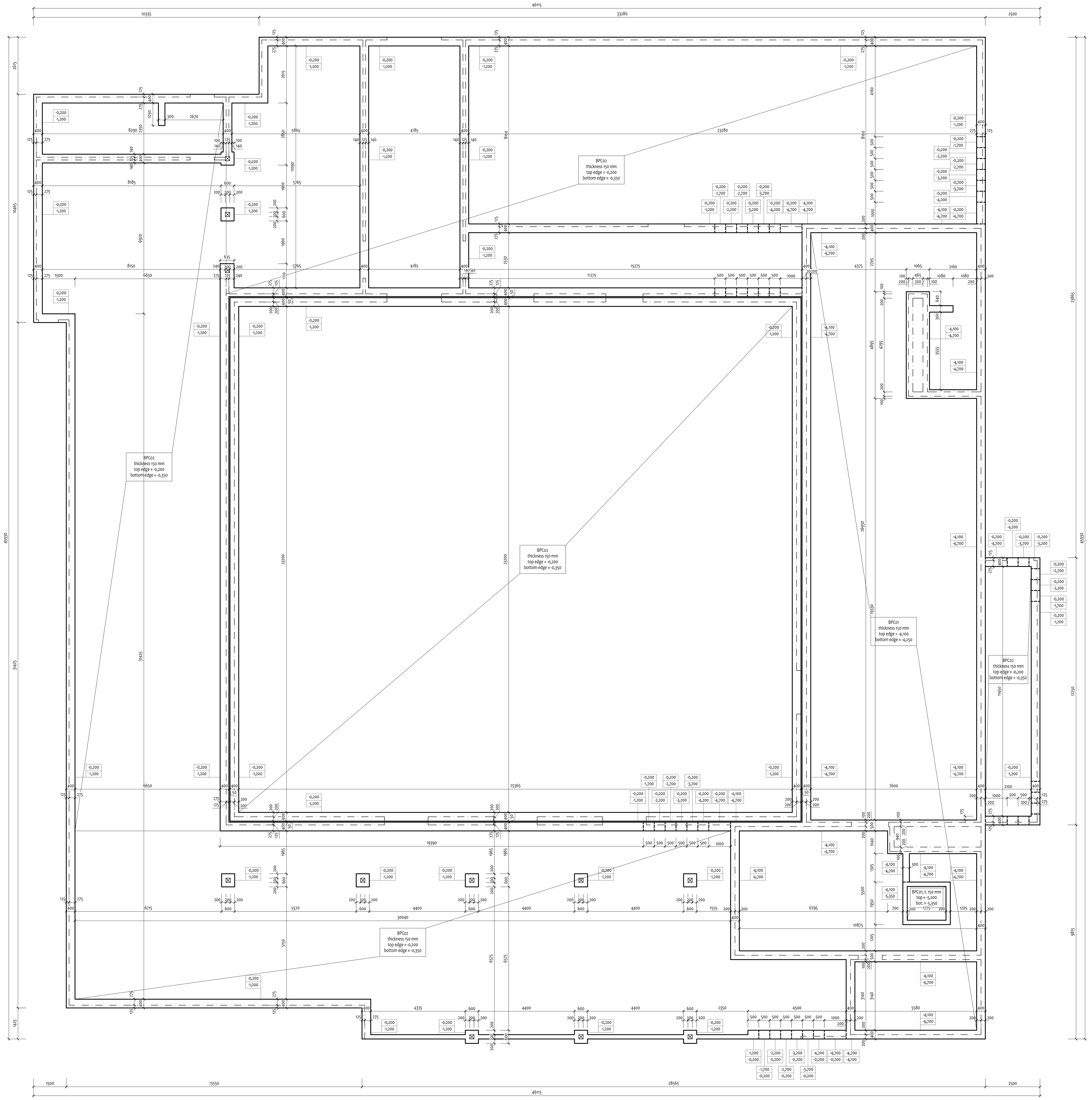
- The black box theatre space will be separated from the rest of the building to break the acoustic bridges. This applies to the walls, roof, floor and foundations, an air gap of at least 50 mm will be left between the walls of the black box theatre and the rest of the building..
- The thicknesses and dimensions of the individual structures will be specified in the preliminary static calculation.
- 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.
- 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.)

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	8 x A4
LOCATION	Czech Republic - Vodňany	DATE	10/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	D.1.2 STRUCTURAL DESIGN	SCALE	NO.
CONTENT	STRUCTURAL SYSTEM - FL No.2	1:100	D.1.2-3

FOUNDATIONS



LEGEND OF THE ELEMENTS:

BASE PLAIN CONCRETE:

BPC01 base plain concrete, reinforced concrete, monolithic, thickness 150 mm

BPC02 base plain concrete, reinforced concrete, monolithic, thickness 150 mm

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

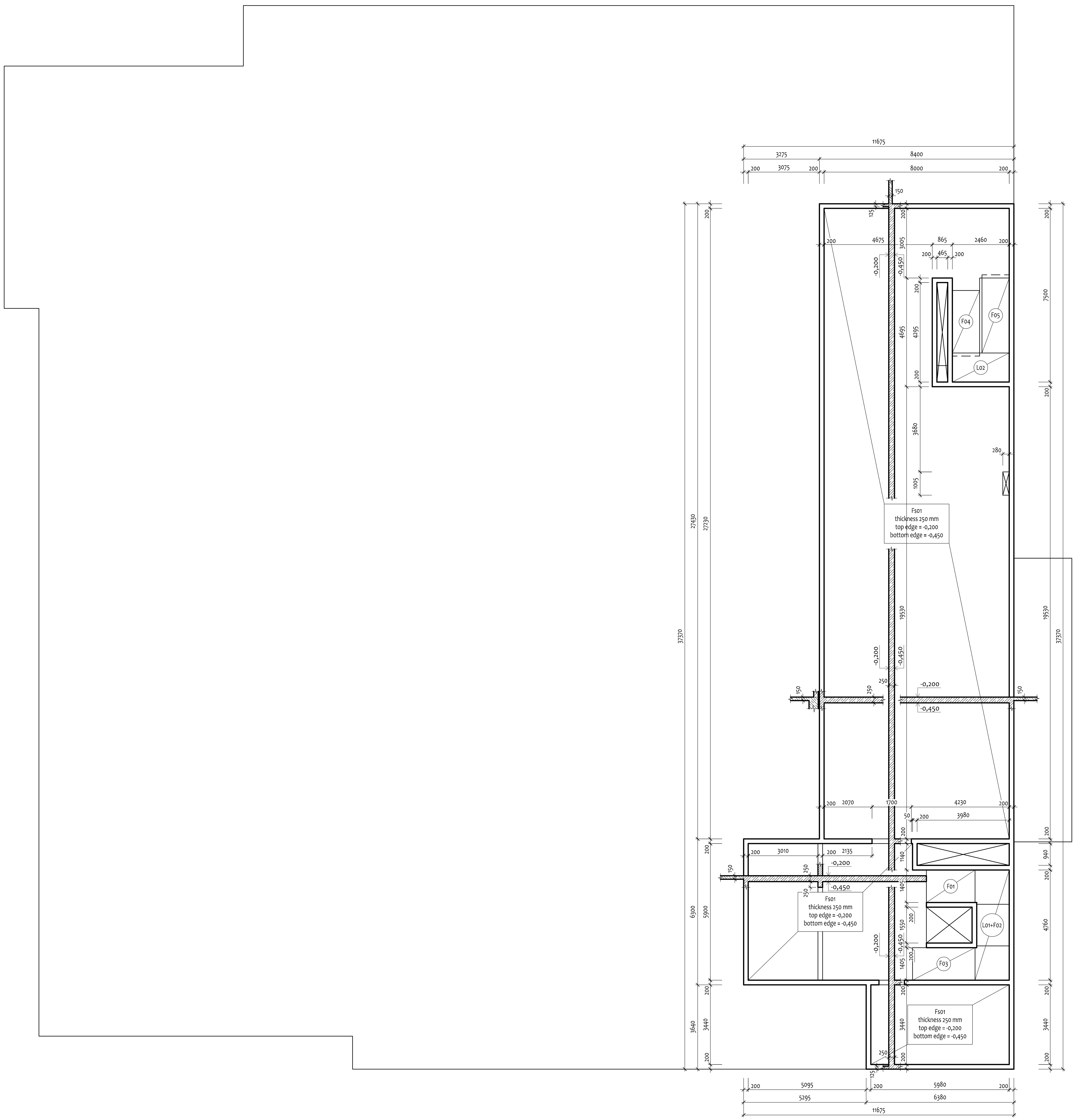
NOTES:

- min. covering layer of reinforcement c = 25 mm
- The black box theatre space will be separated from the rest of the building to break the acoustic bridges. This applies to the walls, roof, floor and foundations, an air gap of at least 50 mm will be left between the walls of the black box theatre and the rest of the building.
- 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.)

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	16 x A4
LOCATION	Czech Republic - Vodňany	DATE	11/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	D.1.2 STRUCTURAL DESIGN	SCALE	NO.
CONTENT	LOAD-BEARING STRUCT. LAYOUT - FOUNDATIONS	1:75	D.1.2-4

UNDERGROUND FLOOR No.1



LEGEND OF THE ELEMENTS:

		UNITS
FLOOR SLABS:		
FS01	floor slab, reinforced concrete, monolithic, thickness 250 mm	
STAIRCASE ELEMENTS:		
L01	staircase landing, reinforced concrete, prefabricated	2
L02	staircase landing, reinforced concrete, prefabricated	1
F01	staircase flight, reinforced concrete, prefabricated	1
F02	staircase flight, reinforced concrete, prefabricated	1
F03	staircase flight, reinforced concrete, prefabricated	1
F04	staircase flight, reinforced concrete, prefabricated	1
F05	staircase flight, reinforced concrete, prefabricated	1

WALLS:

all load-bearing walls will be made from RC C30/37 XC2, monolithic, thickness 250 mm

BEAMS:

all beams will be made from reinforced concrete, monolithic, 500 x 200 mm

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

LEGEND OF THE MATERIALS:

- CLT C24 wooden panel (NOVATOP SOLID) + KVH C24 wooden column
- C30/37 XC2 reinforced concrete
- C25/30 XC2 plain concrete

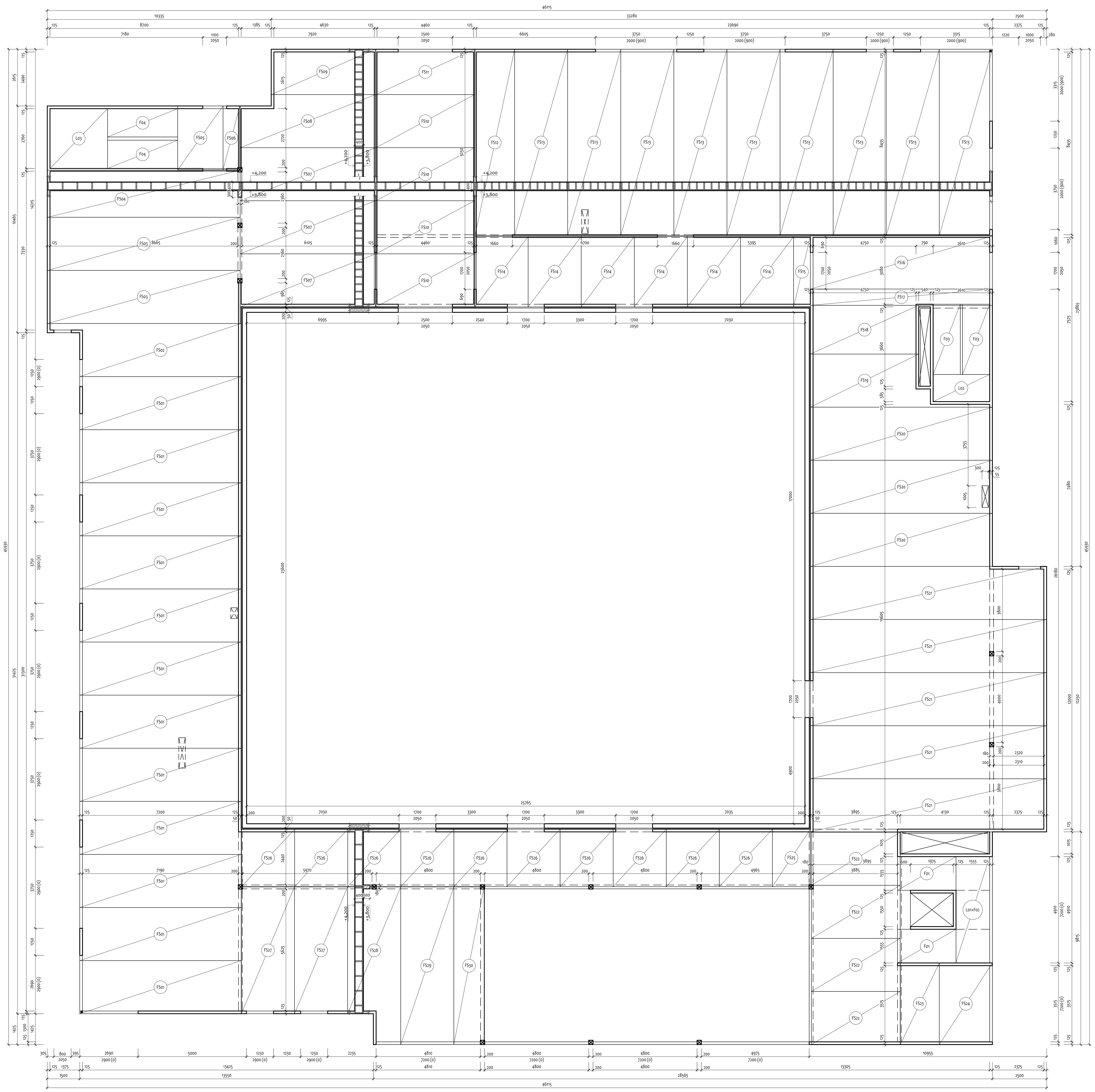
NOTES:

- min. covering layer of reinforcement c = 25 mm
- The black box theatre space will be separated from the rest of the building to break the acoustic bridges. This applies to the walls, roof, floor and foundations, an air gap of at least 50 mm will be left between the walls of the black box theatre and the rest of the building.
- 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.)

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	8 x A4
LOCATION	Czech Republic - Vodňany	DATE	11/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	D.1.2 STRUCTURAL DESIGN	SCALE	NO.
CONTENT	LOAD-BEARING STRUCTURES LAYOUT - UG FL No.1	1:100	D.1.2-5

FLOOR No.1



LEGEND OF THE ELEMENTS:

FLOOR SLABS:		UNITS
FS01	NOVATOP ELEMENT, thickness 400 mm, 7450 x 2450 mm	12
FS02	custom-made NOVATOP ELEMENT, thickness 400 mm, 8950 x 2450 mm	1
FS03	NOVATOP ELEMENT, thickness 400 mm, 8900 x 2450 mm	2
FS04	custom-made NOVATOP ELEMENT, thickness 400 mm, 2175 x 2450 mm	1
FS05	NOVATOP ELEMENT, thickness 400 mm, 2950 x 2090 mm	1
FS06	custom-made NOVATOP ELEMENT, thickness 400 mm, 2950 x 775 mm	1
FS07	NOVATOP ELEMENT, thickness 400 mm, 6250 x 2450 mm	3
FS08	custom-made NOVATOP ELEMENT, thickness 400 mm, 6250 x 2450 mm	1
FS09	NOVATOP ELEMENT, thickness 400 mm, 4800 x 2090 mm	1
FS10	NOVATOP ELEMENT, thickness 400 mm, 4550 x 2450 mm	4
FS11	NOVATOP ELEMENT, thickness 400 mm, 4550 x 2090 mm	1
FS12	custom-made NOVATOP ELEMENT, thickness 400 mm, 8600 x 1825 mm	1
FS13	NOVATOP ELEMENT, thickness 400 mm, 8600 x 2450 mm	9
FS14	NOVATOP ELEMENT, thickness 400 mm, 3250 x 2450 mm	6
FS15	custom-made NOVATOP ELEMENT, thickness 400 mm, 775 x 2450 mm	1
FS16	NOVATOP ELEMENT, thickness 400 mm, 8400 x 2450 mm	1
FS17	custom-made NOVATOP ELEMENT, thickness 400 mm, 8400 x 750 mm	1
FS18	custom-made NOVATOP ELEMENT, thickness 400 mm, 5000 x 2250 mm	1
FS19	custom-made NOVATOP ELEMENT, thickness 400 mm, 8400 x 2450 mm	1
FS20	NOVATOP ELEMENT, thickness 400 mm, 8400 x 2450 mm	3
FS21	NOVATOP ELEMENT, thickness 400 mm, 10900 x 2450 mm	5
FS22	NOVATOP ELEMENT, thickness 400 mm, 4100 x 2450 mm	4
FS23	custom-made NOVATOP ELEMENT, thickness 400 mm, 3765 x 1800 mm	1
FS24	custom-made NOVATOP ELEMENT, thickness 400 mm, 3765 x 2450 mm	1
FS25	custom-made NOVATOP ELEMENT, thickness 400 mm, 2650 x 1750 mm	1
FS26	NOVATOP ELEMENT, thickness 400 mm, 2650 x 2450 mm	10
FS27	NOVATOP ELEMENT, thickness 400 mm, 5850 x 2450 mm	2
FS28	custom-made NOVATOP ELEMENT, thickness 400 mm, 7275 x 2450 mm	1
FS29	custom-made NOVATOP ELEMENT, thickness 400 mm, 7275 x 2450 mm	1
FS30	custom-made NOVATOP ELEMENT, thickness 400 mm, 7275 x 1400 mm	1
STAIRCASE ELEMENTS:		
L01	staircase landing, supported by wooden staircase beams, wooden	2
L02	staircase landing, supported by wooden staircase beams, wooden	1
L03	staircase landing, supported by wooden staircase beams, wooden	1
F01	staircase flight, supported by wooden staircase beams, wooden	2
F02	staircase flight, supported by wooden staircase beams, wooden	1
F03	staircase flight, supported by wooden staircase beams, wooden	2
F04	staircase flight, supported by wooden staircase beams, wooden	2

WALLS:

all load-bearing walls will be made as wooden panels NOVATOP SOLID, thickness 124 mm

COLUMNS:

all columns will be made from wood KVH C24, 200 x 200 mm

BEAMS:

all beams will be made from wood BSH GL30, 300 x 180 mm

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

LEGEND OF THE MATERIALS:

- CLT C24 wooden panel (NOVATOP SOLID)
- SWP + BSH GL32h wooden floor slab (NOVATOP ELEMENT)
- BSH GL30 wooden beams
- C30/37 XC1 reinforced concrete wall

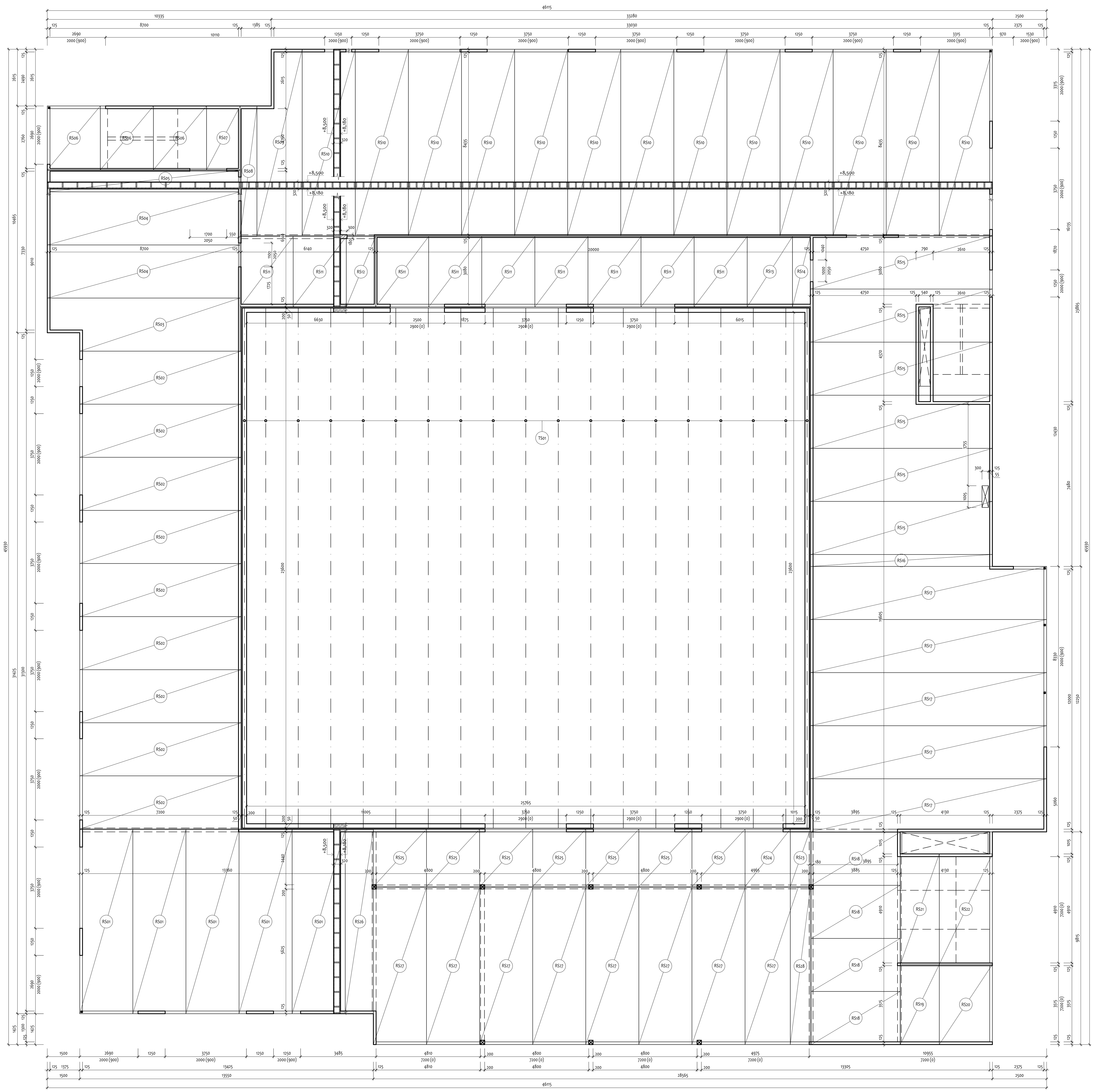
NOTES:

- min. covering layer of reinforcement c = 25 mm
- The black box theatre space will be separated from the rest of the building to break the acoustic bridges. This applies to the walls, roof, floor and foundations, an air gap of at least 50 mm will be left between the walls of the black box theatre and the rest of the building.
- the minimum width of installation of the NOVATOP ELEMENT floor slabs on the vertical load-bearing structures is 40 mm
- 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.)

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	16 x A4
LOCATION	Czech Republic - Vodňany	DATE	11/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	D.1.2 STRUCTURAL DESIGN	SCALE	NO.
CONTENT	LOAD-BEARING STRUCTURES LAYOUT - FL No.1	1:75	D.1.2-6

FLOOR No.2



LEGEND OF THE ELEMENTS:

ROOF SLABS:		UNITS
RS01	NOVATOP ELEMENT, thickness 320 mm, 8500 x 2450 mm	5
RS02	NOVATOP ELEMENT, thickness 320 mm, 7450 x 2450 mm	9
RS03	custom-made NOVATOP ELEMENT, thickness 320 mm, 8900 x 2450 mm	1
RS04	NOVATOP ELEMENT, thickness 320 mm, 8900 x 2450 mm	2
RS05	custom-made NOVATOP ELEMENT, thickness 320 mm, 8900 x 1000 mm	1
RS06	NOVATOP ELEMENT, thickness 320 mm, 2950 x 2450 mm	3
RS07	custom-made NOVATOP ELEMENT, thickness 320 mm, 2950 x 1550 mm	1
RS08	custom-made NOVATOP ELEMENT, thickness 320 mm,6000 x 775 mm	1
RS09	custom-made NOVATOP ELEMENT, thickness 320 mm, 8600 x 2090 mm	1
RS10	NOVATOP ELEMENT, thickness 320 mm, 8600 x 2450 mm	13
RS11	NOVATOP ELEMENT, thickness 320 mm, 3250 x 2450 mm	9
RS12	custom-made NOVATOP ELEMENT, thickness 320 mm, 3250 x 1350 mm	1
RS13	custom-made NOVATOP ELEMENT, thickness 320 mm, 3250 x 2090 mm	1
RS14	custom-made NOVATOP ELEMENT, thickness 320 mm, 3250 x 825 mm	1
RS15	NOVATOP ELEMENT, thickness 320 mm, 8400 x 2450 mm	6
RS16	custom-made NOVATOP ELEMENT, thickness 320 mm, 8400 x 550 mm	1
RS17	NOVATOP ELEMENT, thickness 400 mm, 10900 x 2450 mm	5
RS18	NOVATOP ELEMENT, thickness 320 mm, 4100 x 2450 mm	4
RS19	custom-made NOVATOP ELEMENT, thickness 320 mm, 3700 x 1800 mm	1
RS20	NOVATOP ELEMENT, thickness 320 mm, 3700 x 2450 mm	1
RS21	custom-made NOVATOP ELEMENT, thickness 320 mm, 5100 x 1800 mm	1
RS22	NOVATOP ELEMENT, thickness 320 mm, 5100 x 2450 mm	1
RS23	custom-made NOVATOP ELEMENT, thickness 320 mm, 2650 x 925 mm	1
RS24	NOVATOP ELEMENT, thickness 320 mm, 2650 x 2090 mm	1
RS25	NOVATOP ELEMENT, thickness 320 mm, 2650 x 2450 mm	7
RS26	custom-made NOVATOP ELEMENT, thickness 320 mm, 8500 x 1300 mm	1
RS27	NOVATOP ELEMENT, thickness 320 mm, 7250 x 2450 mm	8
RS28	NOVATOP ELEMENT, thickness 320 mm, 7250 x 925 mm	1

WALLS:

all load-bearing walls will be made as wooden panels NOVATOP SOLID, thickness 124 mm

COLUMNS:

all columns will be made from wood KVH C24, 200 x 200 mm

BEAMS:

all beams will be made from wood BSH GL30, 300 x 180 mm

TRUSS BEAMS:

TS01 wooden truss beams KVH/DUO C24 (S4S)

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

LEGEND OF THE MATERIALS:

- CLT C24 wooden panel (NOVATOP SOLID)
- SWP + BSH GL32h wooden floor slab (NOVATOP ELEMENT)
- BSH GL30 wooden beams
- C30/37 XC1 reinforced concrete wall

NOTES:

- min. covering layer of reinforcement c = 25 mm
- The black box theatre space will be separated from the rest of the building to break the acoustic bridges. This applies to the walls, roof, floor and foundations, an air gap of at least 50 mm will be left between the walls of the black box theatre and the rest of the building.
- the minimum width of installation of the NOVATOP ELEMENT floor slabs on the vertical load-bearing structures is 40 mm
- 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.)

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	16 x A4
LOCATION	Czech Republic - Vodňany	DATE	11/2022
BUILDING'S NAME	Community Centre - Vodňany	LEVEL OF PD	DSP
SUBDIVISION	D.1.2 STRUCTURAL DESIGN	SCALE	NO.
CONTENT	LOAD-BEARING STRUCTURES LAYOUT - FL No.2	1:75	D.1.2-7