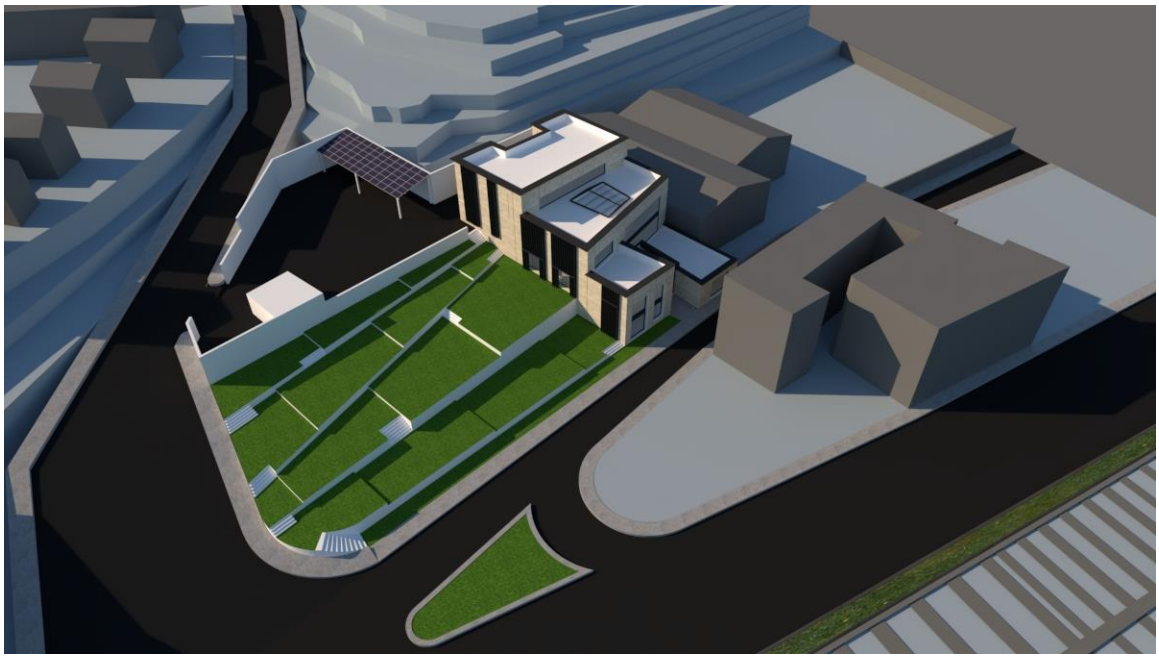
BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS

DEPARTMENT OF URBAN PLANNING AND DESIGN

FACULTY OF ARCHITECTURE



BUDAFOK COWORKING

BUILDING CONSTRUCTION STUDY

ALMELHEM SABA

CYQJKG

Table of Contents

I. Introduction

Budafok is a neighborhood in Budapest, Hungary. It is located in the southwestern part of Buda, near the Danube, and belongs to District XXII. The village was known for wine and champagne making, it was home to what used to be the most important vineyard of the greater Budapest area as well as Central Hungary.

Budafok was ideal for wine production because of the Tétényi plateau and its slopes along the Danube. In 1880, with increasing commercial wine production underway, a union of wine producing and bottling industries created a cellar network hollowed out of the limestone beneath Budafok. The cellar system, 25 kilometers in length and the largest in all of Europe, is still extant today. As such, Budafok is commonly referred to as “Cellar Town.”

In general Budapest is a hub for arts and design, as well as Budafok is known by its artists, sculptors, musicians, and designers where you can find more than 20 art studios in the neighborhood. Also, there is a variety of cultural, musical, and artistic festivals which held every year in Budafok with an amazing outdoor environment.

Therefore, the idea of creating a new dynamic space for these talents in the area will be a good choice for the locals there. Simultaneously, the number of startup businesses and entrepreneurs are growing up, Hence, offering affordable, convenient, and inspiring space for them will help to meet their unique needs.

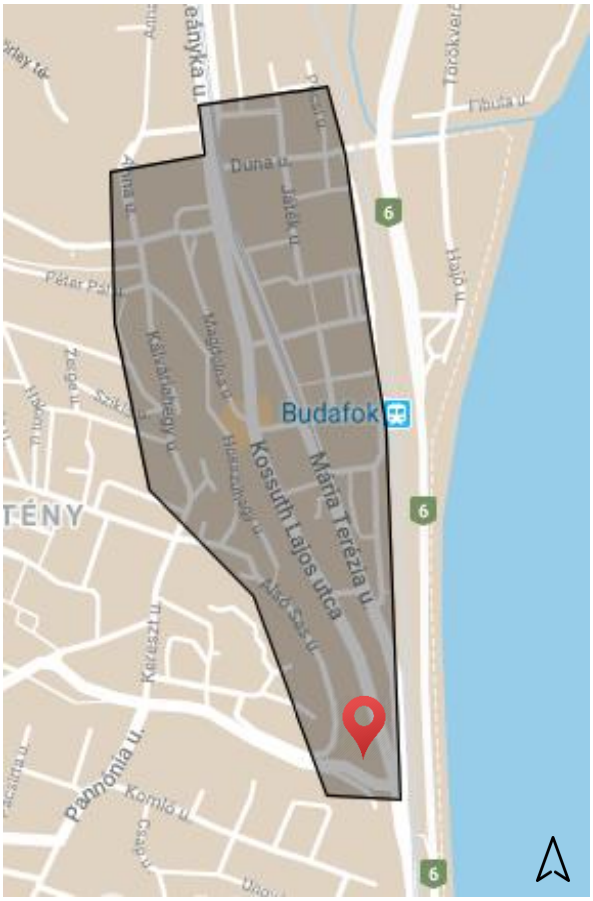
Coworking space is a space where freelancers, designers, small business owners share a common place to work. As mentioned before the targeted group will be artist, sculptors, and freelancers where they can work freely in a creative and inspiring space with a visual and genuine connection with the surrounding environment. The project will provide different spaces with diverse experiences according to the specific usage of the space; like workshops, studios, open workstation, meeting rooms, and other supportive functions. Project capacity will be 100-150 people.

II. Project overview

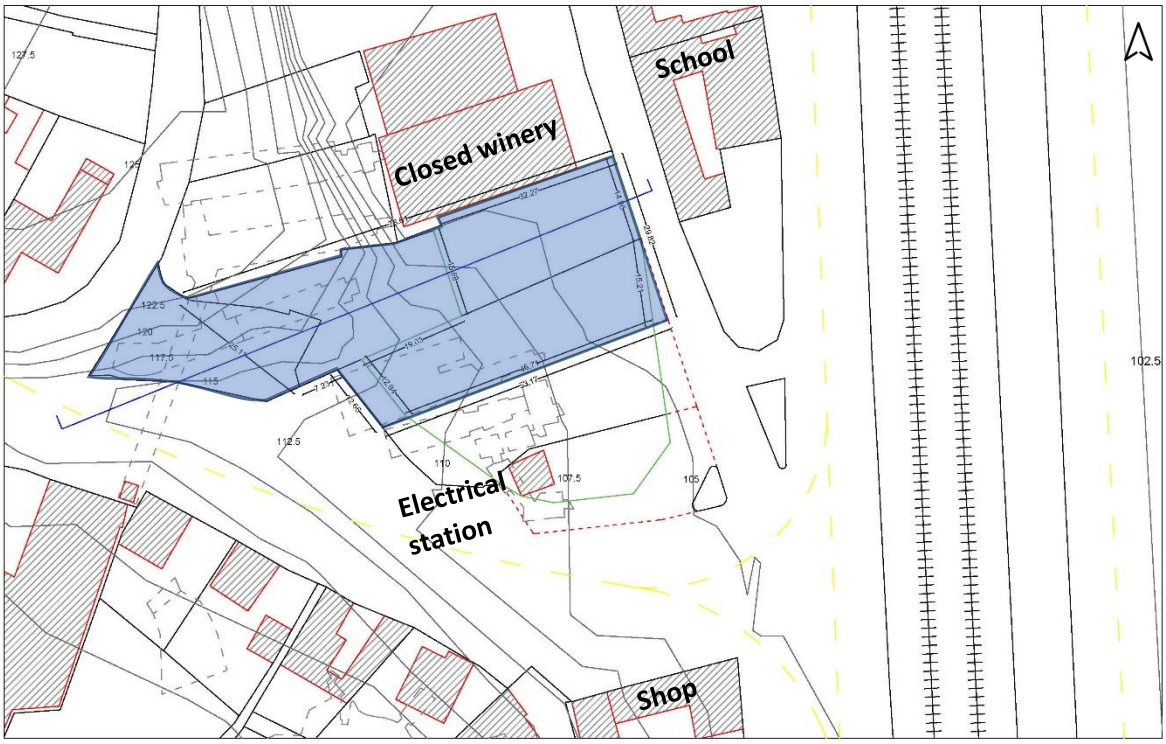
1. Site analysis

Study area extends along Kossuth Lajos utca to the south where Budafok train station stands on the middle of the area. There are many landmarks around like: Saint Leopold Church, Budafok wine-cellars, castles, chapel, Calvary, … etc.

The chosen plot is the last plot on the study area which is located on Tóth József junction.



Excellent view Central location Easy access to different transportation options Safe area	Noise Traffic junction Train station – separation from Danub Surrounded with construction sites
Development already started Major Touristic destination Well served area – supporting functions Probability of traffic calming	How to attract people Parking availability How to deal with slop Construction cost



Site regulations:

- Minimal plot width: 14m
- Layout typology: adjacent to neighbor, with a closed facade on main street front
- Plot area = 1860 m²
- Allowed area to be built on according to regulation plan = 1220 m²
- Max. Floor area ratio = 35% = 650 m²
- Gross area of all floors = 70% = 1302 m^2
- Min. Green area ratio = 35% = 650 m²
- Max. building height = 7.5 m
- Parking numbers: 50% of calculated can be provided in 500m distance of plot

Due to the development strategy planned for the whole district by the municipality, “Traffic Concept” shall be a critical factor to consider when designing phase starts.

2. Architectural program

The project will be directed by two aspects; the functions and the site. The functions will divide the building into three different spaces according to the privacy needed by the users which contains different categories. First off, Private like studios or workshops, Shared such as open workstations and exhibition space, and Semi shared which includes meeting rooms and offices where a group of people can rent it together for a couple of hours. While the site will divide the building into multi levels following the topography, also it will be deciding the pedestrian and car entrances.

The following schedule contains the main functions and approximate sizes for the spaces. Where circulation area will be defined later on according to the concept and function arrangement, but it has to be between 15-20% from the total area.

Project function	Dimensions m	Area m^2	Number of cars	Number of bikes
Reception and lobby	-	30-40 m^2	-	-
Open auditorium	-	100-150 m^2	8	2
Exhibition space	-	100-150 m^2	8	2
Workstations	-	80-100 m^2	5	1
Large workshop	7*7 m	49 m^2	2	1
2 Small meeting rooms	4*6 m	48 m^2	3	1
Conference room	6*9 m	54 m^2	3	1
Management offices	-	60 m^2	3	1
2 Team offices	6*6 m	72 m^2	4	1
Printing room	4*7 m	28 m^2	-	-
Café bar for snacks	4*6 m	24 m^2	-	-

IT room and server	3*4 m	12 m²	-	-
Furniture storage	4*5 m	20 m²	-	-
Cloak room and lockers	3*4 m	12 m²	-	-
W.Cs	-	40 m²	-	-
Building utilities	-	70-100 m^2	-	-
Total	870 m²		36	10

3. Building users and design requirements

Artists generally fall into one of four categories. **Art directors;** who formulates design, concepts, and presentation approaches for visual communications. **Craft artists;** who creates or reproduces handmade objects for sale or exhibition. **Fine artists;** including painters, sculptors, and illustrators, who creates original artwork using a variety of media and techniques. **Multimedia artists**, and **animators** who creates special effects, animations, or other visual images on film, on video, or using computers or other electronic media tools.

Regarding the working space; many artists work in fine art or commercial art studios located in office buildings, warehouses, or lofts. Others work in private studios in their homes. Some fine artists share studio space, where they also may exhibit their work.

Studio surroundings usually are well lighted and ventilated; however, fine artists may be exposed to fumes from glue, paint, ink, and other materials and to dust or other residue from filings, splattered paint, or spilled cleaners and other fluids; therefore, they need closed workshops for this kind of work.

In conclusion these aspects must be applied in the design:

- Welcoming and spacious workspace
- Collaboration and Privacy
- Scaling and Social Interactions
- Personality and Visual Interest
- Offer WIFI and wired connections, plenty of outlets
- Good lighting
- Silence and Noise

4. Design concept

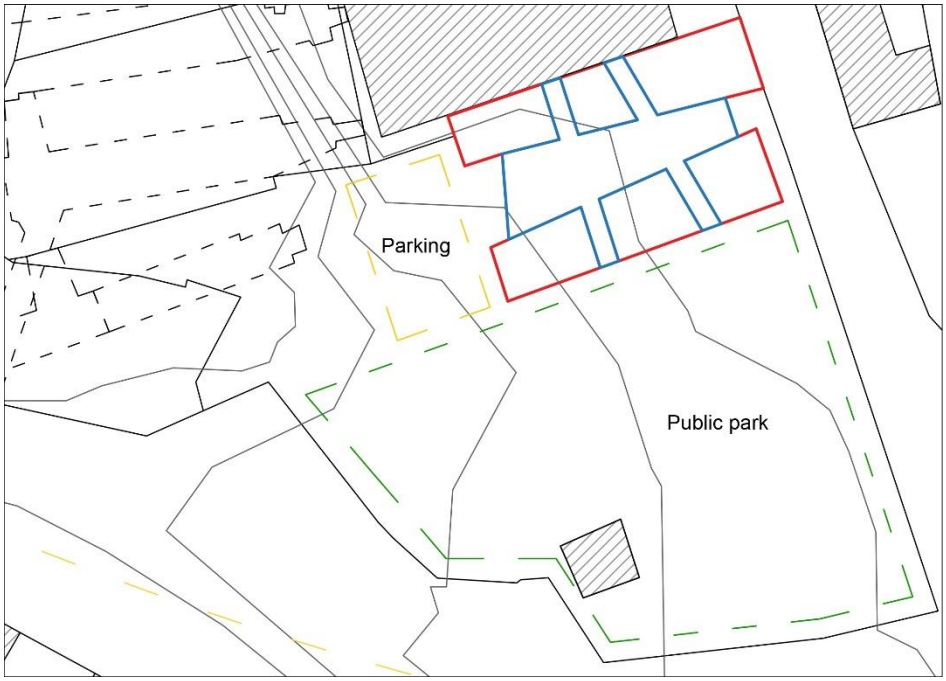
Starting from the idea of creating a dynamic and an inspiration space, the project needs to have an interactive space “the shared part” in the middle of the working area that will act as a gathering point for all users and at the same time can be used by people who likes to work in an unusual place.

The main inspiration of the project is Budafok sloped terrain and the hidden stairways which will be reflected on the interior spaces, building formation, and site design in general.

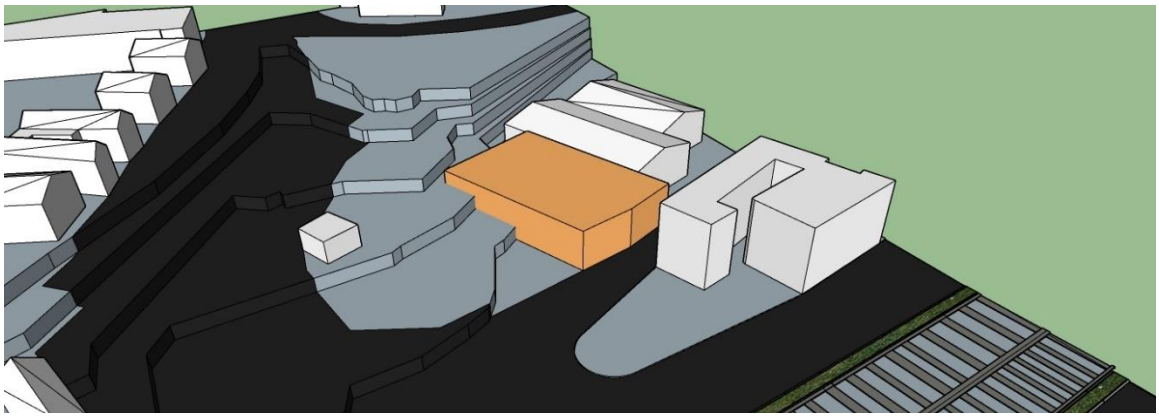
Taking all of the previous aspects and applying them on the site is explained in the following drawings:

Allowed area to be built on

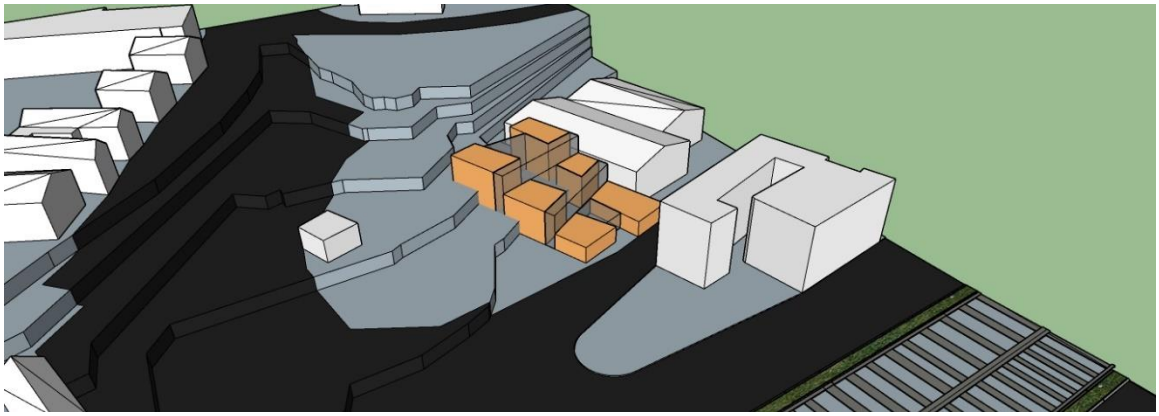
Site forces “views and terrain direction”



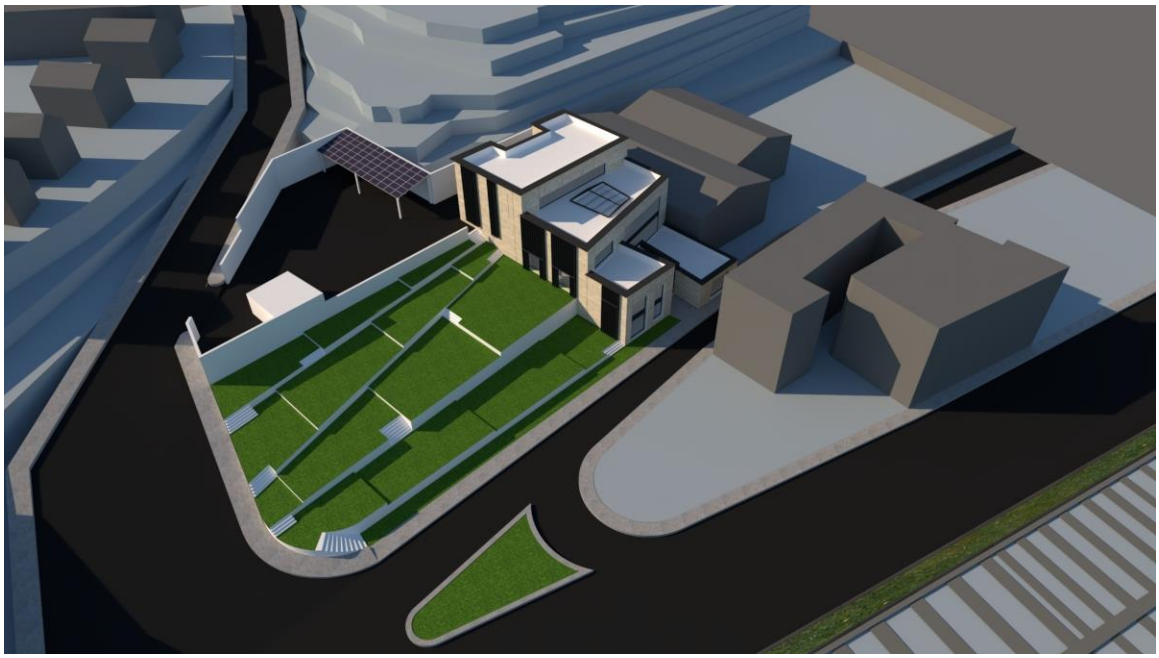
Building formation and site zoning



Allowed area to be built with the maximum height



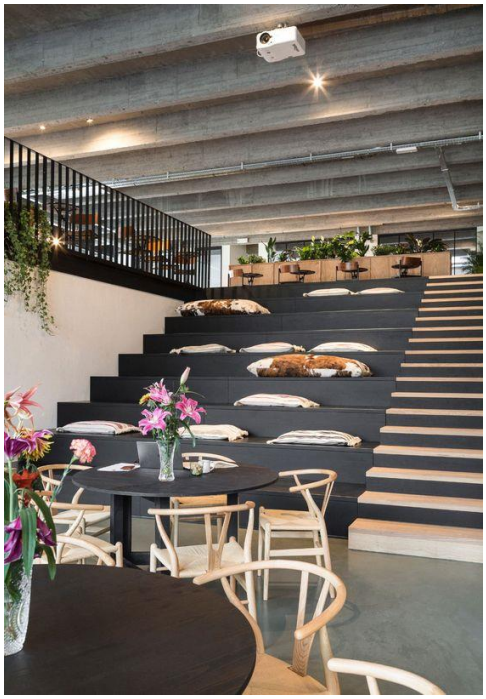
Building formation in 3D applying the concept



Applying the concept on the whole site

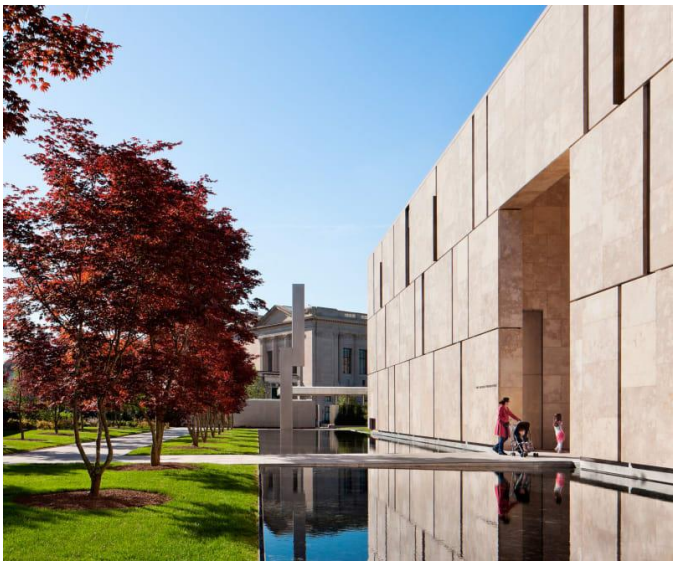
5. Building atmosphere and material selection

Open auditorium can be the best function to act as a dynamic space in the middle of the building which can be used as an extraordinary working space with a sky-lighted ceiling to provide the maximum amount of natural light.



To keep the building in harmony with the context; the material selection should be similar to the local material used. All at once a contemporary touch can be added to give the building its unique identity.

Limestone is popular in Budafok with smooth surface and clean cut like the following image, therefore it will be used as an exterior cladding for the project.



III. Building structure

1. Environmental factors

1.1 Weather conditions

Budapest has a borderline humid continental climate, with relatively cold winters and warm summers according to the 1971-2010 climatological norms when the 0°C. Winter (November until early March) can be cold and the city receives little sunshine. Snowfall is fairly frequent in most years, and nighttime temperatures of −10 °C (14 °F) are not uncommon between mid-December and mid-February.

The average annual percentage of humidity is: 73.0%. Humidity also affects the performance of buildings, causing condensation and poor performance of insulation. Condensation can occur on surfaces, or can be interstitial condensation, occurring between the layers of the building envelope.

As a result of the mentioned information it's highly recommended to install adequate thermal insulation and water proofing to protect the building from these conditions.

1.2 Wind

The building will be located in an open and high area which can receive more winds than the other sites on the study area. Budapest in winter can receive strong northern winds which can affect the building stability. This factor will be taken into consideration while designing the bracing system of the building.

1.3 Sun

On average, the sunshine hours in Budapest for many years is close to 1930 hours. Within a year the sunshine duration is increasing from December till July, then it is decreasing. The mean values of the two extreme months are 52 and 250 hours respectively; which points out the importance of providing the appropriate shading elements on the Southern elevation of the building which has the largest windows due to the view outside.

1.4 Terrain

Slope difference up to 10 meters between the lower and the upper street

1.5 Soil Mechanics

Soil mechanics characteristics for the central part of Budafok:

- 0.0 – 1.4 m heterogeneous backfill (ϕ = 28°, c = 10 kPa, γ = 18 kN/m3, Es = 7 MPa)
- 1.4 – 1.9 m silt-sand soil (ϕ = 24°, c = 20 kPa, γ = 19,5 kN/m3, Es = 9,2 MPa)
- 1.9 – 3.2 m silt-sand soil with stone rubble (ϕ = 24°, c = 25 kPa, γ = 19,8 kN/m3, Es = 12,2 MPa)
- 3.2 – 3.5 m silt- soil with stone rubble (ϕ = 23°, c = 30 kPa, γ = 19,8 kN/m3, Es = 11 MPa)
- 3.5 – 4.8 m silt- with gravel (ϕ = 24°, c = 33 kPa, γ = 20,3 kN/m3, Es = 12,1 MPa)
- 4.8 – 5.5 m silt-sand soil (ϕ = 25°, c = 10 kPa, γ = 21 kN/m3, Es = 11,1 MPa)
- Groundwater at approx. 9-11 m depth from ground

Silt – Silty soil can be smooth to the touch and retains water longer because of its smaller particles. When compacted and moist it holds together fairly well, and if compacted these make for good soils to support a foundation because of their non-water-retaining properties.

The following types of foundations are valid options for this type of soil:

- Wide strip footing
- Raft foundation
- Pile to firmer strata below

Frequently, Sub-soil can be improved using vibro-treatment, and it would be an economical efficient solution if employed in conjunction with strip or raft foundation.

1.6 Traffic and noise

Most of the noises come from road 6 which has the railway as indicated on the drawing above, in this case noise level can reach 65-70 db and the allowed noise level for offices shouldn't exceed 40 db. Meanwhile, on Tóth József junction the site receives a little bit noise from cars passing daily to the residential area there. As mentioned before Kossuth Lajos street will be transformed to pedestrian road only according to Budafok development traffic plan.

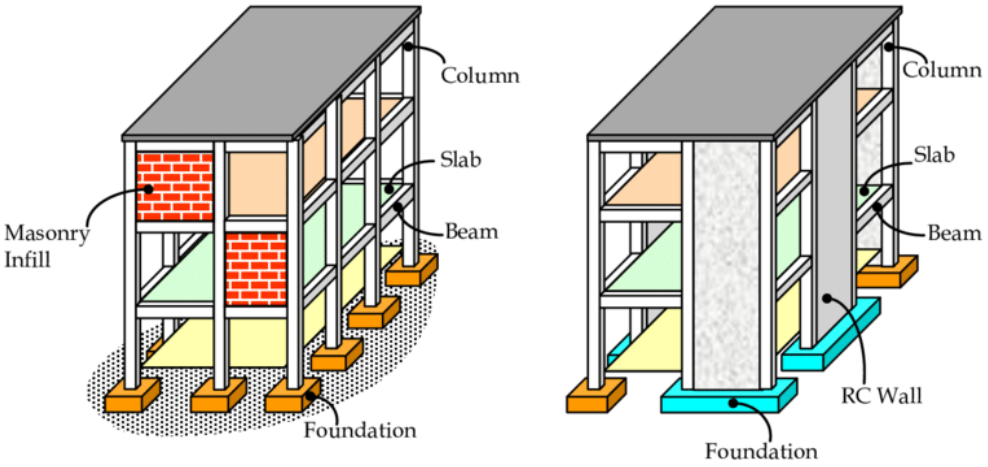
1.7 Fire safety and evacuation requirements

These are some requirements should be taken into consideration in the design phase:

- A clear passageway to all escape routes
- Clearly marked escape routes that are as short and direct as possible
- Enough exits and routes for all people to escape
- Emergency doors that open easily
- All of the corridors should be wider than 1.5 m
- A good structure should be used for fire resistance including the thermal materials and special utility rooms partitions

2. Construction analysis

The building is relatively small with 4 stories and due to the Design Concept, the building is similar to an open plan. Therefore, the best structural system to be used is the RC skeleton frame.



2.1 Loadbearing systems

2.1.1 Foundation

Since it is a skeleton frame building, the foundation design basically R.C slab foundation with 60 cm depth will be used as a building base level according to the collected data for the soil characteristics and ground water level with adequate waterproofing.

2.1.2 Columns

The bellow schedule will be used to estimate the column sizes in order to check them with the right calculations and design method:

Number of floors	Vertical forces on structure	Steel section 200N/m^2	RC 20 15N/m^2	RC 80 60N/m^2
1 story	75 KN	37.5 cm^2 HEC θ16	1500 cm^2 ☐ 23cm	125 cm^2 ☐ 12cm
5 story	350 KN	187 cm^2 HEA 500	2500 cm^2 ☐ 50cm	625 cm^2 ☐ 25cm
10 story	7500 KN	375 cm^2 HEA 1000	5000 cm^2 ☐ 70cm	1250 cm^2 ☐ 80cm
50 story	37500 KN	1875 cm^2 I section	25000 cm^2 ☐ 160cm	6250 cm^2 ☐ 80cm
100 story	75000 KN	3700 cm^2	50000 cm^2 ☐ 223cm	12500 cm^2 ☐ 100cm

2.1.3 Bracing system

To protect the building from the horizontal loads caused by the wind, the building needs very solid vertical elements to combine it with the frame structure so RC sheer walls will be used with minimum 3 walls between column lines in two different directions. Also, it withstands overall sway of the structure.

Elevator walls can be considered as part of the bracing system as they made of reinforced concrete which is a continuous vertical structure that connects all floors together. As we know R.C walls are not a good sound insulation element and the elevator is one of the biggest noise sources of the building, therefore; a double R.C walls shall be used with a 5 cm Rock wool sound insulation layer in between to reduce the noise to the required level.

2.2 Loadbearing subsystems

2.2.1 Slabs

According to the ratio between the spans RC two-way solid slabs are used with drop beams. Laminated safety glass bridge will be used on the third level.

2.2.2 Roof

In general, the roof will be flat roof designed to deal with weather conditions, loads, and drainage issues. In addition, it is not accessible. Therefore; normal non-walkable roof layers will be applied with PVC waterproof membrane and soft gravel on top.

2.2.3 Façade

Natural limestone used as a cladding material for the building which will be hanged from the back using HALFEN system with a good thermal insulation in order to create a suitable environment for the users and to reduce energy consumption of the building.

The HALFEN SUK system is an adjustable suspended channel system suitable for cavities larger than (160mm), with support and restraint fixings which are adjustable vertically along the channel. The system is especially suitable for natural stone facades with large and varying distances between the façade and load bearing structure.

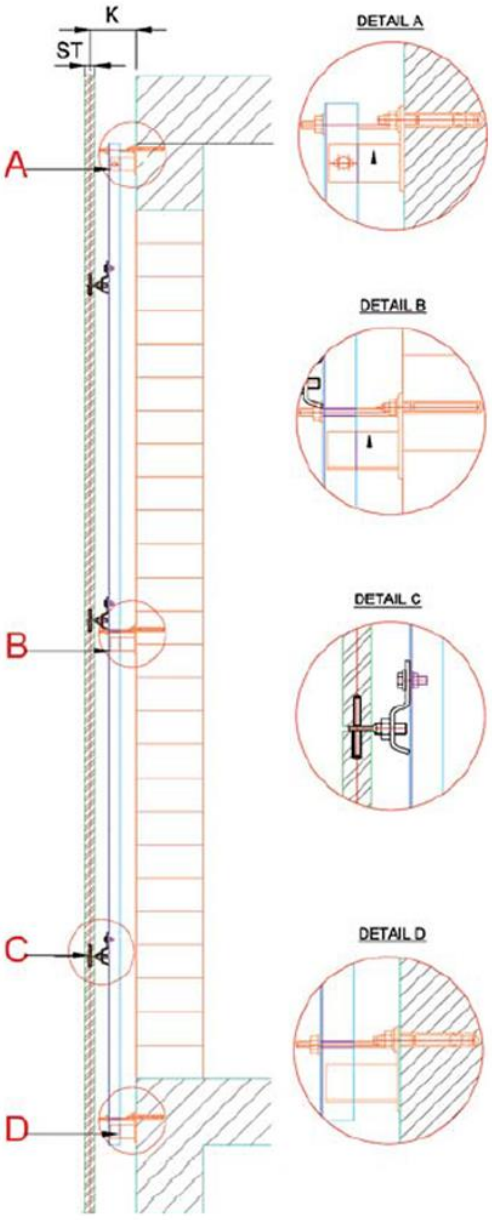
The stone will be fixed as following details:

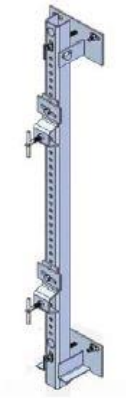
A: Channel support brackets are fixed to the upper concrete beams with expansion bolts. Channels are supported with channel support brackets using hex bolts. The levelling of the wall tolerances is made by adjusting the channel through the support bracket.

B: Channel restraint brackets are fixed to masonry wall with chemical bolts. Channels are fixed to the channel restraints with contra nuts. This prevents the channels from deflection.

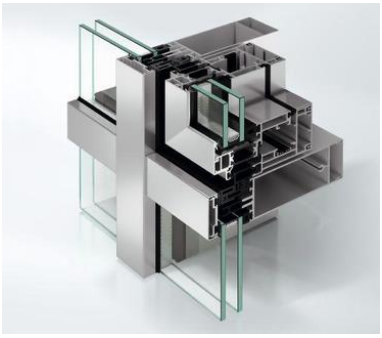
C: Installation of stone slabs is done with the Z Anchors which are fixed onto the channels with hex screws and nuts.

D: Channel restraint brackets are fixed to the lower concrete beams. Channels end is fixed to the bracket with contra nuts.





2.2.4 Curtain wall



Schüco Façade FW 50+ curtain wall system used for building entrances and skylights with maximum thermal insulation through to standard thermal insulation, geometrically complex skylight constructions can be easily constructed with this system with a wide range of cover caps offer outstanding design options for a variety of façade styles and can also be used as a fire-resistant façade (BF).

Another important thing to be mentioned here that the curtain walls are almost used from the ground till the upper floors as a continuous façade, in this case slabs structure behind them and up-stand fire protection block walls should be covered from the street. As a double insulated glass layers are used, the back structure can be hidden by adding a colored film layer on the interior side of the external glass layer of the curtain wall.

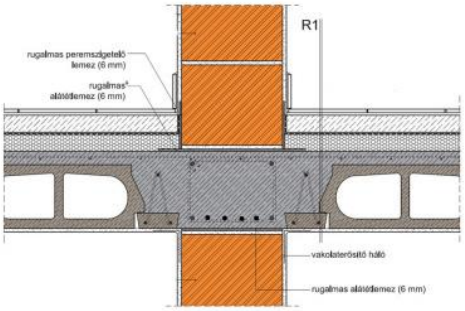
For shading system specially for the southern façade KRÜLLUNG SOLONIA WO-3000 RE used with the following specifications:

- Vertical large lamella structure - rectangular with wooden lamellas rotatable along their vertical longitudinal axis
- Counter-rails with double rectangular shaped cross-section, line by the curtain wall mullion with extruded aluminum mounting brackets
- 230 V/AC electric motor tilts the fins by solid stainless-steel driving rod
- Stainless steel fastening fixtures

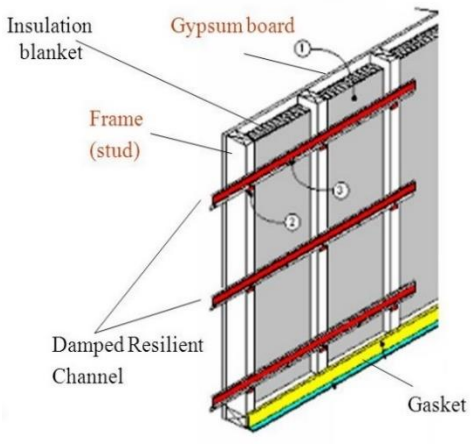
2.2.5 Partitioning

As the building has many different functions, different types of partitions should be used according to the required noise capacity between them and fire safety requirements:

- Brick party walls are high performance partition walls which are used for utility rooms on the ground floor that can be made from 20 cm RC, 25-30 cm sand lime, or heavy clay block meanwhile connects to the slab with soft acoustic plate.



- Gypsum plasterboard wall (GB): drywall consisting on a galvanized cold formed Steel frame, with a ceiling channel of 7 × 3 × 3 cm and vertical studs of 6.9 × 3.8 × 3.6 cm every 60 cm; with a gypsum plasterboard of 1.5 cm at both sides, the inner field with an insulation of a rigid panel of volcanic Rockwool of 7 cm and joined by steel screws. By using a combination of acoustic insulation, sound breaker bars, and soundproof plasterboard; we can ensure this type of wall construction meets the required levels of sound reduction requirement's. This type of partition is used on the toilets, storages, and meeting rooms where wiring and fixtures needed to be fixed.



- As the building designed to be an open plan with the central open space, the same experience should be reflected on the meeting rooms with privacy needed to hold meetings without compromising on natural light by using Glass partitions which create excellent acoustic properties within the room and are extremely effective at cancelling out external noise from the rest of the building. 108mm Soundproof fireproof glass wall separation wall office partition.

2.3 Building layer arrangement

2.3.1 Roof layers

Since it is a non-walkable roof and, in some offices, it can be visible from the building inside the following layers will be applied from the base to the top:

- 23 cm R.C slab
- Polyethylene plastic sheet Vapor barrier layer
- 20 cm Flat EPS Thermal insulation layer
- Another layer of inclined EPS thermal insulation to achieve the required slope
- 1 Layer of glass fleece to protect the EPS
- 1 Layer of PVC waterproof membrane
- Geotextile separation and filtration layer
- White rounded roofing pebbles – soft gravel –

2.3.2 Intermediate slab layers

According to the functions of the building and the number of daily users of the spaces, a heavy-duty finishing is needed with a good sound insulation. The following layers will be applied from the base of the slab to the finishing floor layer:

- 20 cm R.C slab
- 3 cm Rock wool sound insulation boards
- PE foil layer to protect the insulation boards
- 8 cm Polished and impregnated screed layer – this height can be increased according to the adjacent different levels between different function –

To avoid screed cracks expansion joints should be fitted when the surface area of the screed is greater than 40 m^2 or within any single length of screed greater than 8 m using aluminum or stainless-steel rails.

2.3.3 Ground floor slab layers

In this building there's no basement therefore the ground floor has to be well insulated and protected from underground soil conditions as the following from the finishing layer to the ground earth level:

- 8 cm Polished and impregnated screed layer
- PE Foil layer
- 3 cm Rock wool sound insulation boards
- 20 cm EPS thermal insulation layer
- 110 cm R.C slab foundation

- 1 Layer of PREPRUFE 300 plus waterproofing membrane -heavy duty-
- 10 cm Screed layer
- 30 cm Gravel
- Compacted soil

2.3.4 Auditorium construction layers

In order to make a contrast with the exhibition space a new light material is used to cover stair steps. The stair run is made of reinforced concrete supported by beams underneath between the central columns, but the landings are precast R.C because of the difficulty of assembling formwork inside. Landing layer arrangement is as the following:

- 15 cm R.C precast slab
- 3 cm Rock wool sound insulation boards
- 2 cm Parquet tiles fixed on wooden battens and wedges – rock wool boards are placed between the battens with polythene layer underneath as a vibration insulating layer –

2.3.5 Exterior walls

As mentioned before in the concept and façade construction, natural Limestone is used as a cladding material for the building and since it is a ventilated façade, layer arrangement of the wall is as the following from inside to outside the building:

- 30 cm Ceramic block walls –type B- with plaster and paint finish
- 20 cm Semi-rigid Rock wool thermal insulation with glass fiber protection layer
- 8 cm Air gap in order to install stone fixation system
- 3 cm Natural Limestone

2.3.6 Exterior walls underground

Most of the ground floor walls are surrounded by soil according to the slope of the site which they need to be treated in a different way than the exterior walls in order to protect the structure from the surrounding conditions. Layer arrangement of the wall is as the following from inside to outside the building:

- 30 cm R.C retaining wall with plaster and paint finish
- 1 Layer of Bituminous waterproofing membrane
- 20 cm XPS thermal insulation boards with glass fiber protection layer
- 10 cm concrete crust panel

2.3.7 Neighboring building situation

There is a closed winery beside the building with a pitched roof which is located 10 meters far from the street with a continuous solid wall closing the plot line between the two plots and the street façade. This is a dangerous case because of the sloped roof that will bring large quantities of rain water between the two buildings which can affect the structure negatively.

This problem can be solved by pushing the building 60 cm from the plot edge in order to let the rainwater flow without effecting both buildings using water gutter with sloped perforated pipes rapped with geotextile layer to allow water penetration without blocking the holes. The gap is filled with gravel and the rainwater will be directed to the sewage system underneath.

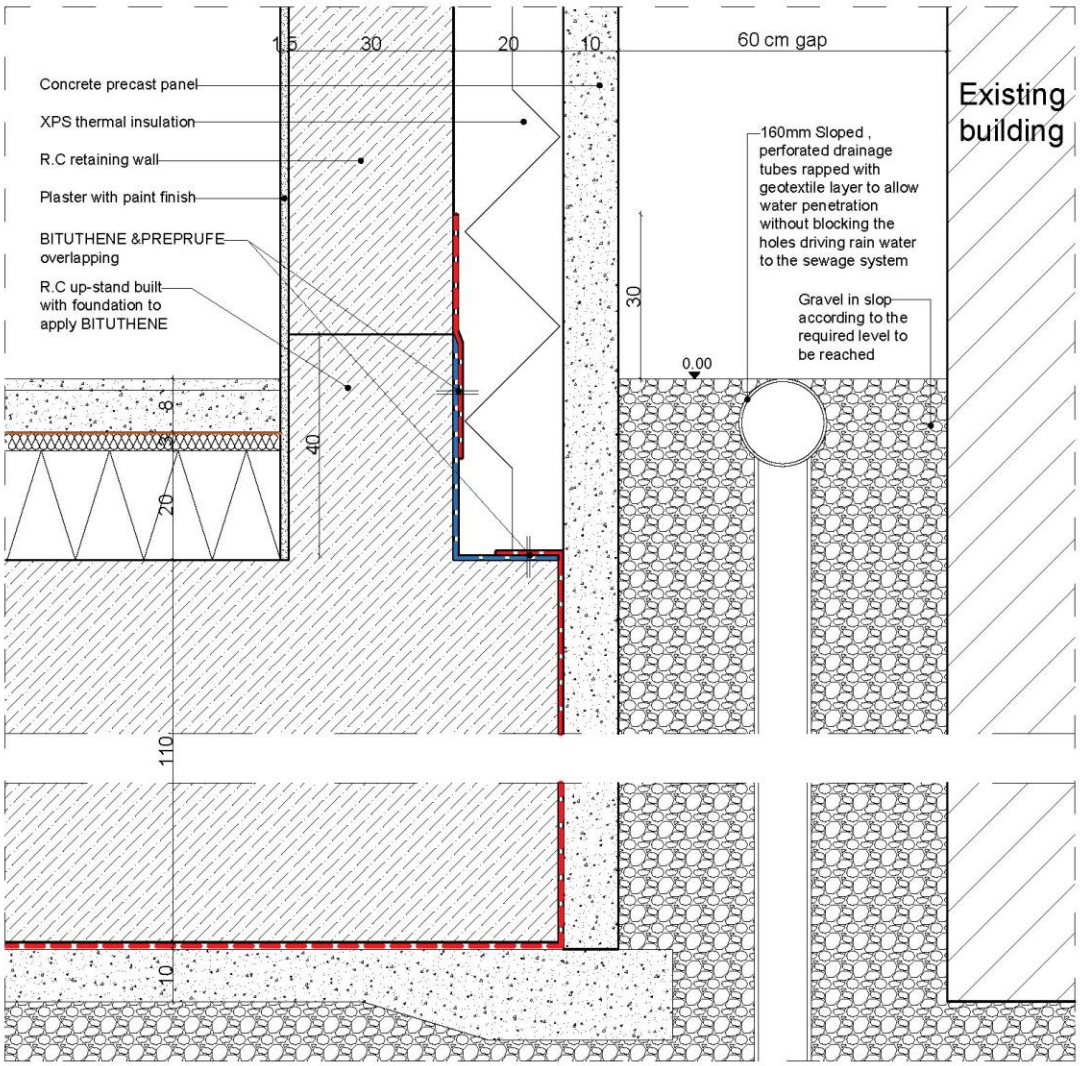
As the building is divided into 3 masses, the wall from the neighboring side will be constructed in two ways according to the reached level whether it is below-grade construction or visible to the street. The below-grade part will be constructed using R.C retaining wall with concrete crust panels as the last wall mentioned before, and the upper part will be a ceramic block wall with ventilated façade as the whole building.

Another important issue to be highlighted here is how to deal with waterproofing and slab foundation on this side? For the slab foundation PREPRUFE 300 plus membrane is used underneath as a waterproofing system that creates integral adhesive bond to poured in place concrete.

The previous system is called pre-applied system, with a post-applied system using BETUTHENE 8000 membrane that they can work together to achieve the maximum protection for the structure from any expected water leakage.

The slab construction will be done as the following:

A 40 cm up-stand R.C wall will be constructed with the slab foundation in order to apply the BETUTHENE membrane on the top of the slab as shown on the below figure.

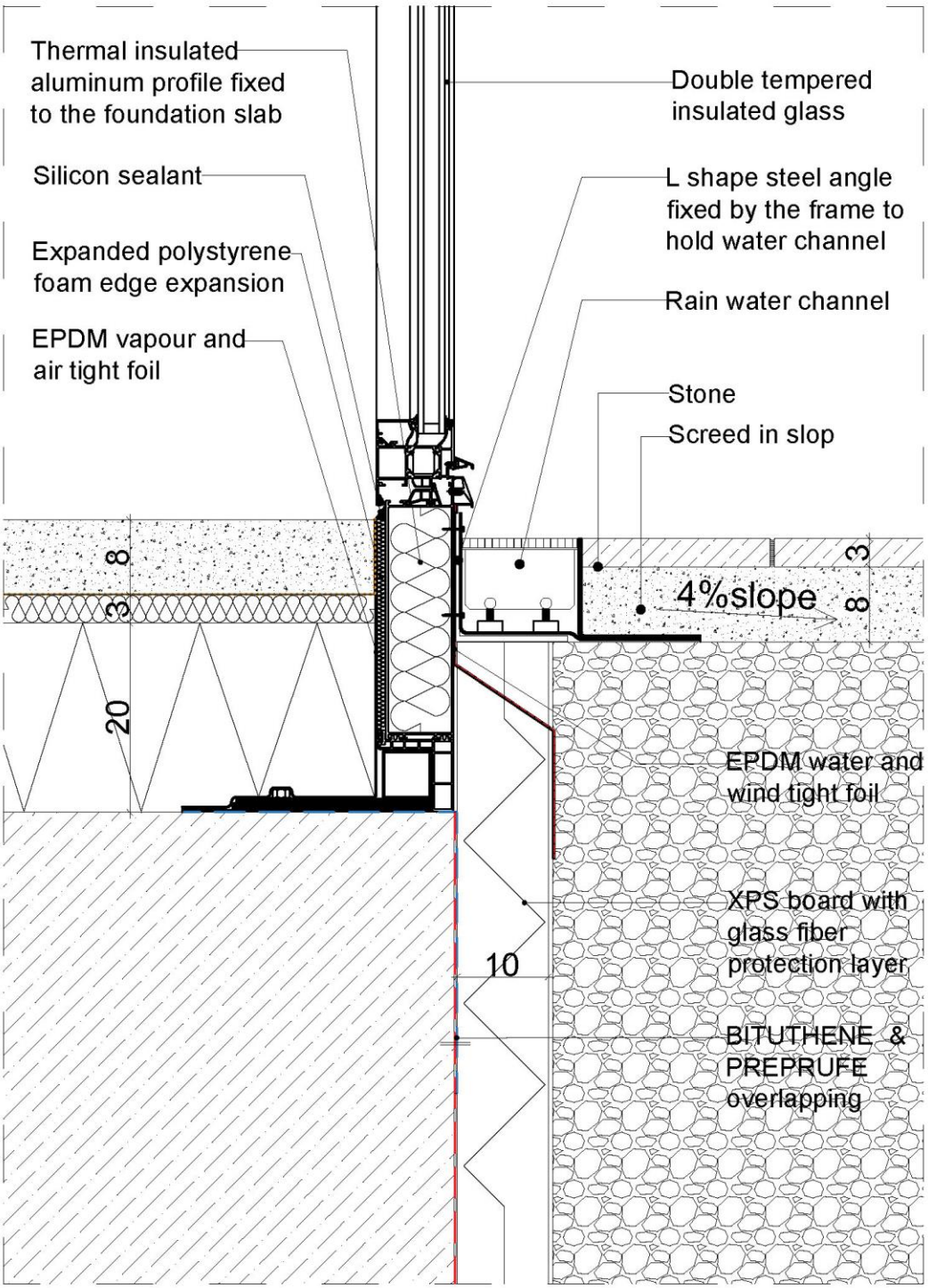


1:10 scale

PREPRUFE 300 PLUS membrane

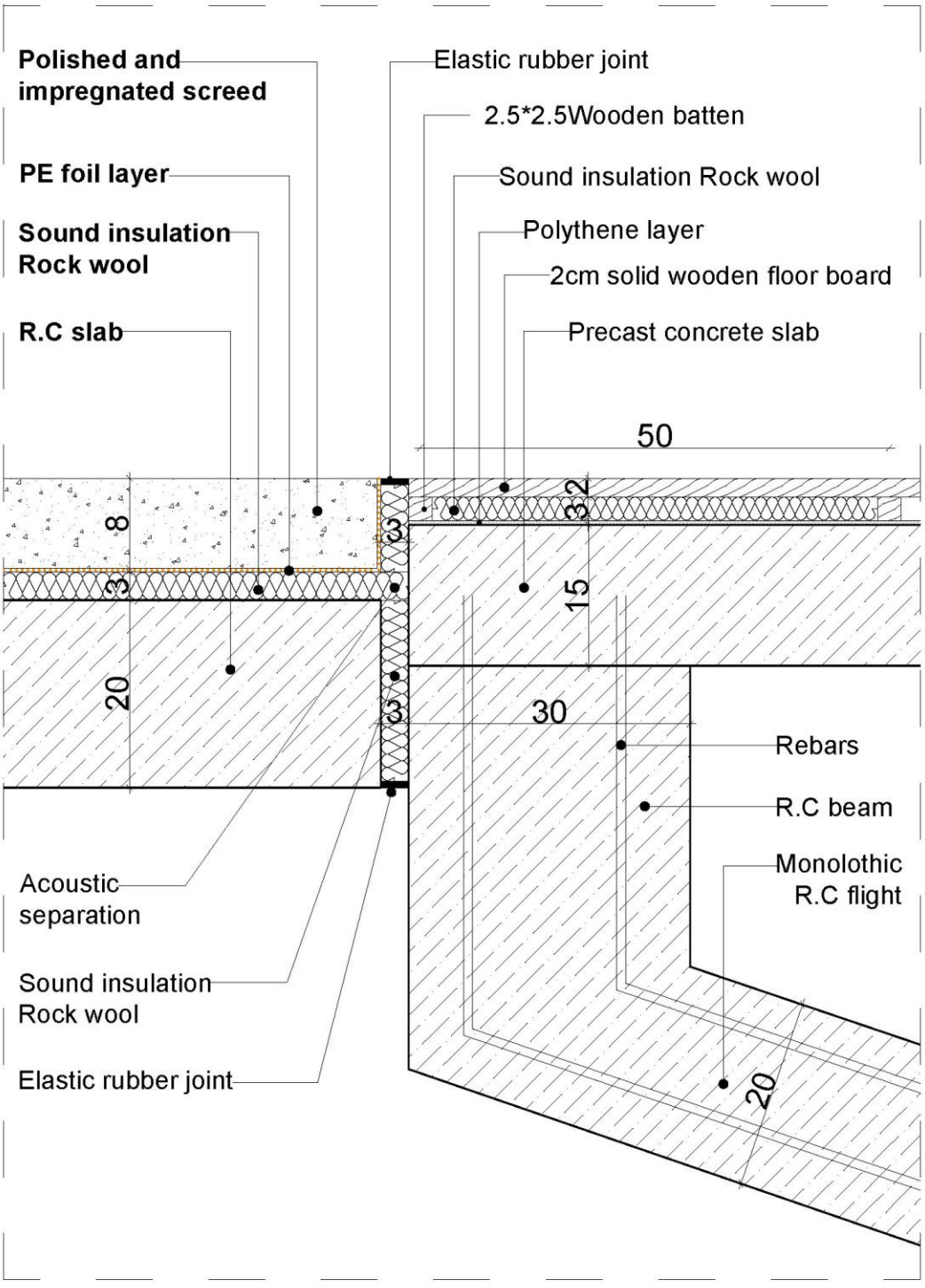
BETUTHENE 8000 membrane

3. Construction details



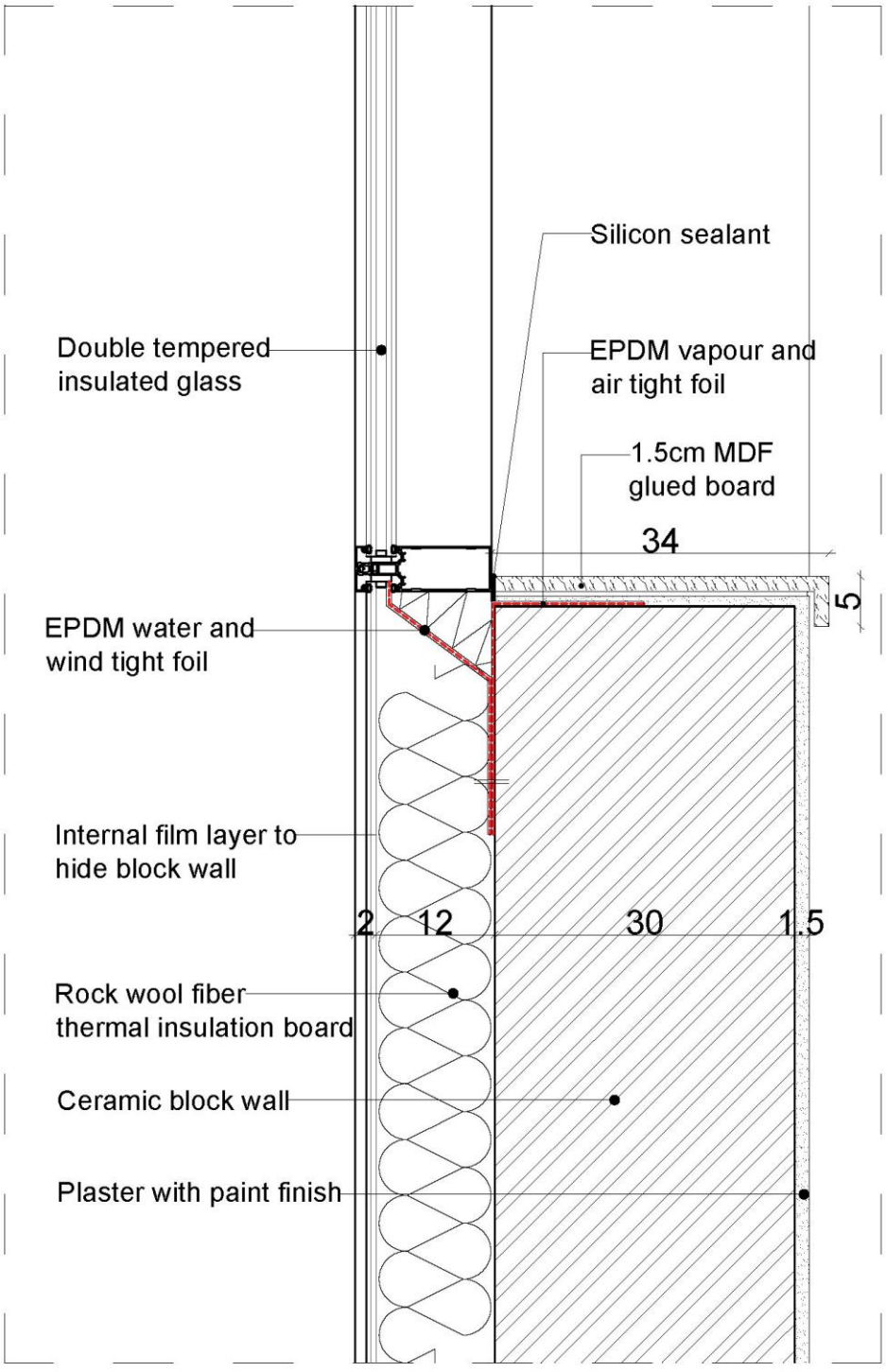
Main entrance door detail

Scale 1:5



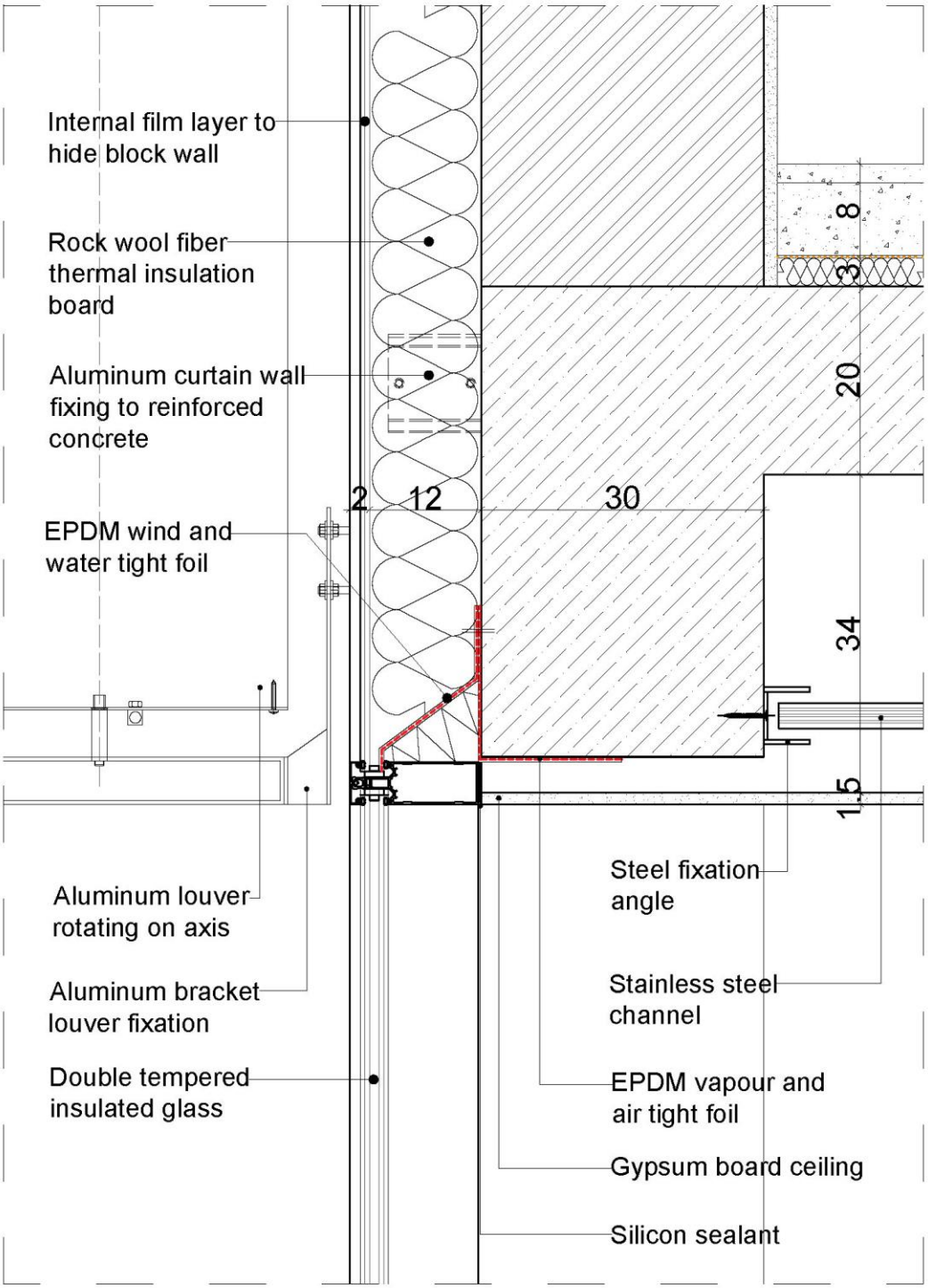
Auditorium with first floor slab connection detail

Scale 1:5



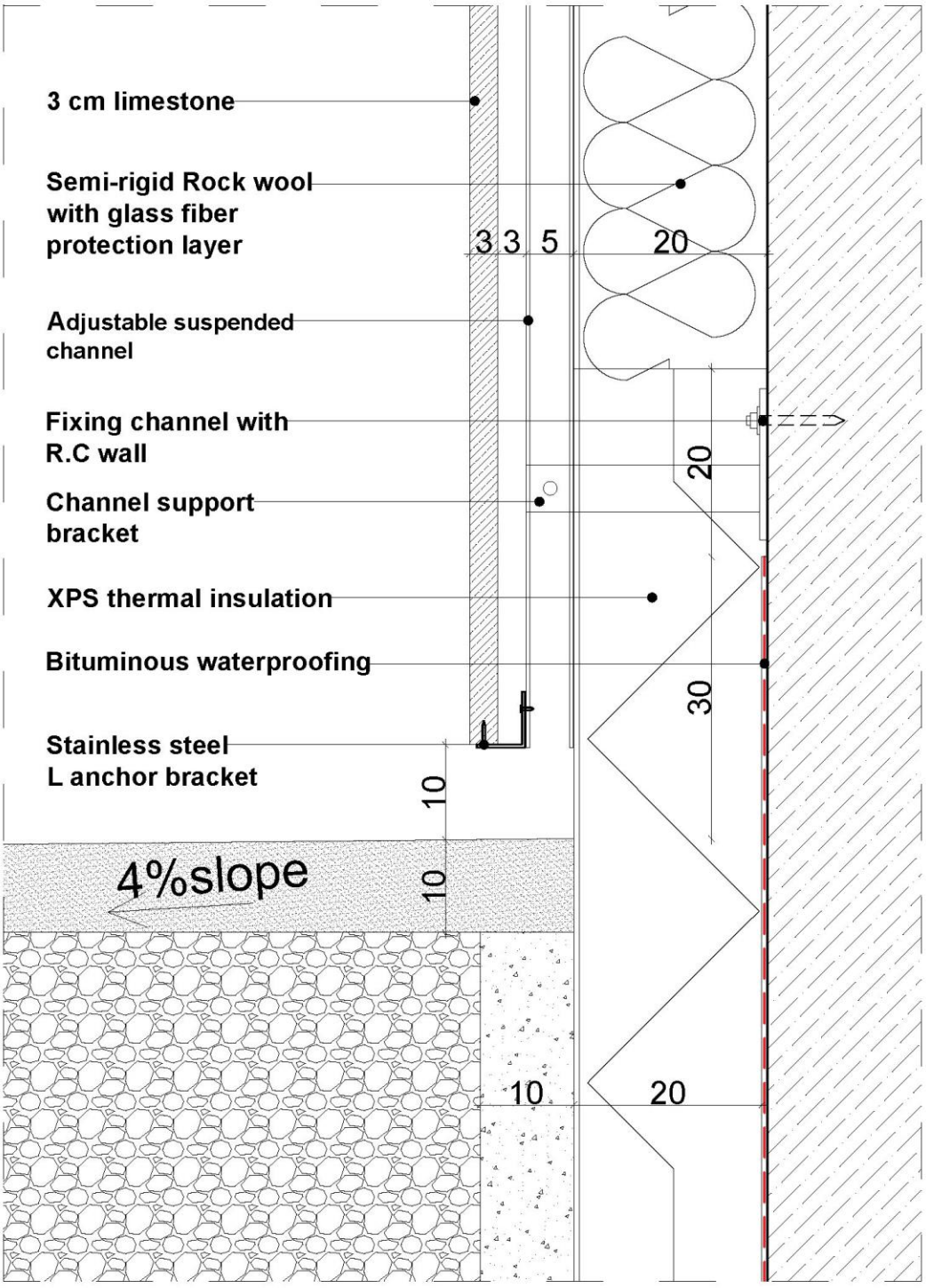
Curtain wall connection with block wall bottom detail

Scale 1:5



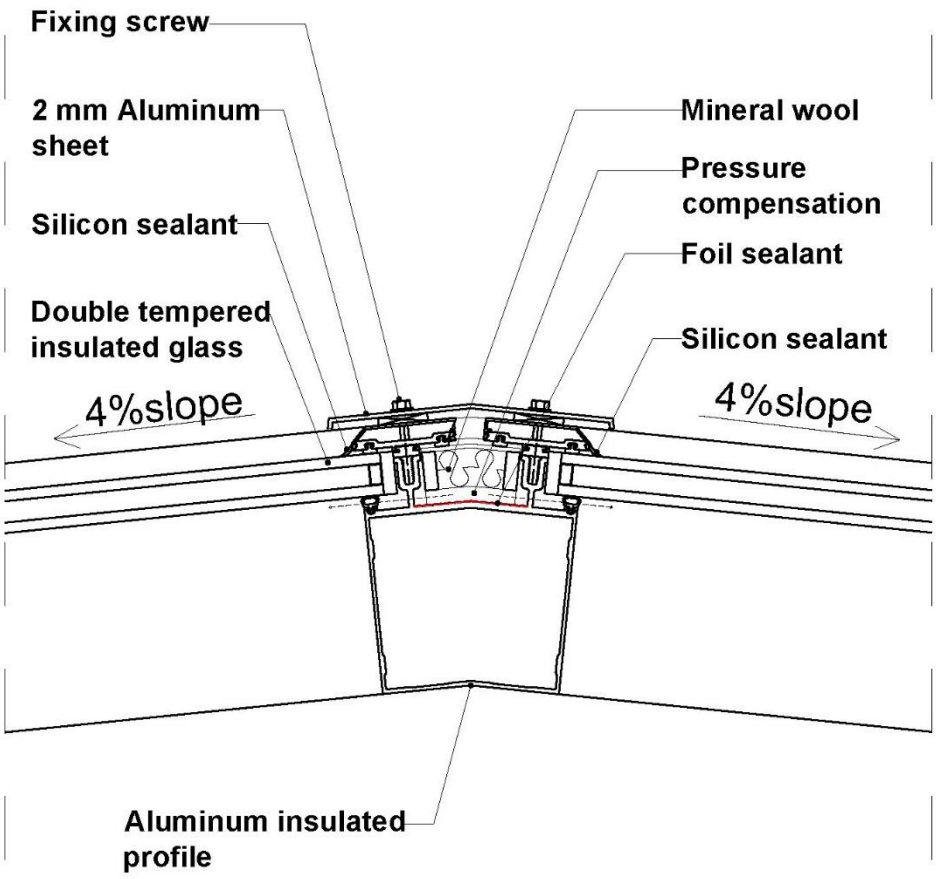
Curtain wall connection with beam detail

Scale 1:5



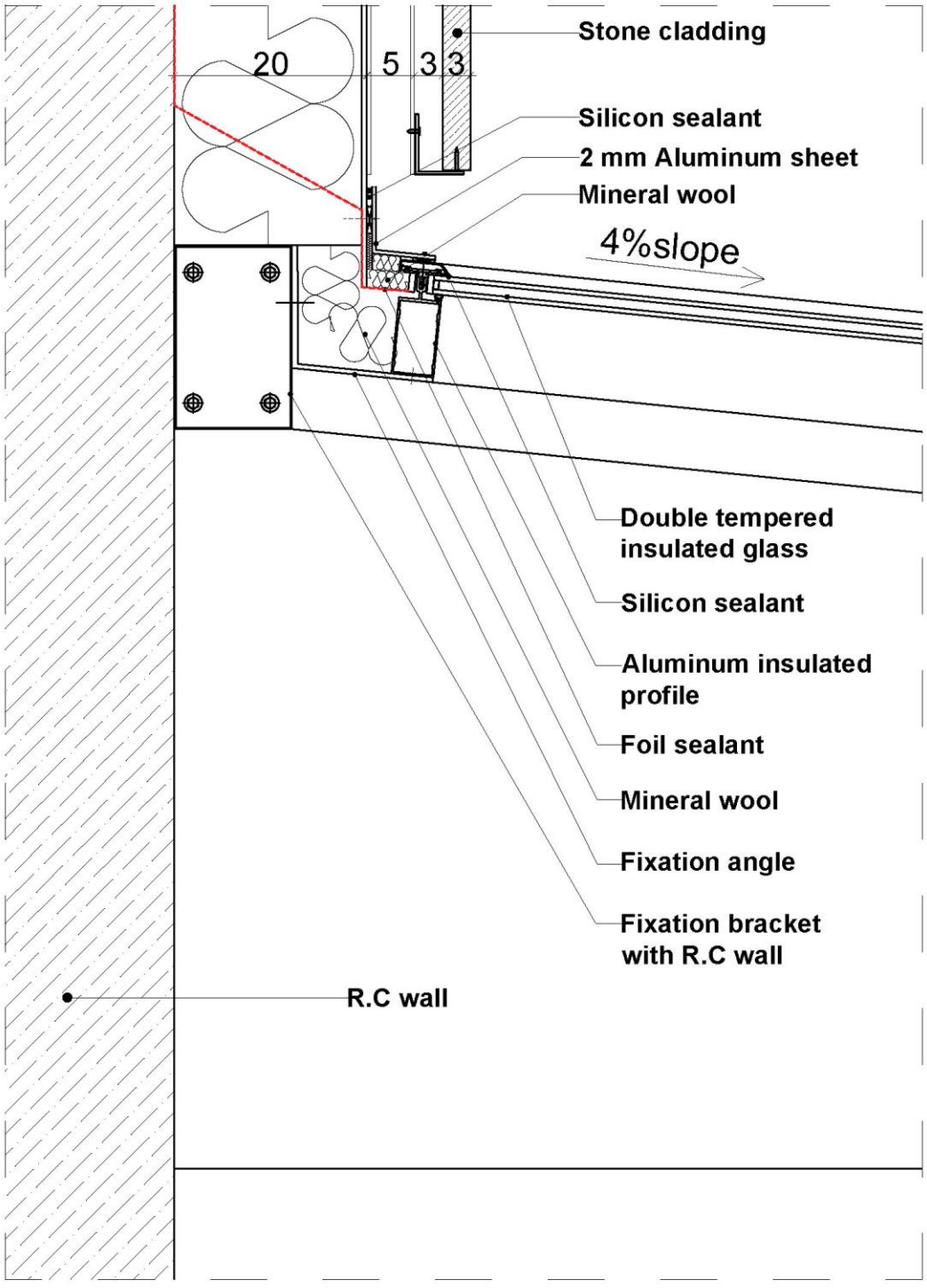
Base stone fixation detail

Scale 1:5



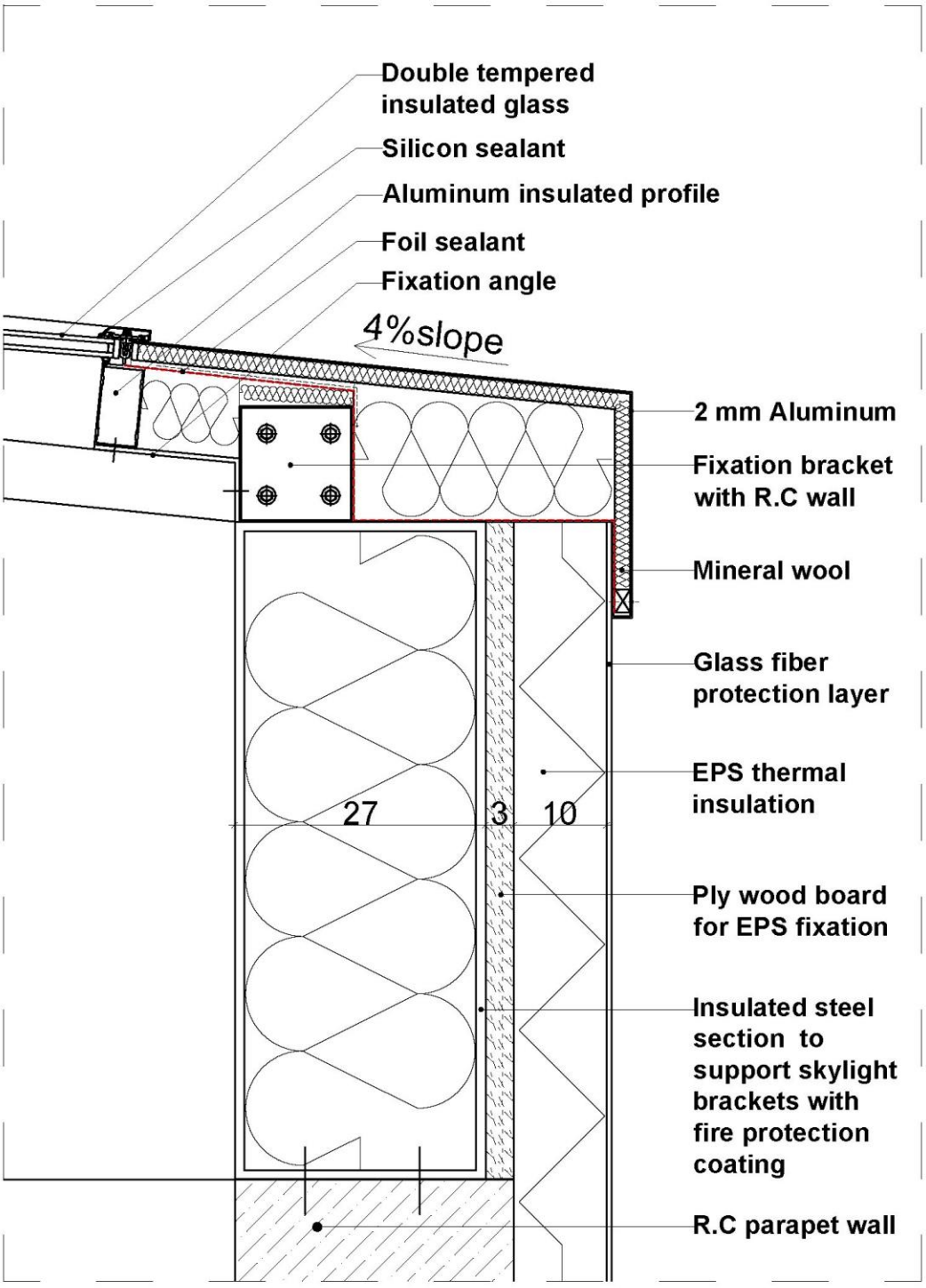
Skylight top corner connection

Scale 1:5



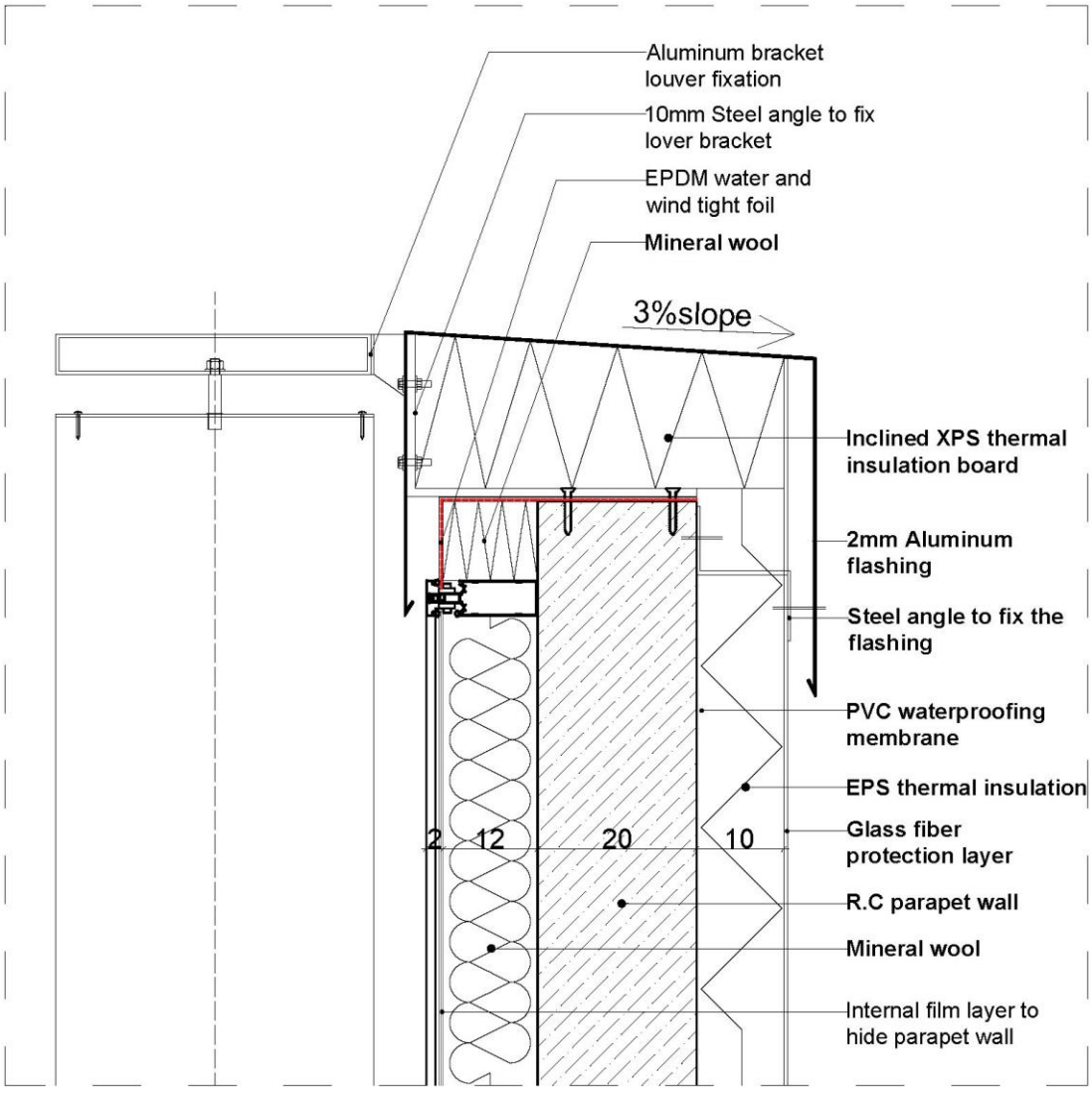
Entrance skylight left side connection detail

Scale 1:5



Entrance skylight right side connection detail

Scale 1:5



Parapet wall with louvers connection detail

Scale 1:5