M30654

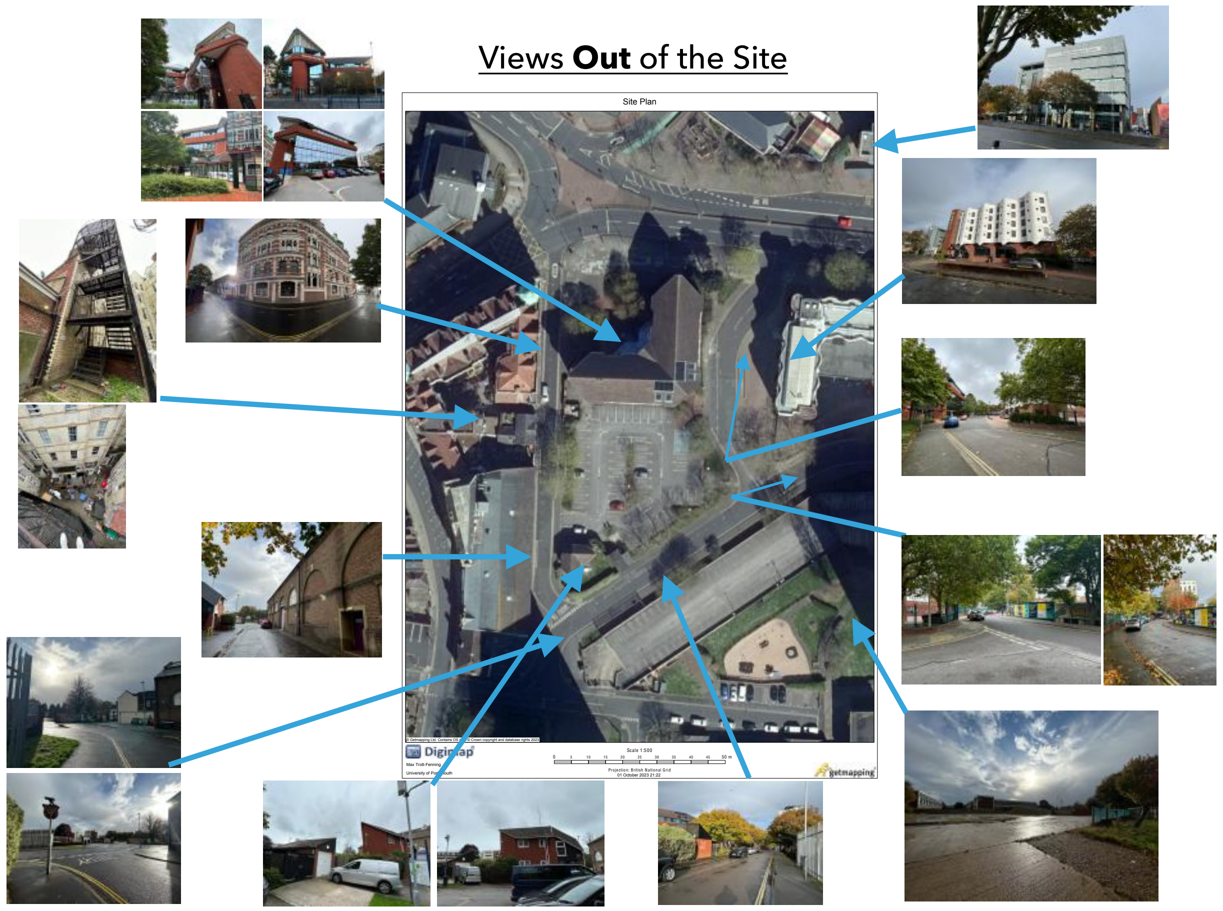
TECHNOLOGY & ENVIRONMENT: DISCOVERY

LECTURE HALL

ENVIRONMENTAL PERFORMANCE

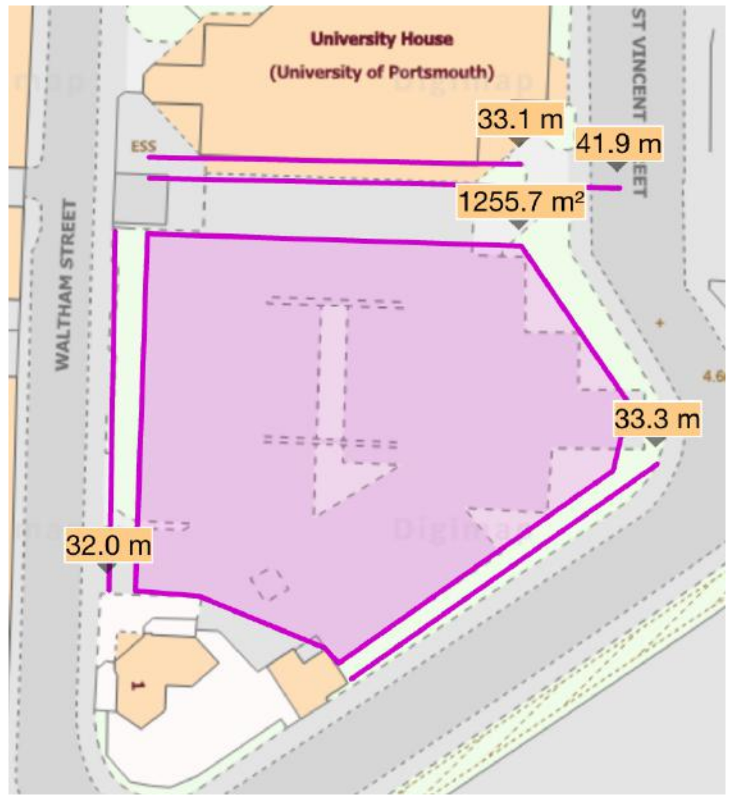
SITE RESPONSE: UNDERSTANDING THE SITE

Views **Out** of the Site



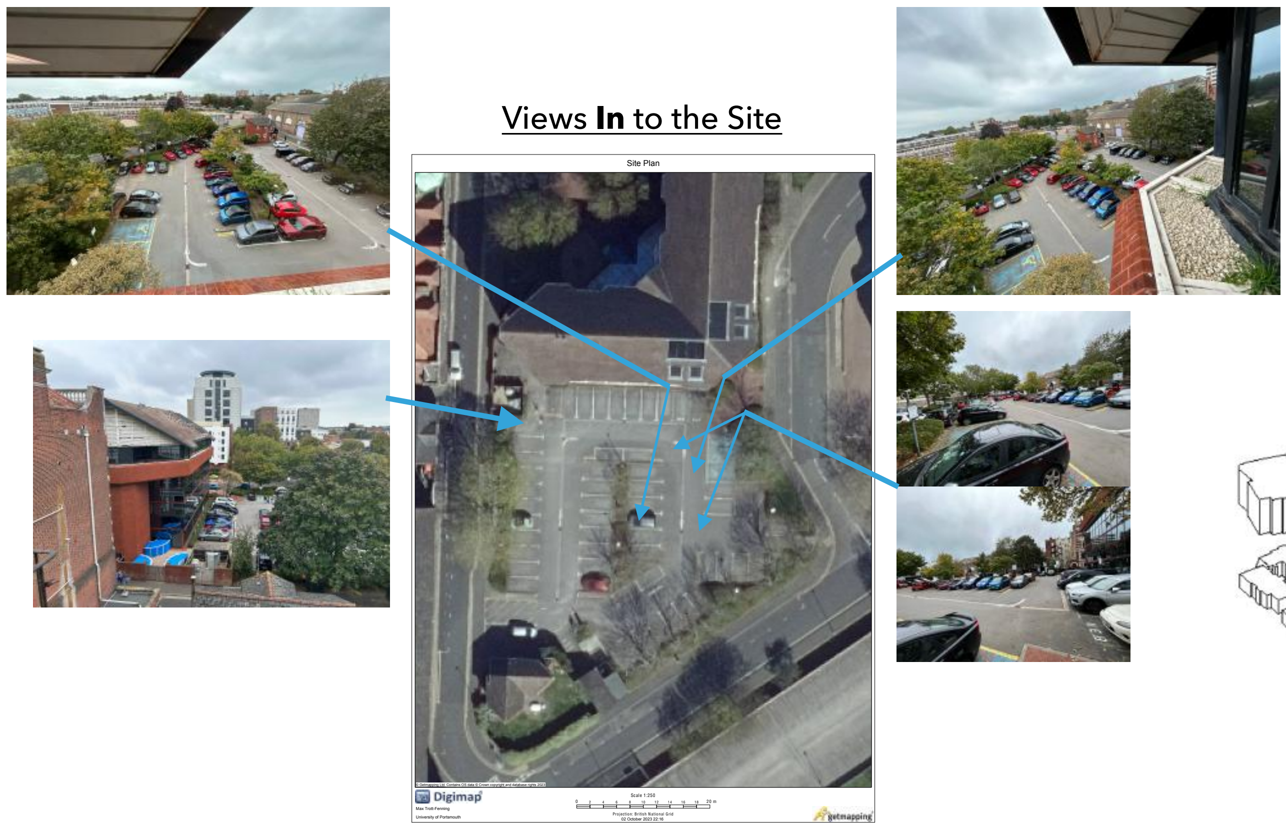
Site location within Portsmouth

Site Measurements

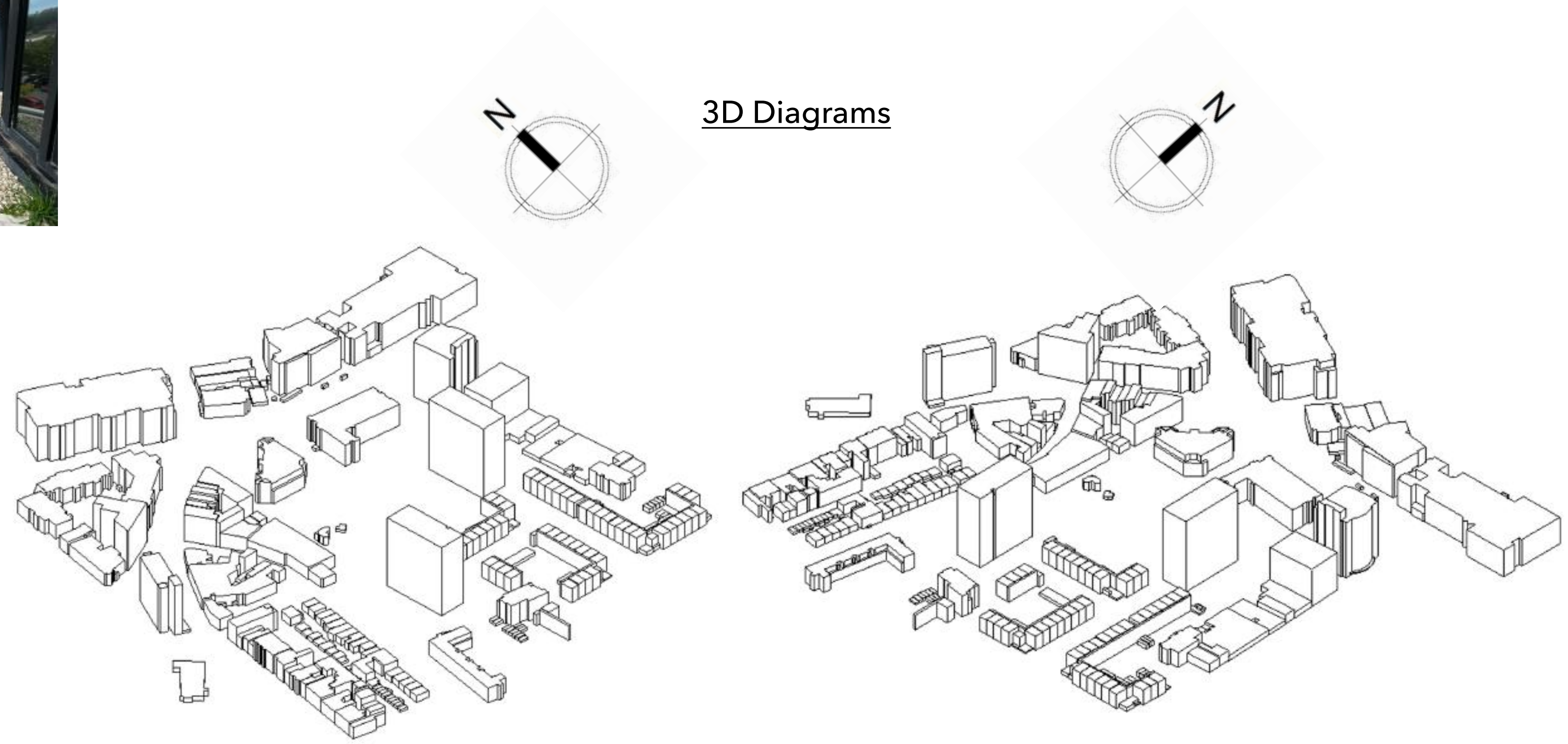


These analysis methods allow one to obtain a better understanding of the sites' surroundings and dimensions. These will allow me to assess the impact of my design on the site and surrounding buildings.

Views **In** to the Site

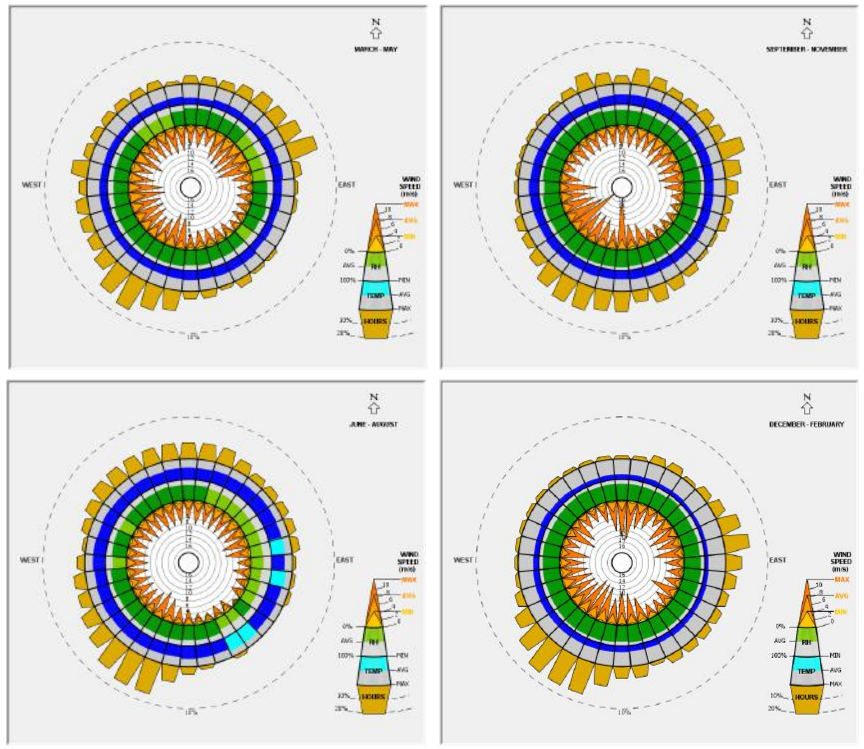


3D Diagrams



CLIMATE RESPONSE: WIND

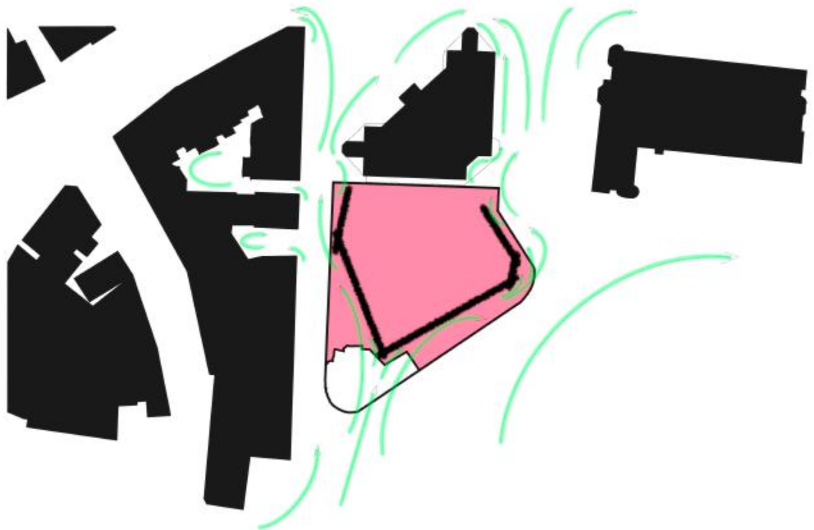
This plan diagram illustrates the anticipated wind flow patterns within the immediate site. It is anticipated that the wind will primarily be channeled through the southern opening, particularly due to the presence of a neighbouring building site located directly to the south of our designated building area.



The Wind diagrams, sourced from Climate Consultant, depict data gathered from the closest location to London Gatwick. Over the course of each season, a consistent pattern emerges, indicating a prevalent south-south-west wind and another notable trend of wind originating from the east-east-north direction. It is important to note that the wind patterns at Portsmouth may be distinct due to its coastal location. In this area, it is anticipated that there will be a higher frequency of southward winds and a comparatively lesser occurrence of winds originating from the north-east.

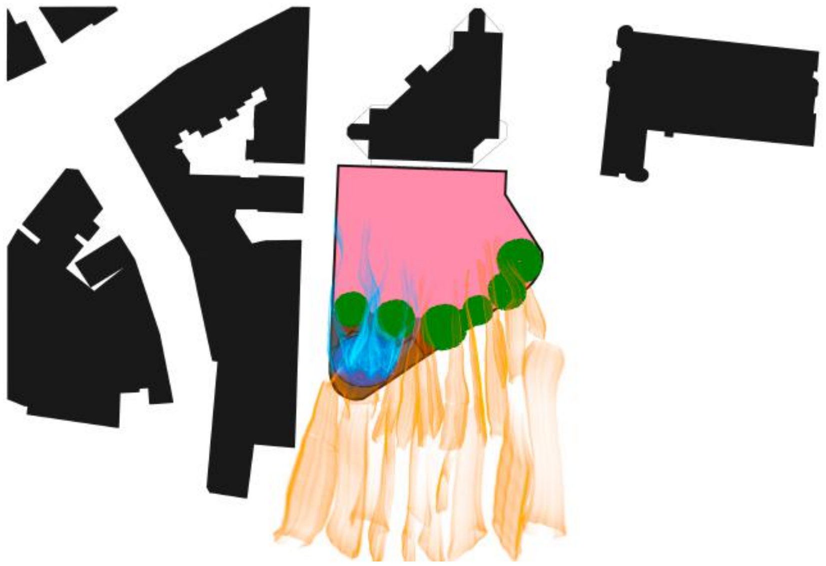
PASSIVE DESIGN RESPONSES:

Wind Buffeting



This diagram illustrates a proposed building design incorporating the strategic use of wind buffeting to mitigate the impact and turbulence caused by the strong winds prevalent on the site.

Wind Break & Water Cooling



This shows how I would utilise evaporative cooling in the form of a small body of water in front of the wind. As well as a line of trees between the prevailing wind and my building facade in order to break & funnel the wind.

Microclimate courtyard

There is a possibility of a microclimate within an enclosed courtyard on the premises, which can be accessed from the North in order to avoid wind exposure.

3D SOLAR SHADING, CLIMATE CONDITIONS & PSYCHROMETRICS

ENVIRONMENTAL SHADOWS ANALYSIS

Spring | Summer | Autumn | Winter

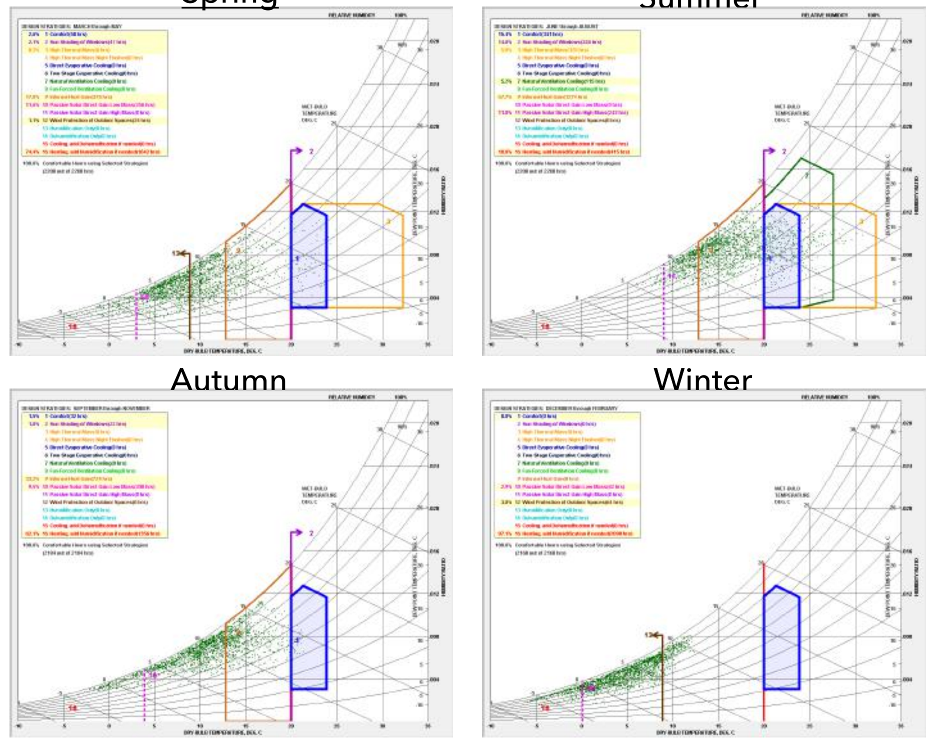
9 AM / 12 PM / 3 PM

PSYCHROMETRICS

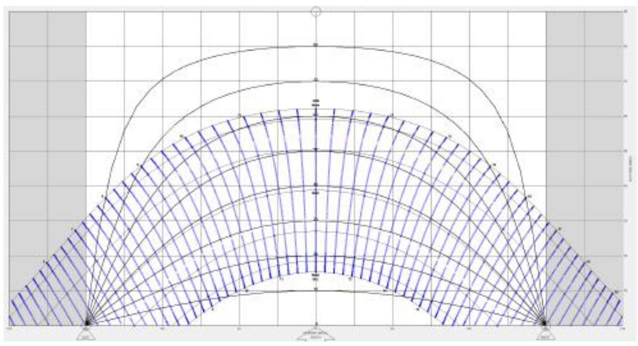
Design Guidelines

The solar shading system should be designed to effectively block the high summer sun from entering the building, while still allowing the low winter sun to pass through the large south-facing windows and warm the space.

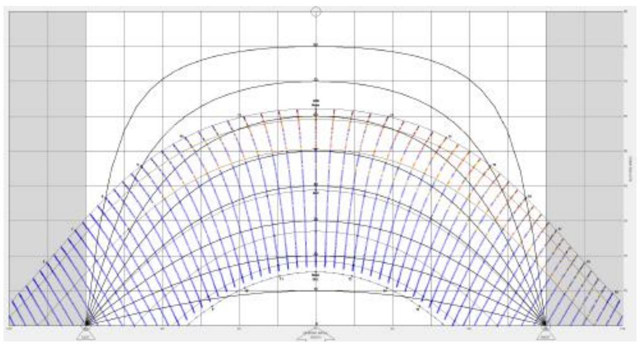
Spring | Summer | Autumn | Winter



SOLAR SHADING DIAGRAMS



Winter & Spring

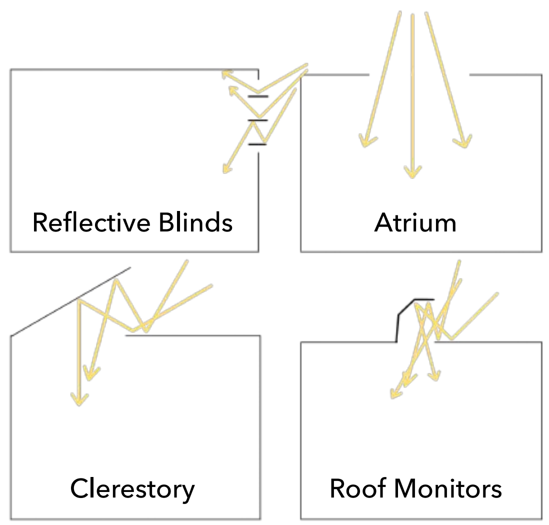


Summer & Autumn

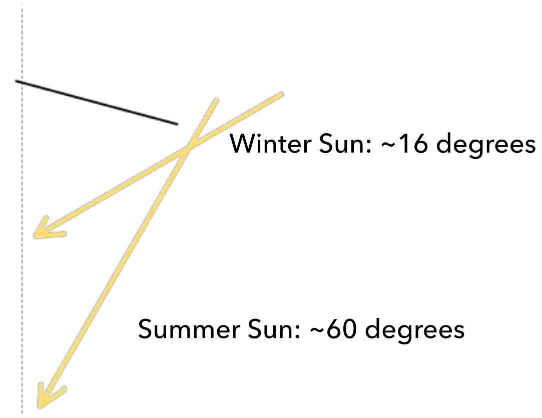
I plan to incorporate a substantial glass component on the South & South-East sides of the building to facilitate natural light penetration, offering warmth during the winter months. Simultaneously, this design will act as a solar shading mechanism to prevent excessive heat during the summer season. Additionally, by incorporating foliage along the South side of the building, sunlight will be dispersed in the summer as the vegetation flourishes, while still permitting light transmission during the winter when the foliage sheds.

PASSIVE DESIGN RESPONSES:

Natural Lighting



sunshades/direct solar gain



CONSULTING THE METRIC HANDBOOK: SPATIAL CONSIDERATIONS

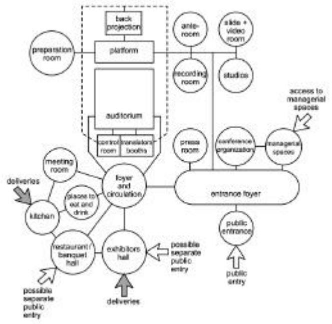
33.79 *Conference hall formats for lectures requiring projection facilities:* **a** *Rectangular with or without rear balcony.* **b** *60° fan with or without rear balcony*

7.03 Functional requirements
With the lecture format the functional requirements include:

- The audience needs to see and hear the speaker, chairman and panel of speakers in the various positions on the platform
- They need a clear view of screens, chalkboard and other visual displays: each has its own physical requirement
- Acoustic clarity of sound listening to speaker and to reproduced sound, and
- Adequate presentation and viewing of any demonstrations.

With the debating format:

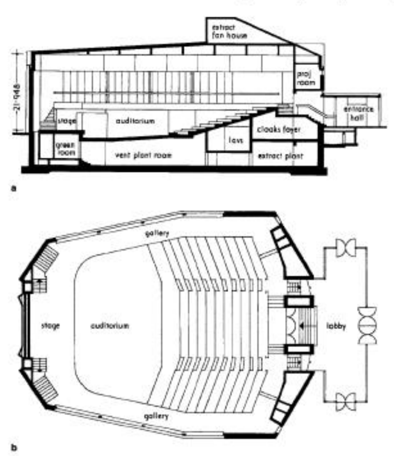
- Awareness of the whole audience by every member
- The audience able to hear all speakers and chairman, and
- A clear view of the chairman.



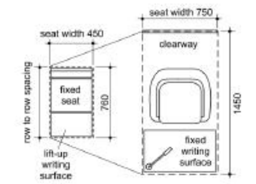
33.78 *Relationship diagram for conference hall*

• Coffin.

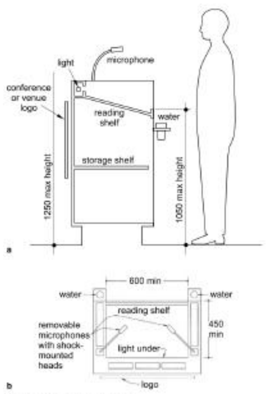
An example of a facility used only for lecturing is shown in **33.81**.



33.81 *Lady Mitchell Hall, Cambridge. A large lecture theatre for 450 students. Architects: Casson, Conder and Partners:* **a** *Longitudinal section.* **b** *Plan of auditorium*



33.20 *Seating density in conference halls, from 0.34 m² to 1.09 m² per person*



33.83 *Lectern:* **a** *Section.* **b** *Plan*

7.06 Lectern
This is the normal position for the speaker. The lectern, should have:

- A top sloping at 15° large enough for two A4 sheets
- An adjustable screened light to illuminate script
- A mounted microphone with switch
- A jack point for lapel microphone
- A microphone connection to simultaneous interpretation and/or recording systems
- A level surface for pencils and glass of water and jug
- Controls for dimming house lights
- Controls for remote operation of projectors and screens
- A manual or motorised raise and lower device for lectern stand
- A hand-operated light pointer
- A teleprompter screen (autocue)
- A clock
- Remote cueing
- Possibly red, yellow and green lights visible to both speaker and audience to indicate time available to speaker
- A shelf below the top for brief-case, demonstration items, etc.
- For presentations using laptop images to be operated by a speaker, horizontal table 900 mm high, adjacent to the lectern, would be necessary.

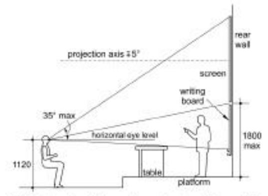
7.05 Platform
Height depends on hall capacity and sightlines:

- 300 mm up to 150 seating capacity
- 600 mm 150–300
- 750 mm over 300.

Steps are required from the auditorium to provide ease of access for speakers onto the platform at ends of gangways and front rows. Ramps may also be needed for wheelchair users.

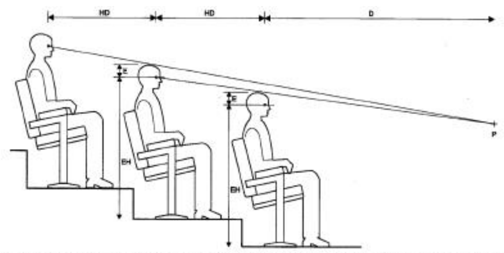
Size and shape depends on extent of audio-visual aids, lectern, demonstration table, panel table and other equipment as well as sightlines and size and shape of auditorium.

The platform may need to accommodate only a single speaker at one time, with no (or limited) audio-visual aids as the least provision, **33.82**. In other cases it will require to allow for scientific demonstrations, a panel of speakers with or without a lectern, or major presentations as with commercial, political and institutional organisations. For major political conferences there can be as many as fifty people to accommodate on the platform.

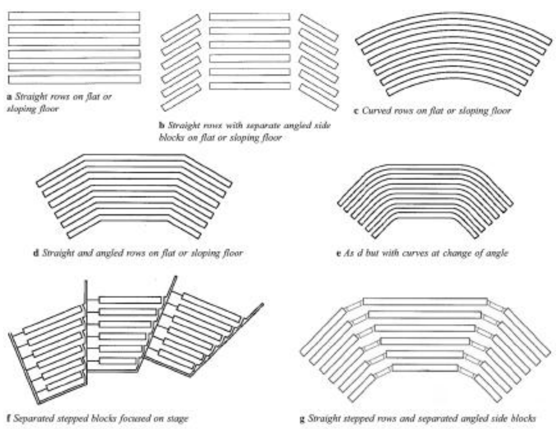


33.82 *Section through lecture theatre showing platform and front wall arrangements*

The setting about the platform can be an architectural setting common to all types of presentations or a shell in which complete new settings can be constructed for each conference.



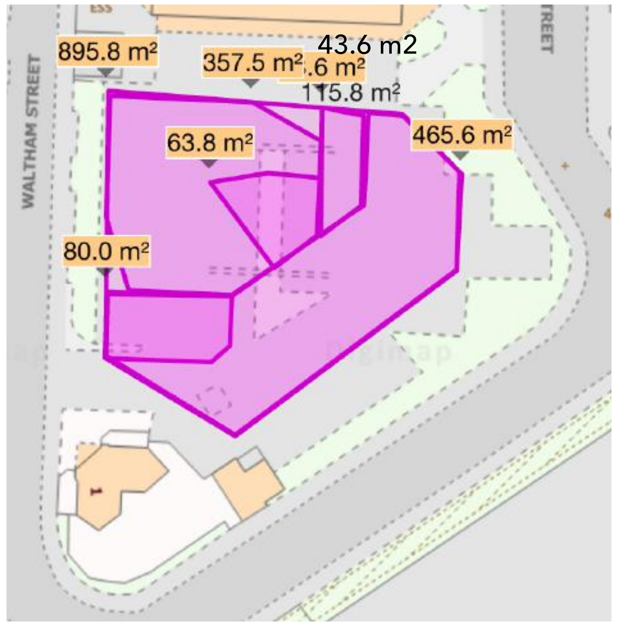
33.21 *Graphic representation of vertical sightlines, P lowest and nearest point on stage clearly visible by audience, HD horizontal distance between eyes in successive audience rows, EH average audience eye height above floor, E height between eye and top of head, D distance from eye of person in front row to P*

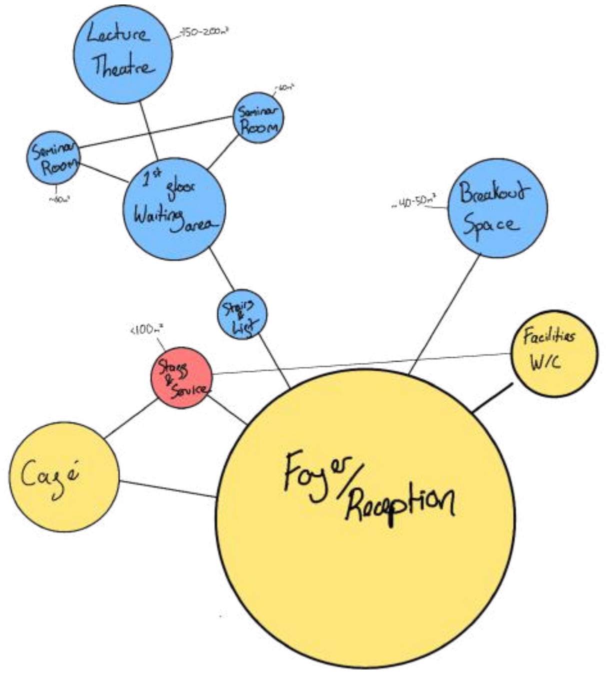


a *Straight rows on flat or sloping floor*
b *Straight rows with separate angled side blocks on flat or sloping floor*
c *Curved rows on flat or sloping floor*
d *Straight and angled rows on flat or sloping floor*
e *As d but with curves at change of angle*
f *Separated stepped blocks focused on stage*
g *Straight stepped rows and separated angled side blocks*

33.17 *Alternative auditorium seating arrangements*

In my lecture theatre, I will be incorporating the 'straight stepped rows and separated angled side blocks' seating arrangement





THEATRE (<350)

Space description

Theatres are designed as education content delivery spaces for large groups, space may also be used for interactive learning through discussion. Refer also to Educational Design Principles within these guidelines.

Adjacencies

This space is to be located adjacent to student / circulation zones.

Components [Expand all]

Planning

Planning

Site factors	-
Room and Spaces Planning Requirements	Proportion should be 1:1.7. Maximum variation 1:2
Design occupancy	150 - 220
Area	1m²/p
Other	Minimum ceiling height 3.2m, for adequate head height or raked to allow minimum 2.7m ceiling height to entire floor. Floor to seating area to rake up to the rear. Maximum rake 1:20. Or be Tiered Allow for wheelchair seating positions to meet Regulation requirements

https://property.mq.edu.au/space_types/teaching_spaces/theatre_350

Active Learning Space - (Informal Breakout Room)

Planning

Site factors	Ideally locate near a student common space and/or a space that allows congregation before and after the room is in use.
Room and Spaces Planning Requirements	Square or rectangular - nominal maximum X:Y, 1:2
Design occupancy	20 - 100
Area	- Approx 2m²/person, depending on desired layout
Other	- Design for complete flexibility with furniture arrangement, device interaction, and subject delivery - Usage is typically transient for 1-4 hour periods - High use space with various user groups.

https://property.mq.edu.au/space_types/teaching_spaces/active_learning_spaces

Lecture rooms

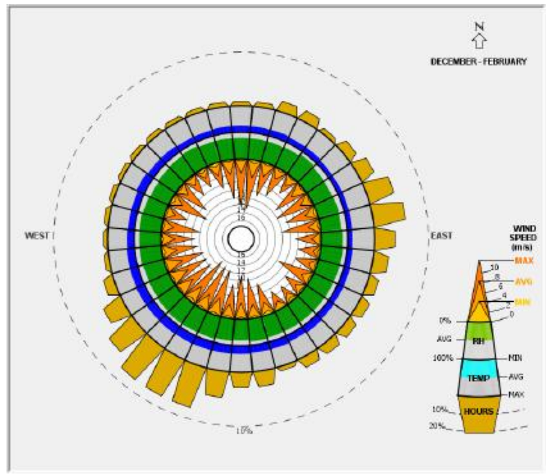
Planning

Site factors	Ideally locate near a student common space and/or a space that allows congregation before and after the room is in use.
Room and Spaces Planning Requirements	Square or maximum X:Y, 1:1.5
Design occupancy	20 - 100
Area	Approx 2m²/p, depending on desired layout
Other	- Design for flexibility with furniture arrangement - Usage is typically transient for 1-4 hour periods - High use space with various user groups.

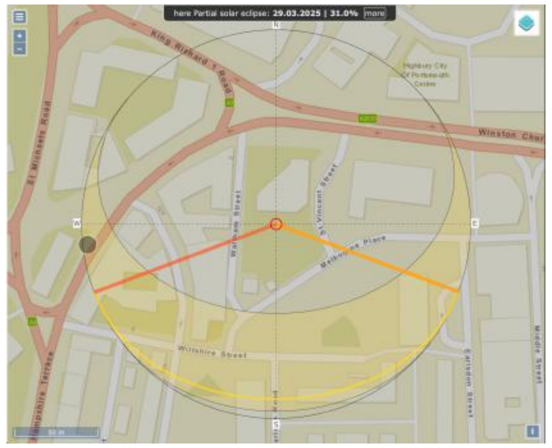
https://property.mq.edu.au/space_types/teaching_spaces/tutorial_room

CONCEPTUAL VOLUMETRIC MASSING BASED ON WIND AND SUN DATA

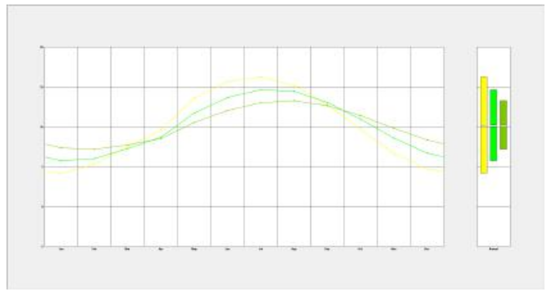
Wind Rose



Sun Path

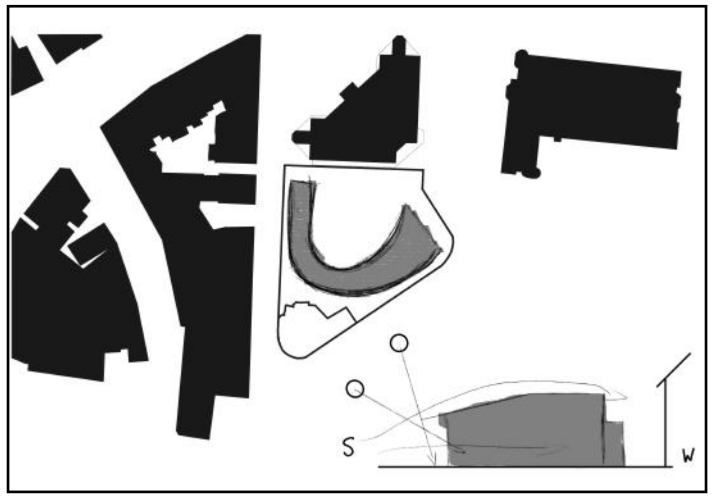


Ground Temperature

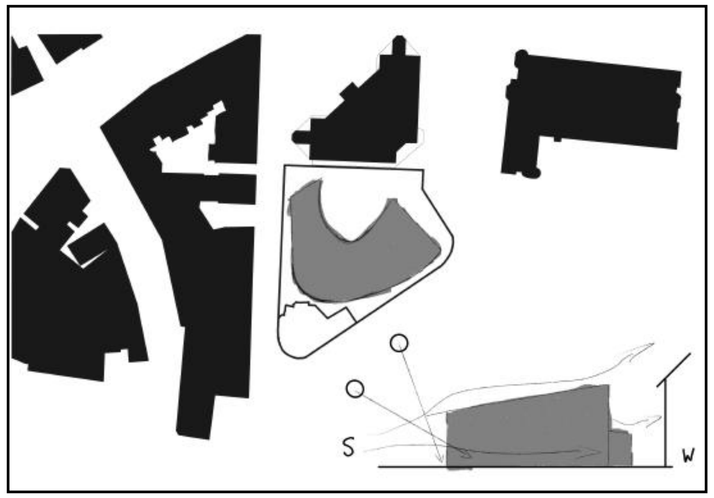


MASSING OPTIONS

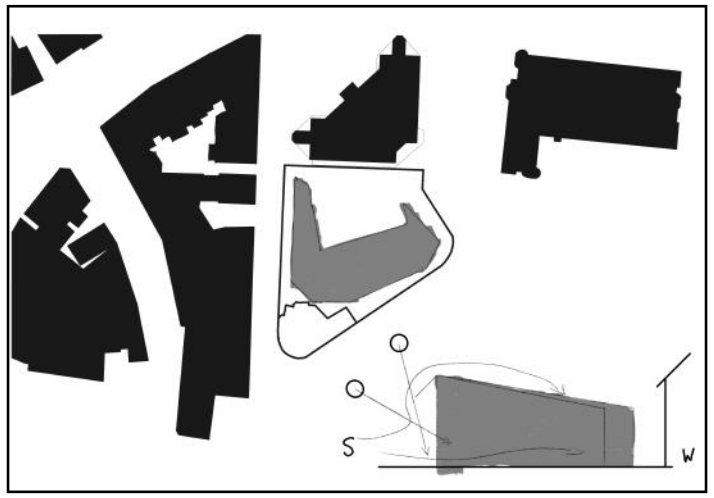
Iteration 1



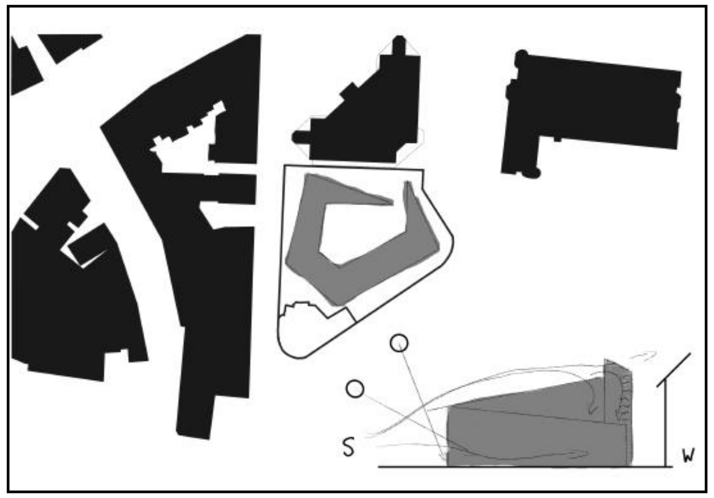
Iteration 2



Iteration 3

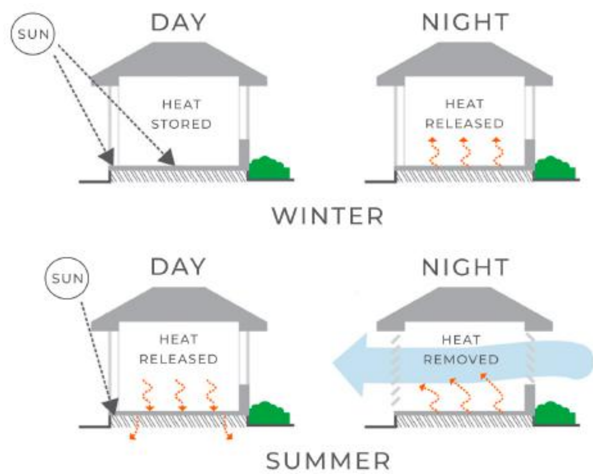


Iteration 4



High Thermal Massing will result in retention of heat during the hours of daylight which can be used at night. This will obviously be less effective in winter due to fewer hours of daylight and the reduced thermal effect of the sun. Due to the high specific heat capacity of seas, sea water retains heat longer than land, thereby heating the inland wind during the autumn and winter seasons, meaning less heat retention is needed.

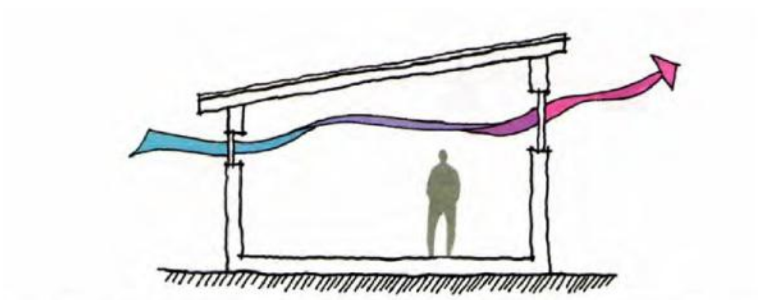
High thermal mass



https://acarchitects.biz/thermal-mass/

PASSIVE DESIGN RESPONSE STRATEGIES:

Cross ventilation

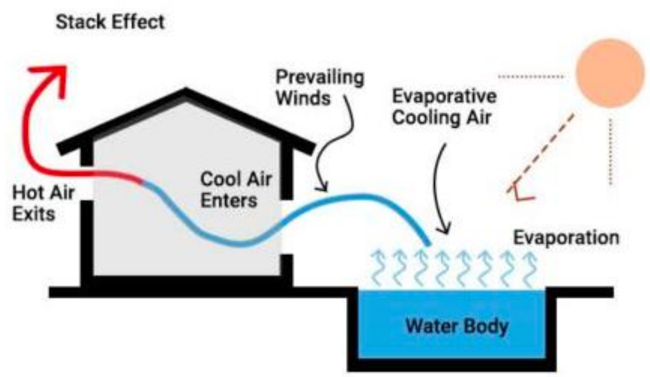


4.153 High inlets and outlets provide structural cooling but no air movement at occupant level. KATE BECKLEY

I will also implement cross ventilation by utilising the existing wind tunnel on site, thereby promoting a pleasant airflow and a reduction of heat during the summer months.

https://ssb2012alg4nr.wordpress.com/2012/11/06/cross-ventilation/

Evaporative cooling



I will also take into consideration the implementation of an evaporative cooling feature located to the southern side of the building. This will serve a dual purpose of not only providing a cooling effect but also creating a calming environment for the students both inside and in close proximity to the building.

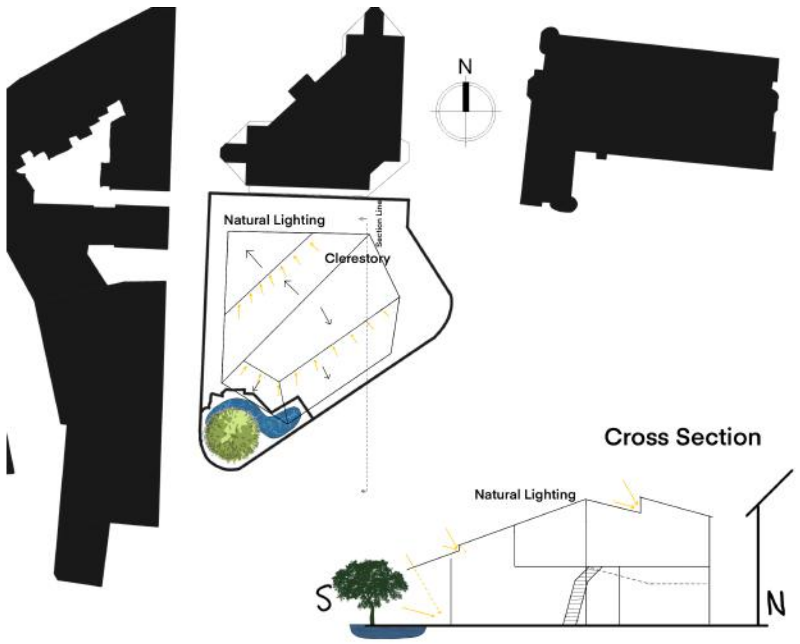
https://layakarchitect.com/passive-cooling/

DESIGN CONCEPT- PASSIVE DESIGN INTEGRATION

Acoustics: I have designed the lecture hall in a way that funnels the voice of the presenter allowing uniform acoustic delivery for the recipients.

Solar Shading: I am implementing measures to minimise excessive sunlight and heat in the main foyer area by designing a substantial overhang above the southern walls of the exterior curtain wall. This overhang will effectively block the intense summer sun while still allowing the gentle winter sun to enter. Additionally, I will incorporate strategically placed trees and foliage to further enhance the shading effect on the southern side of the building.

Evaporative Cooling: I have integrated a water element to induce evaporative cooling prior to the prevailing wind interacting with the building facade. Additionally, the water feature adjacent to the building offers a serene environment for students.

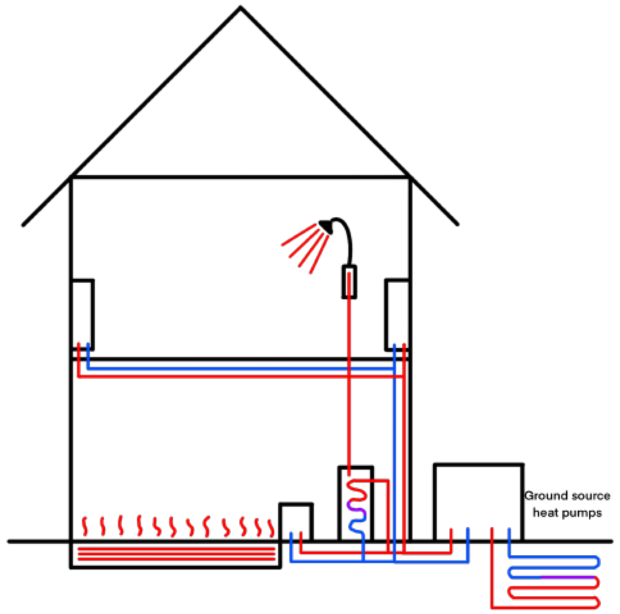


Natural Lighting: In order to enhance the illumination in the foyer and lecture theatre, I have implemented clerestories at various locations. The clerestories situated above the lecture theatre effectively regulate the intensity of sunlight during the summer months by permitting only indirect light to enter.

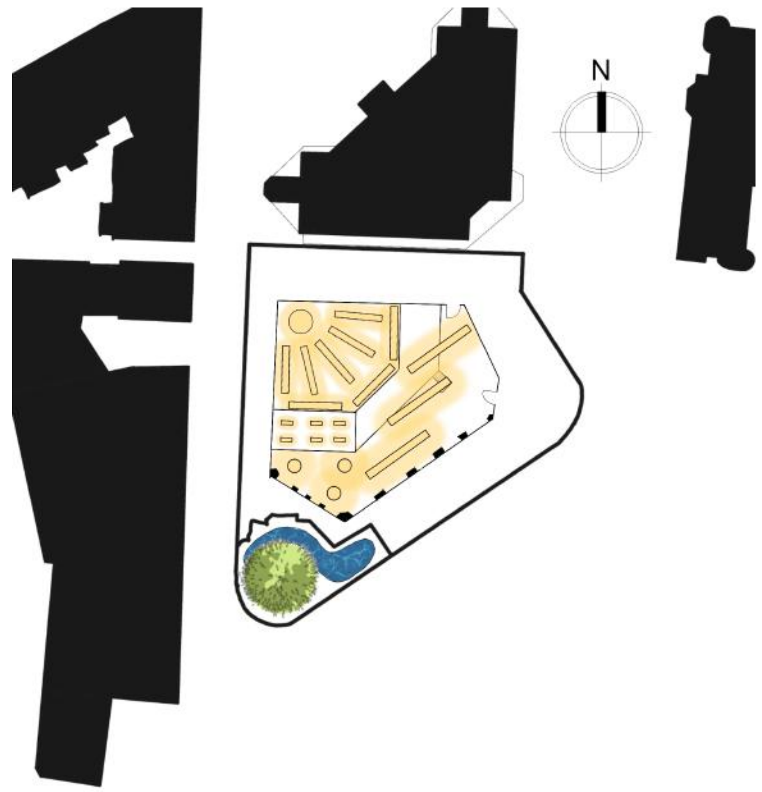
Wind Diffusion: As a result of the significant prevailing Southern wind, the design of the building incorporates measures to prevent wind impact, along with strategically placed trees and foliage to disperse the wind and create a sheltered and tranquil space.

DESIGN CONCEPT: ACTIVE DESIGN INTEGRATION

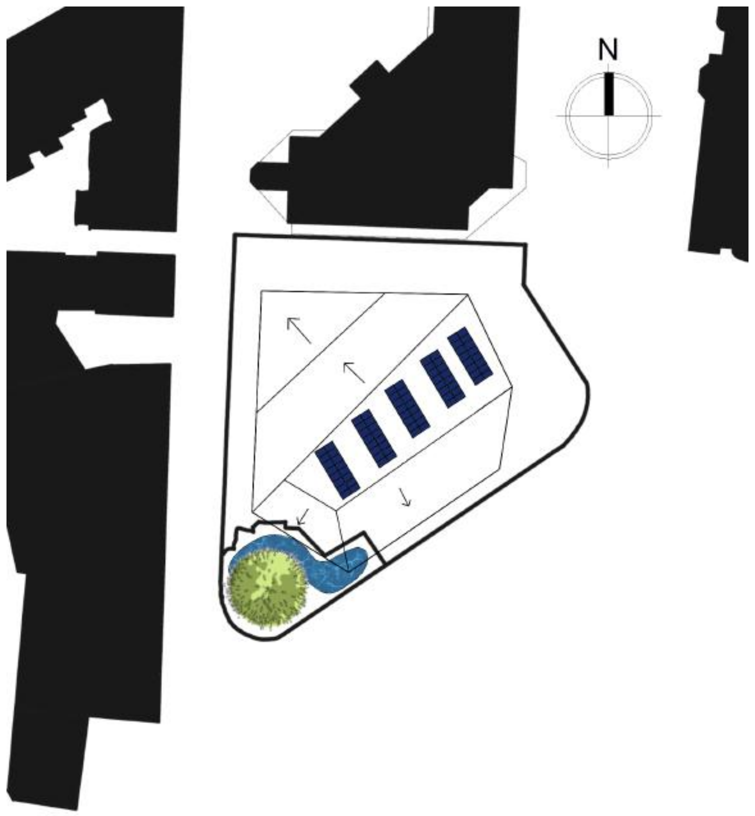
Ground Source Heat Pumps:
In addition, I will be implementing artificial heating methods, including the utilisation of ground source heat pumps. These systems will be located in the services area situated on the ground floor beneath the lecture theatre.



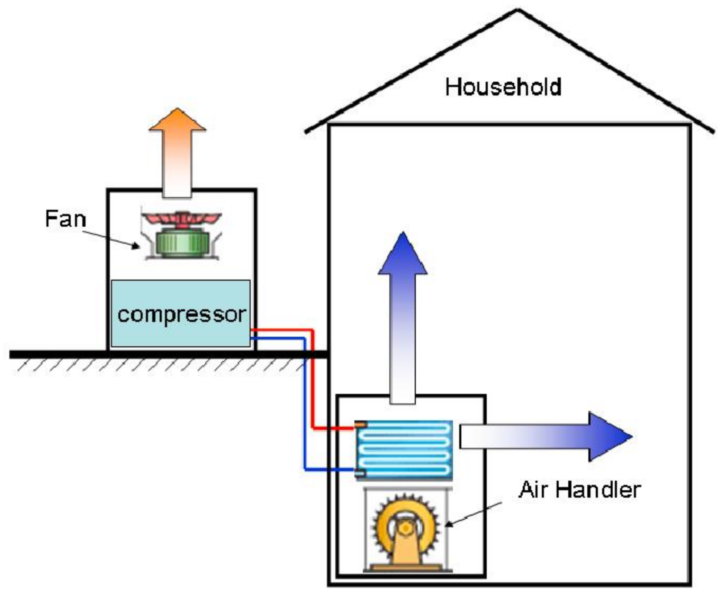
Artificial Lighting:
I intend to utilise a range of artificial lighting sources, particularly in areas where natural light is insufficient. Furthermore, I have made efforts to optimise the lighting-to-space ratio to ensure effective illumination.



Solar Energy:
The sloped roofing provides a prime opportunity to incorporate solar panel systems, capitalizing on their optimal sun exposure due to the roof's south-facing positioning.



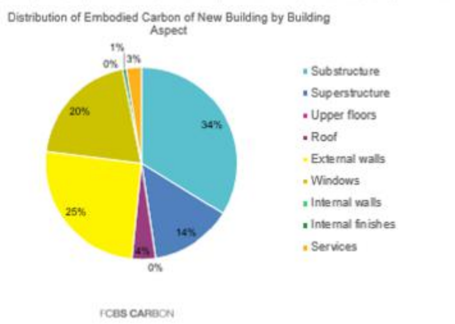
Air Conditioning:
Additionally, I will be implementing artificial ventilation as there are certain areas in the building where natural ventilation may not be sufficient and does not adequately reach all rooms.

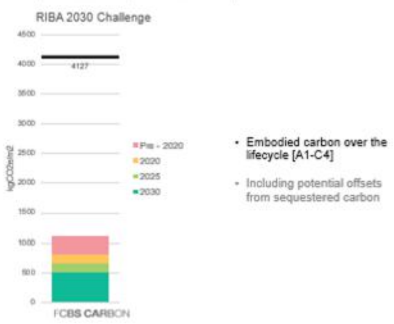


https://www.researchgate.net/figure/The-Configuration-of-an-Air-Conditioner-Unit_fig1_255206351

EMBODIED CARBON ANALYSIS

Building Details		
Supplied on 0. INPUT Project Details		
Building Name	Lecture Hall B	
Sector	office	
Sub-sector	office	
GIA	1000	m2
Associated with selected sub-sector		
Grid size	7.5	m
Partitions factor	0.1	
RIBA 2030 Challenge Category	Non-domestic	
Imposed floor load	2.5	kN/m2
User inputs required		
Building perimeter	1300	m
Building footprint	1000	m2
Building width	33	m
Floor-to-floor height	4	m
No. storeys ground & above	2	
No. storeys below ground	0	
Glazing ratio	33	%

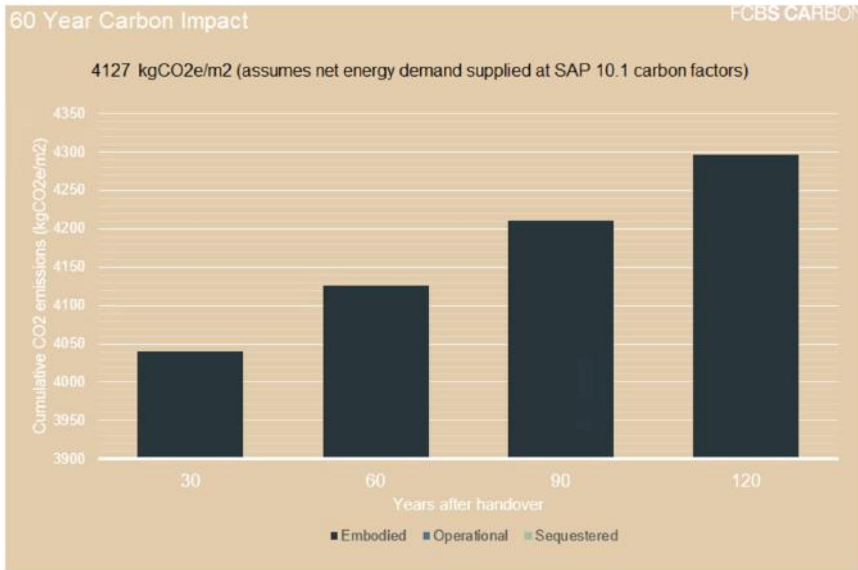




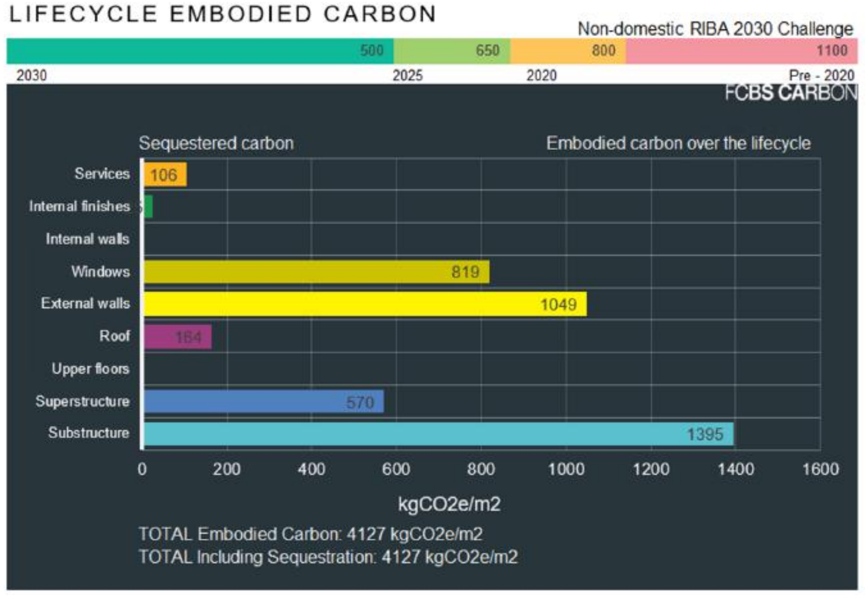
Building Aspect	Building Element	Material	Existing fabric?	Age if existing?	Adjustment Factor (%)	Component Life (years)	Designed for disassembly?	Estimated Quantity	Units	Life cycle embodied carbon estimate A - C (kgCO2e/m2)	A1 - A3 Biogenic carbon (sequestered kgCO2e/m2)	Potential benefits beyond the system boundary D (kgCO2e/m2)	Assumptions	Notes
Substructure	Piles	Steel	New				No	31.2	m3	736.0	0.0	0.0	15 m depth, 600 mm diameter, 16 mm thick, 500 kN per pile calculated dynamically based on building weight.	
Substructure	Pile caps							0.0		0.0	0.0	0.0		
Substructure	Capping beams							0.0		0.0	0.0	0.0		
Substructure	Raft	RC 32/40 (150kg/m3 rein	New				No	600.0	m3	403.1	0.0	0.0	600 mm raft thickness	
Substructure	Basement walls							0.0		0.0	0.0	0.0		
Substructure	Lowest floor slab	RC 32/40 (150kg/m3 rein	New				No	300.0	m3	201.6	0.0	0.0	300 mm slab thickness	
Substructure	Ground insulation	XPS	New				No	250.0	m3	54.1	0.0	0.0	250 mm insulation thickness	
Superstructure	[illegible]rastructure	RC 32/40 (100kg/m3 rein	New				No	109.4	m3	66.3	0.0	0.0	200 mm wall thickness	
Superstructure	Columns	Steel	New				No	2.6	m3	61.1	0.0	0.0	UC 254 x 254	
Superstructure	Beams	Steel	New				No	18.8	m3	443.1	0.0	0.0	UB 533 x 210	
Superstructure	Secondary beams							0.0		0.0	0.0	0.0		
Upper floors	Floor slab	RC 32/40 (100kg/m3 rein	New				No	0.0	m3	0.0	0.0	0.0	150 mm slab thickness. For a flat slab, set an Adjustment Factor of 2 for 300 mm slab thickness and remove any beams.	
Upper floors	Joisted floors							0.0		0.0	0.0	0.0		
Roof	Roof	RC 32/40 (100kg/m3 rein	New				No	150.0	m3	90.9	0.0	0.0	150 mm slab thickness	
Roof	Roof insulation	Glass mineral wool	New				No	250.0	m3	29.6	0.0	0.0	250 mm insulation thickness	
Roof	Roof finishes	Zinc Standing Seam	New				No	1000.0	m2	43.7	0.0	0.0	1.5mm thick zinc.	
External walls	Facade	Curtain Walling	New				No	6968.0	m2	671.4	0.0	0.0	Double glazing with aluminium framing at 1.2m horizontal and vertical centres	
External walls	Wall insulation	XPS	New				No	1742.0	m3	377.1	0.0	0.0	250 mm insulation thickness	
Windows	Glazing	Triple Glazing	New				No	55.6	m3	321.1	0.0	0.0	Three panes of 6 mm glass	
Windows	Window frames	Aluminium	New				No	12870.0	m	497.8	0.0	0.0	2mm thick hollow aluminium frame with internal webbing.	
Internal walls	Partitions							0.0		0.0	0.0	0.0		
Internal finishes	Ceilings							0.0		0.0	0.0	0.0		
Internal finishes	Floors	Stoneware tile	New				No	1000.0	m2	24.7	0.0	0.0	10 mm tile thickness	
Services	Services	High	New				No	1000.0	m2	104.1	0.0	0.0	High tech, full air conditioning (80 kgCO2e/m2)	
								0.0		0.0	0.0	0.0		

According to the Embodied Carbon Analysis; my most polluting building aspect is my **substructure**, which is mostly made of concrete although, within the substructure aspect it would seem that the use of **steel pillars** is the element with the highest *embodied carbon life-cycle estimate*. The second greatest polluter is apparently my **exterior walls**, specifically the **curtain walling** element, although I think a contributing factor of this is that the quantity of curtain walling and framing was over-estimated by the algorithm.

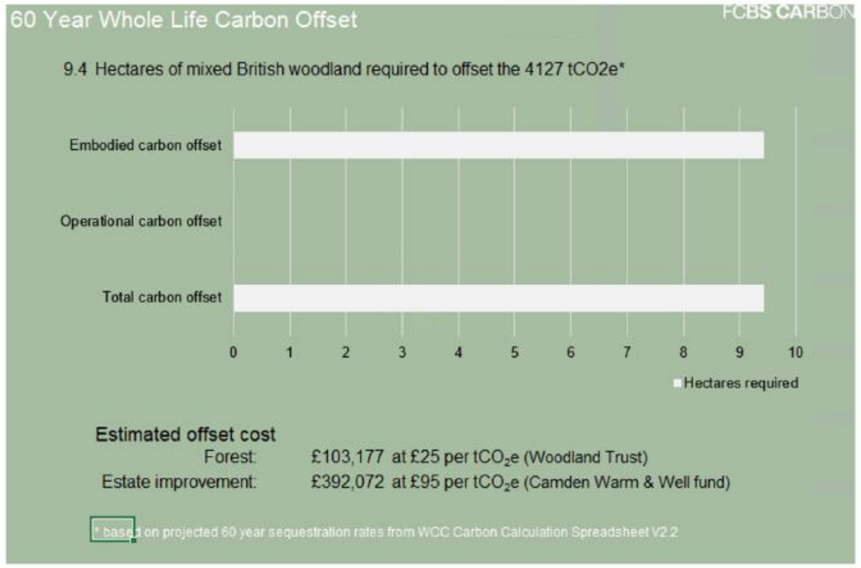
WHOLE LIFE CARBON



LIFECYCLE EMBODIED CARBON

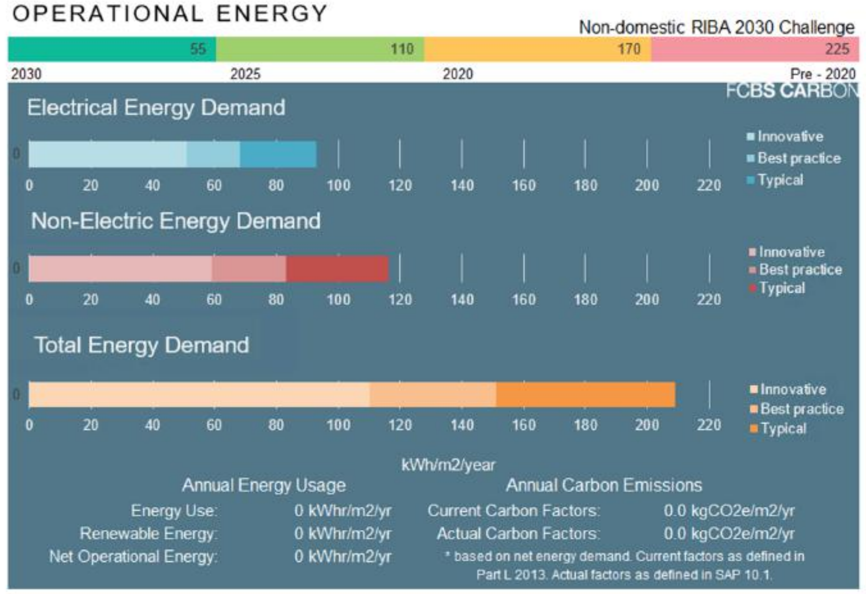


OFFSET CARBON



According to the estimated 60 year **carbon offset** chart it would take *94,000sqm* of woodland to offset the carbon production of my building.

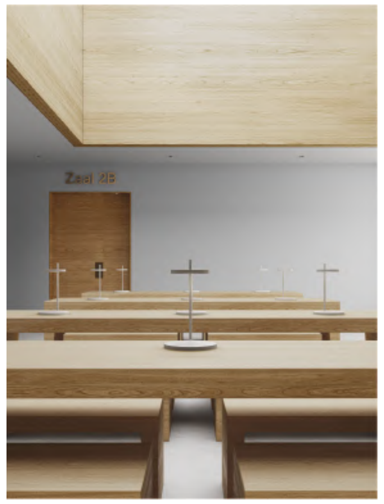
OPERATIONAL ENERGY

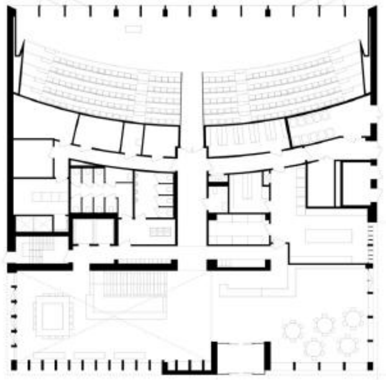
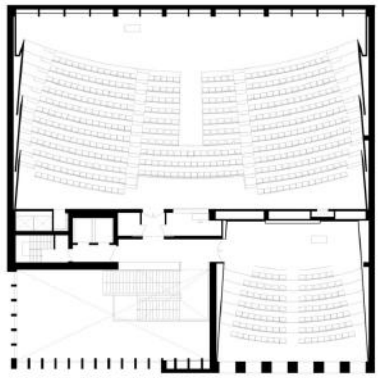
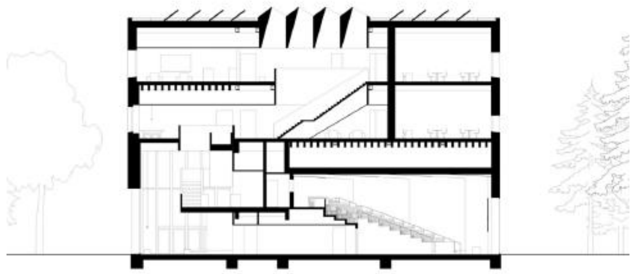


STRUCTURAL DESIGN & DETAILING

PRECEDENTS- LECTURE HALLS

Tilburg University

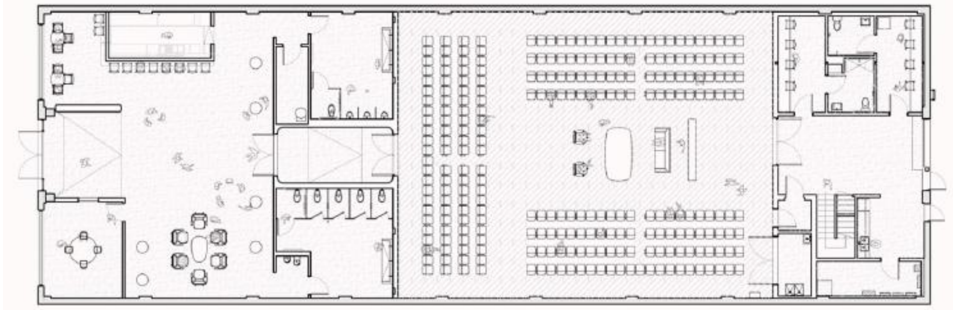




Dutch studio Powerhouse Company designed the Netherlands' first mass-timber university building, a square lecture hall in Tilburg. The sustainable and circular approach includes a hybrid structure made mostly of cross-laminated timber, a concrete core, and steel trusses. The building will be demountable and its limestone facade panels will be recyclable. The architects focused on acoustic performance and views onto the forest for the largest lecture hall. The design is energy-neutral with a flat rooftop for solar panels and other energy-saving features. Powerhouse Company achieved a carbon-neutral, circular, and BREEAM Outstanding design.

https://www.dezeen.com/2022/01/28/powerhouse-company-mass-timber-lecture-hall-tilburg-university-architecture/

Detroit Public Teatre

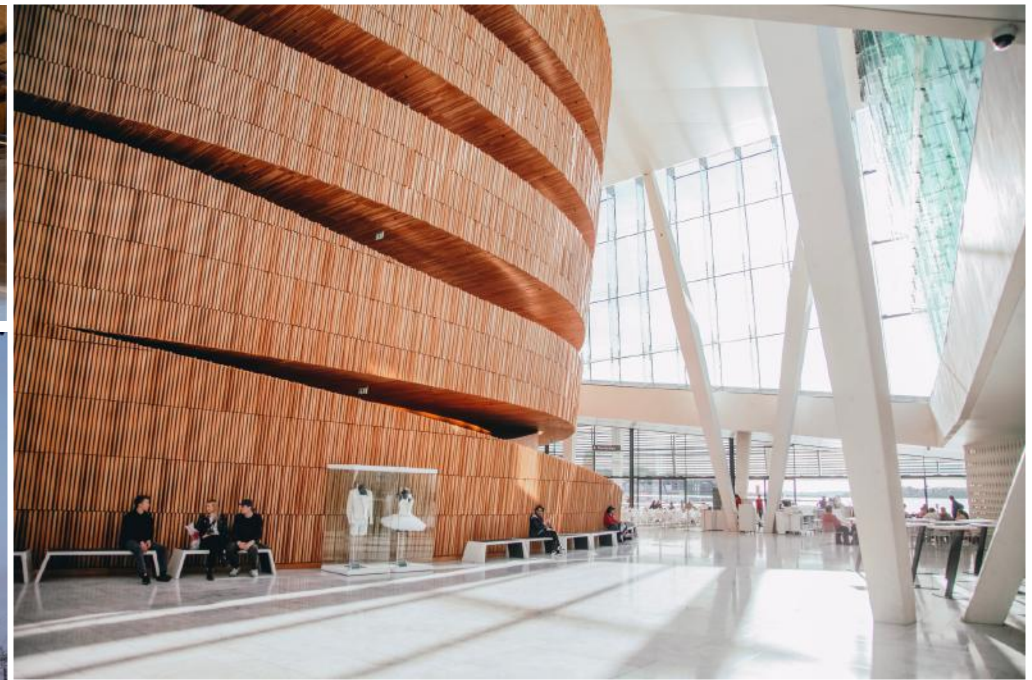


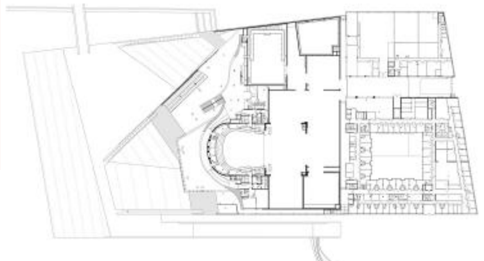
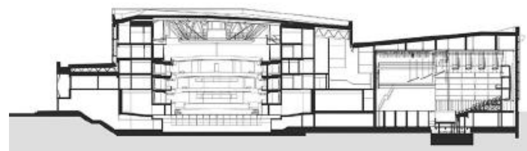



US architecture firm Dash Marshall has transformed a historic garage in Detroit into a performing arts theatre. The 7,000-square foot brick building now serves as the new home for the Detroit Public Theatre, and features a flexible black box theatre that seats 200 people. The renovation involved painting the exterior a dusty black colour, exposing the original brick walls and wooden roof on the interior, and adding light-coloured walls. The space includes a front of house area with a new brick bar and seating space, as well as a flexible open lobby.

https://www.dezeen.com/2023/11/06/dash-marshall-detroit-public-theatre/

Oslo Opera House



https://www.scandinaviastandard.com/take-a-tour-of-the-oslo-opera-house/

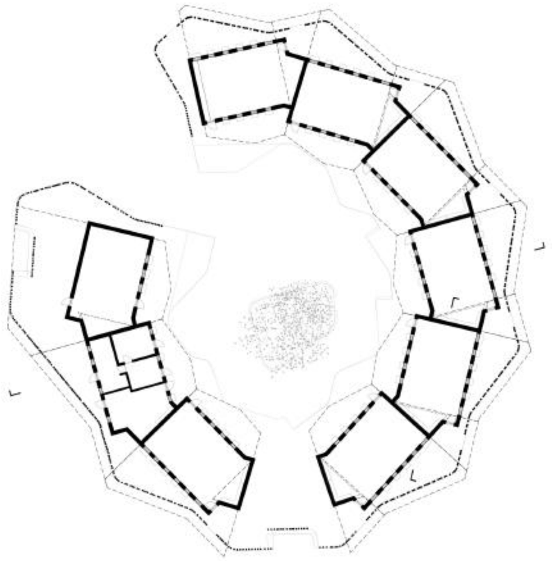
The Oslo Opera House is situated on the Bjørvika peninsula in the Oslo Harbour. It incorporates three main concepts: the Wave Wall, the Factory, and the Carpet. The Wave Wall represents the meeting point between Norway and the rest of the world, acting as a large wall for public engagement with opera and ballet. The Factory concept ensures the opera house's self-sufficiency and adaptability, allowing for flexible room configurations. The Carpet concept emphasises togetherness and open access, with the building's design resembling a carpet and blending with the cityscape. Materials, such as white stone, timber, metal, and glass, were chosen for their defining properties to create the desired aesthetic and functionality. The building is divided by the Opera Street corridor, with public and stage areas to the west and production areas to the east. The main auditorium, designed for opera and ballet, accommodates approximately 1370 visitors and features adaptable orchestra pits and mobile towers. Excellent acoustics and visual intimacy are achieved through architectural intentions, including a clean, modern aesthetic and various design elements. The auditorium is illuminated by a Snøhetta-designed chandelier and LED fittings.

https://www.archdaily.com/440/oslo-opera-house-snohetta

PRECEDENTS- STRATEGIES

LYCÉE SCHORGE SECONDARY SCHOOL

https://www.dezeen.com/2017/06/23/diebedo-francis-kere-local-materials-ring-shaped-school-burkina-faso/



Wind-catching towers can be seen rising from the circular rippled roof of this brick and wood school building in Koudougou, Burkina Faso. This was crafted by renowned architect Diébédo Francis Kéré, who also designed the prestigious Serpentine Pavilion. The building incorporates various advanced cooling techniques, with a notable feature being the utilisation of a central courtyard water body for evaporative cooling. This ingenious system effectively cools and slightly humidifies the surrounding hot air, offering optimal comfort.

'House with a Light Void' by FujiwaraMuro Architects in Hyogo, Japan features five cement-clad boxes with overhead illumination. Due to privacy concerns and lack of attractive views, the architects utilised skylights to bring in natural light to the 85-square-meter building. This approach is common in densely populated Japanese cities and suburbs where street-facing windows are often absent.

HOUSE WITH A LIGHT VOID

https://www.dezeen.com/2021/01/28/house-with-light-void-fujiwaramuro-architects-hyogo-japan/

FIFTH + TILLERY OFFICE, AUSTIN, TEXAS

American architecture studio Gensler created the Fifth + Tillery office in Austin, Texas. The three-storey mass-timber office complex features a canopy of photovoltaic panels that provide shade for the plaza and roof terrace. The building, located on a former industrial site near the Colorado River, includes a tree-lined central courtyard that extends through the upper levels. The courtyard is designed to resemble the native ravine microhabitats of Central Texas and can be viewed from many of the interior spaces. Gensler aimed to create a more social and communal building by turning a traditional office building inside out. The facades have punched window openings to shade the interiors, while continuous glass facades were used in areas with more shading.

https://www.dezeen.com/2022/06/13/gensler-fifth-tillery-solar-panel-canopy-austin/

MATERIALS EXPLORATION

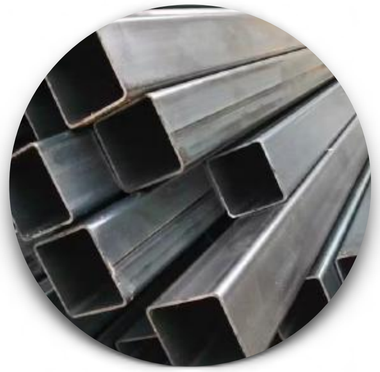
PRIMARY STRUCTURE

Concrete

https://www.google.com/url?sa=i&url=https%3A%2F%2Flesvrais.com%2Fmaterials%2Fconcrete%2F&psig=AOvVaw0TgHz8-dbfp7zJZ5eW_c5-&ust=1706625448144000&source=images&cd=vfe&opi=89978449&ved=0CBYQ3YkBahgKEwiAn5DV6YKEAxUAAAAAHQAAAAAQzwI

Concrete is a highly durable and low maintenance material that offers thermal mass, leading to reduced energy consumption in operational buildings. There are numerous advantages associated with concrete. It is cost-effective and has a long lifespan with minimal maintenance requirements. Concrete possesses excellent compressive strength and is easily mouldable in its pliable state prior to hardening. Furthermore, it is non-combustible. To reinforce the wide-span structure of my concrete roof, I will incorporate pre-stressed steel reinforcements to effectively withstand tensional forces. Additionally, to address the relatively high embodied carbon content of concrete, I plan to incorporate recycled materials like RCA, GGBS, and PFA into the concrete mix.

Steel



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.xometry.com%2Fresources%2Fmaterials%2Fcarbon-steel%2F&psig=AOvVaw3F2yn-ABXlLq12ZSsG5vkt&ust=1706625950446000&source=images&cd=vfe&opi=89978449&ved=0CBYQ3YkBahcKEwjIj82e64KEAxUAAAAAHQAAAAAQDA

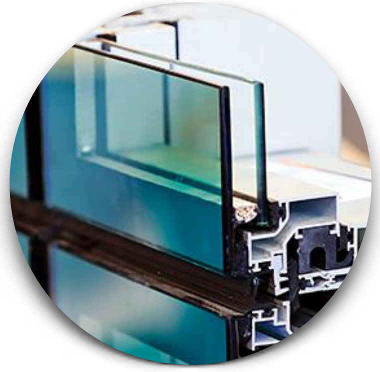
Steel structures are frameworks made of steel columns and beams. They are joined together using methods like riveting, welding, or bolting, often in a grid-like pattern. They are commonly used in medium and high-rise buildings, industrial facilities, warehouses, and residential dwellings.

Steel structures offer numerous advantages, including earthquake and wind load resistance, easy assembly and disassembly, fast construction time, fire resistance with proper treatment, compatibility with other construction methods, simple joinery, precise fabrication offsite, high strength-to-weight and strength-to-volume ratios, the ability to create long clear spans with narrow columns, and the option for an exposed appearance.

For this project, I will be implementing a wall bearing framing system. This type of framing requires the assembly of masonry walls on the exterior and interior of the building. The structural steel members will then be secured to the masonry walls using anchor bolts.

Double glazed glass

Glass curtain wall systems offer excellent thermal efficiency. Designed with double-glazed panels that meet high performance standards comparable to those of opening windows and sliding doors, a glass curtain wall effectively prevents heat loss in the building. These curtain walls provide expansive glass facades without compromising the structural integrity or security of the building.



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.which.co.uk%2Freviews%2Fdouble-glazing%2Farticle%2Fhow-to-buy-double-glazing%2Fchoosing-double-glazed-windows-and-doors-auxkN5y2Y0Zn&psig=AOvVaw3qrY1VwuTPf0sj7t7E9C0f&ust=1706626246921000&source=images&cd=vfe&opi=89978449&ved=0CBYQ3YkBahcKEwjQ3L2q7IKEAxUAAAAAHQAAAAAQBg

Insulation

https://wtinsulation.en.made-in-china.com/product/HwWtxzlrgIVM/China-Thermal-Insulation-Material-PIR-Foam-Rigid-Foam-Insulation-Board-with-Aluminum-Foil.html

Insulation serves various purposes in the construction industry:

1. Thermal insulation: It is used to hinder heat transfer, especially between the interior and exterior of a building.
2. Acoustic insulation: It is employed to prevent sound transmission, such as between recording studios and performance areas.
3. Fire insulation: Its purpose is to impede the spread of fire between sections or components.
4. Electrical insulation: It is utilised to confine and isolate electrical conductors.

External Walls

Thermal insulation minimises heat transfer in enclosed spaces like buildings. External wall insulation (EWI) adds insulation material and finish to outer walls, enhancing thermal performance. Benefits of EWI include reduced heat loss, lower energy costs, less condensation, aesthetic flexibility, decreased summer heat gain, space savings, improved weather resistance and comfort, preservation of existing substrate, and non-disruptive installation. However, EWI increases wall thickness, potentially creating challenges around openings and roof overhangs, and may limit wall access and hide underlying issues.

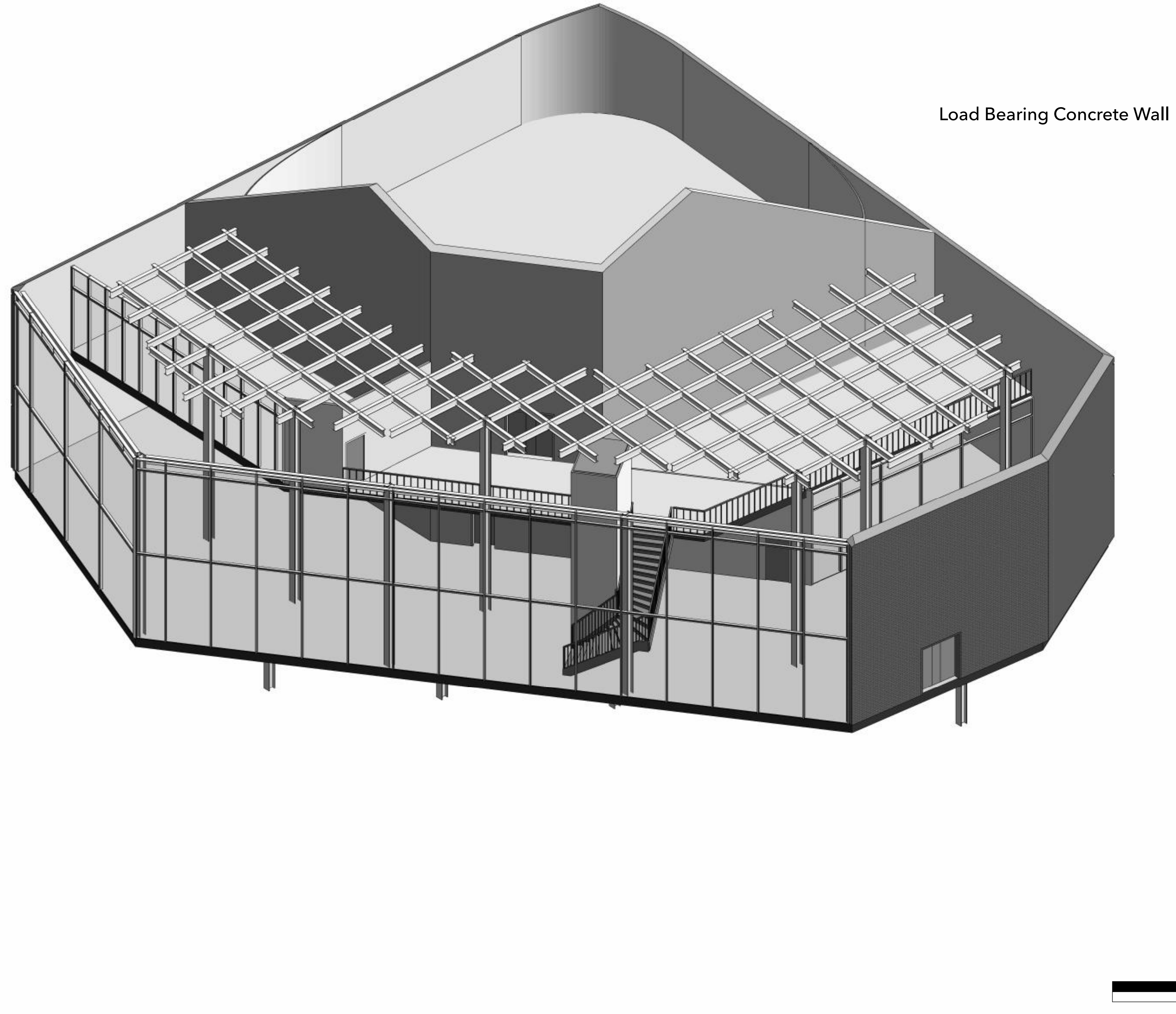
Floor

Insulation present in the flooring effectively retains heat within the building and prevents the transfer of cold from the foundations. Placement of the insulation below the slab enhances the building's thermal capacity, aiding in the maintenance of consistent internal temperatures. On the other hand, if the insulation is installed above the slab, the building will respond more promptly to the heating system. I will therefore be inserting my insulation below the floor slab to increase the thermal capacity.

Roof

For my roof, I have chosen to install a Warm Roof. This entails placing insulation directly beneath the roof, within the plane of the roof pitch. As a result, the loft space below is also kept warm.

Regarding the chosen insulation type, I will be utilising foam board insulation. These are rigid panels of insulation that are accurately shaped and installed in the designated areas. The most common materials used for these panels are polystyrene, polyisocyanurate, and polyurethane. The insulation depth typically ranges around 175 mm.



No.	Description	Date

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UP2068014

University House Lecture Hall

Isometric

Project number	0001
Date	14.01.2024
Drawn by	Max Trott-Fenning
Checked by	Checker

A107

Scale @ A3 1:200

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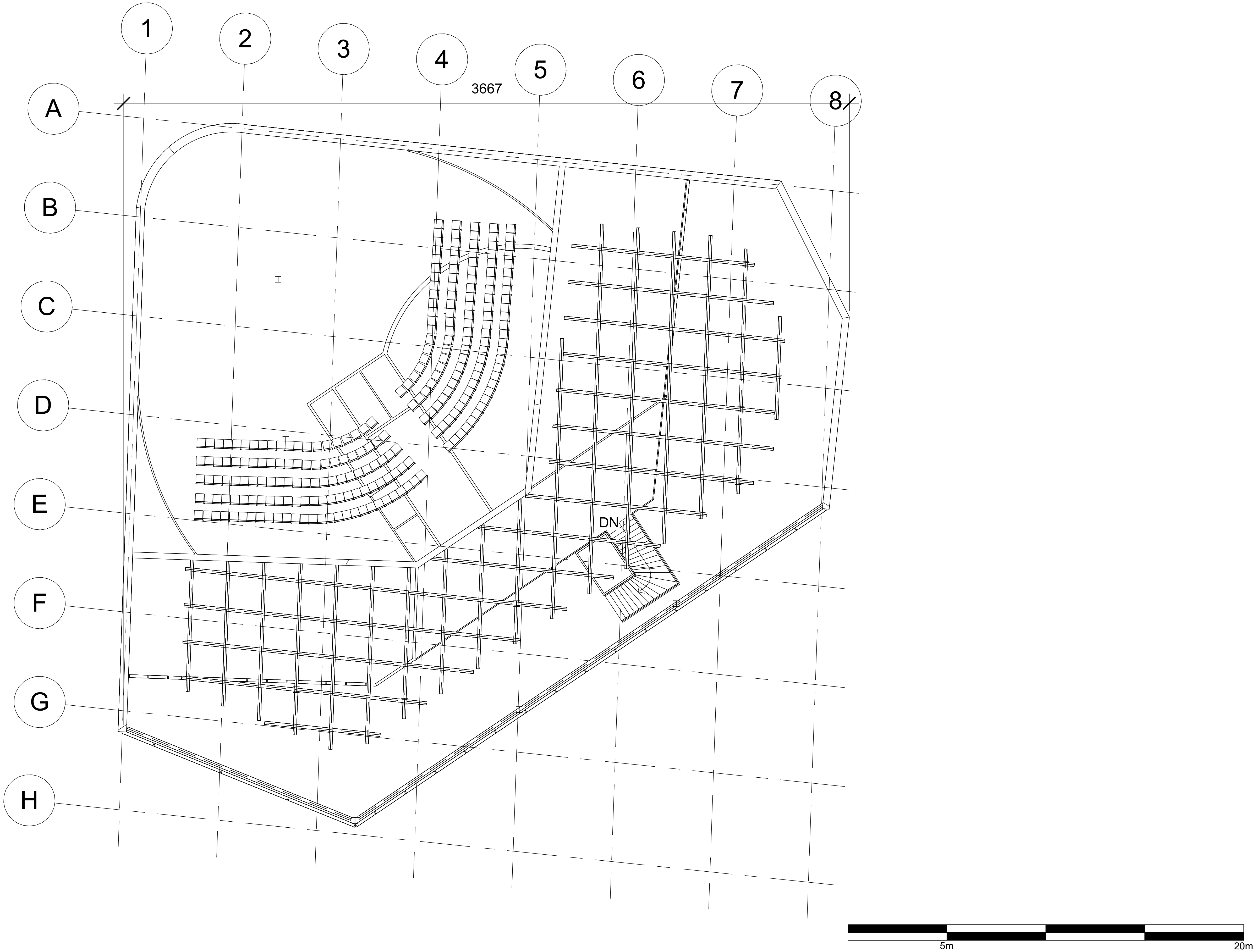

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No.	Description	Date

UP2068014

University House Lecture Hall

Site Plan

Project number	0001
Date	14.01.2024
Drawn by	Max Trott-Fenning
Checked by	Checker

A103

Scale @ A3 1 : 200

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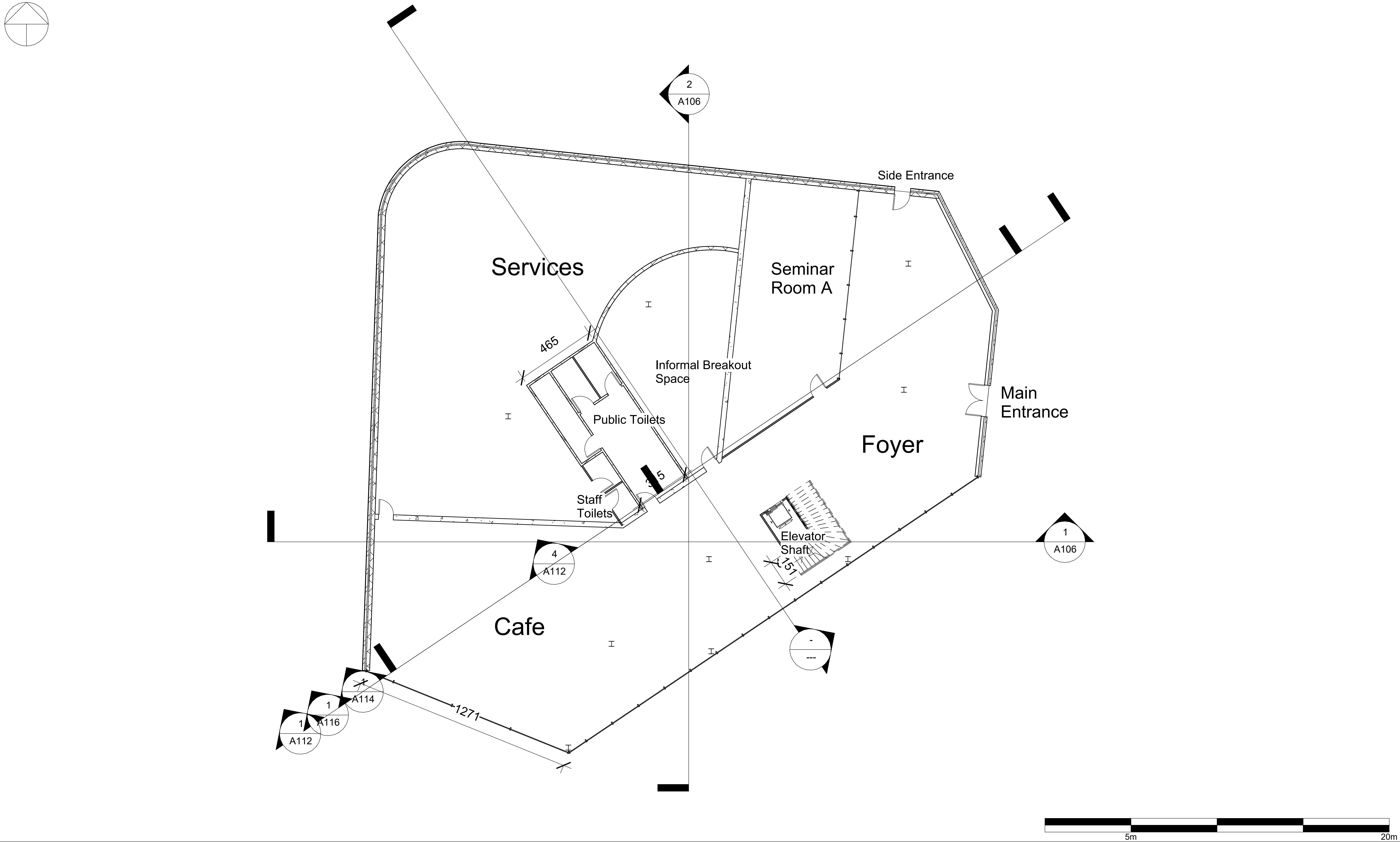

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No.	Description	Date

UP2068014

University House Lecture Hall

Ground Floor

Project number	0001
Date	14.01.2024
Drawn by	Max Trott-Fenning
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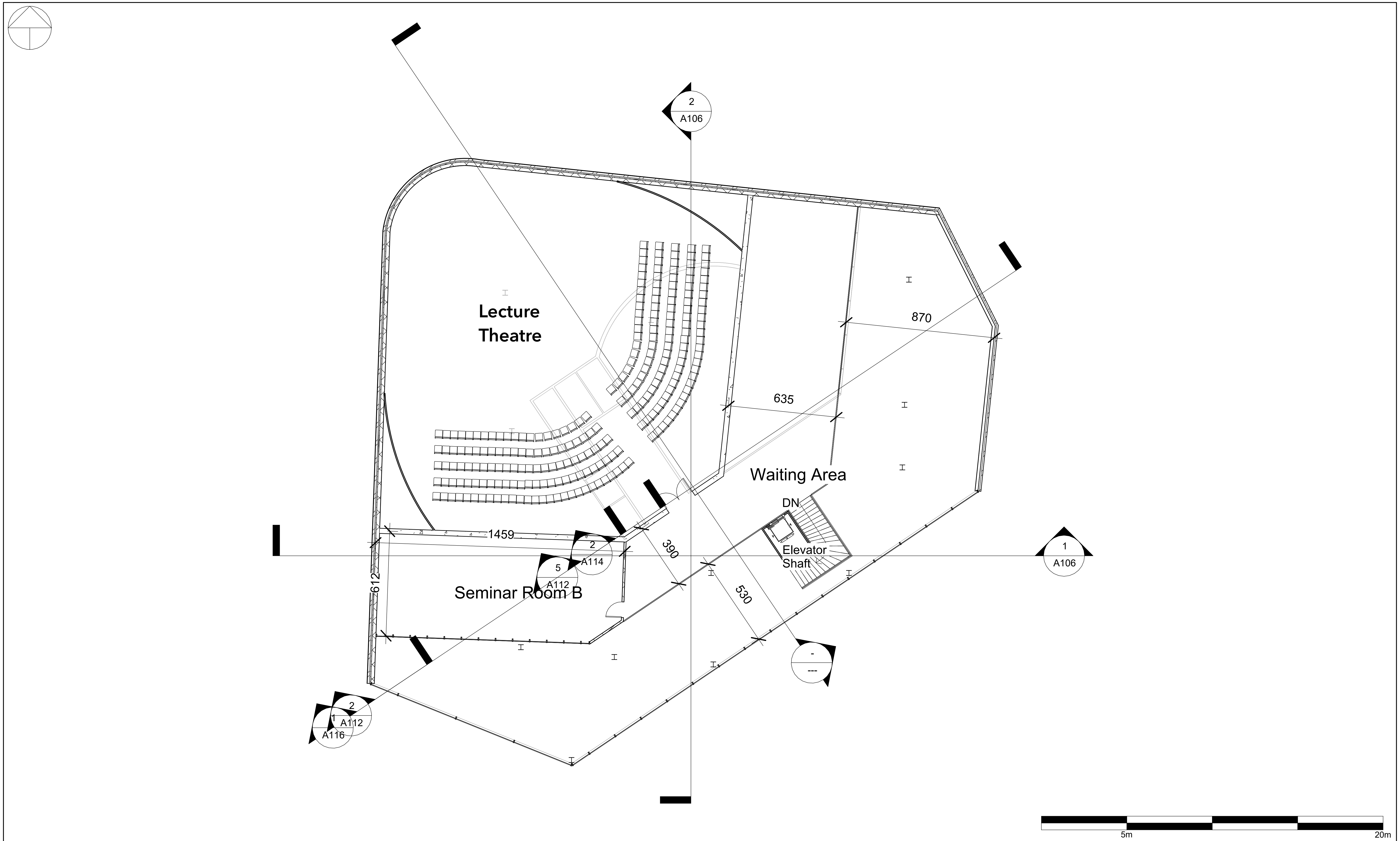
A101

Scale @ A3 1 : 200

29/01/2024 13:56:59



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No.	Description	Date

UP2068014

University House Lecture Hall

First Floor

Project number	0001	A102
Date	14.01.2024	
Drawn by	Max Trott-Fenning	
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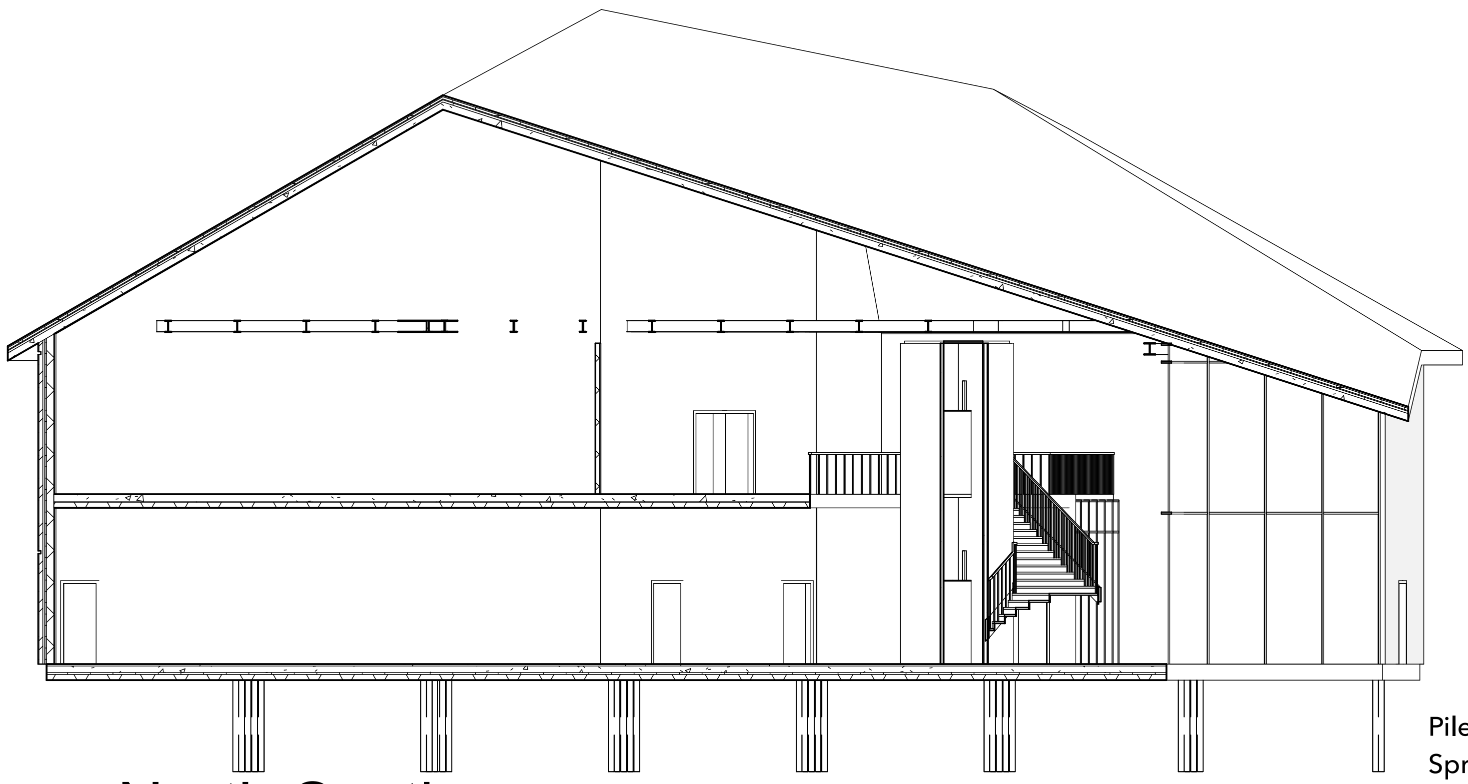
29/01/2024 13:57:12



1 North Section

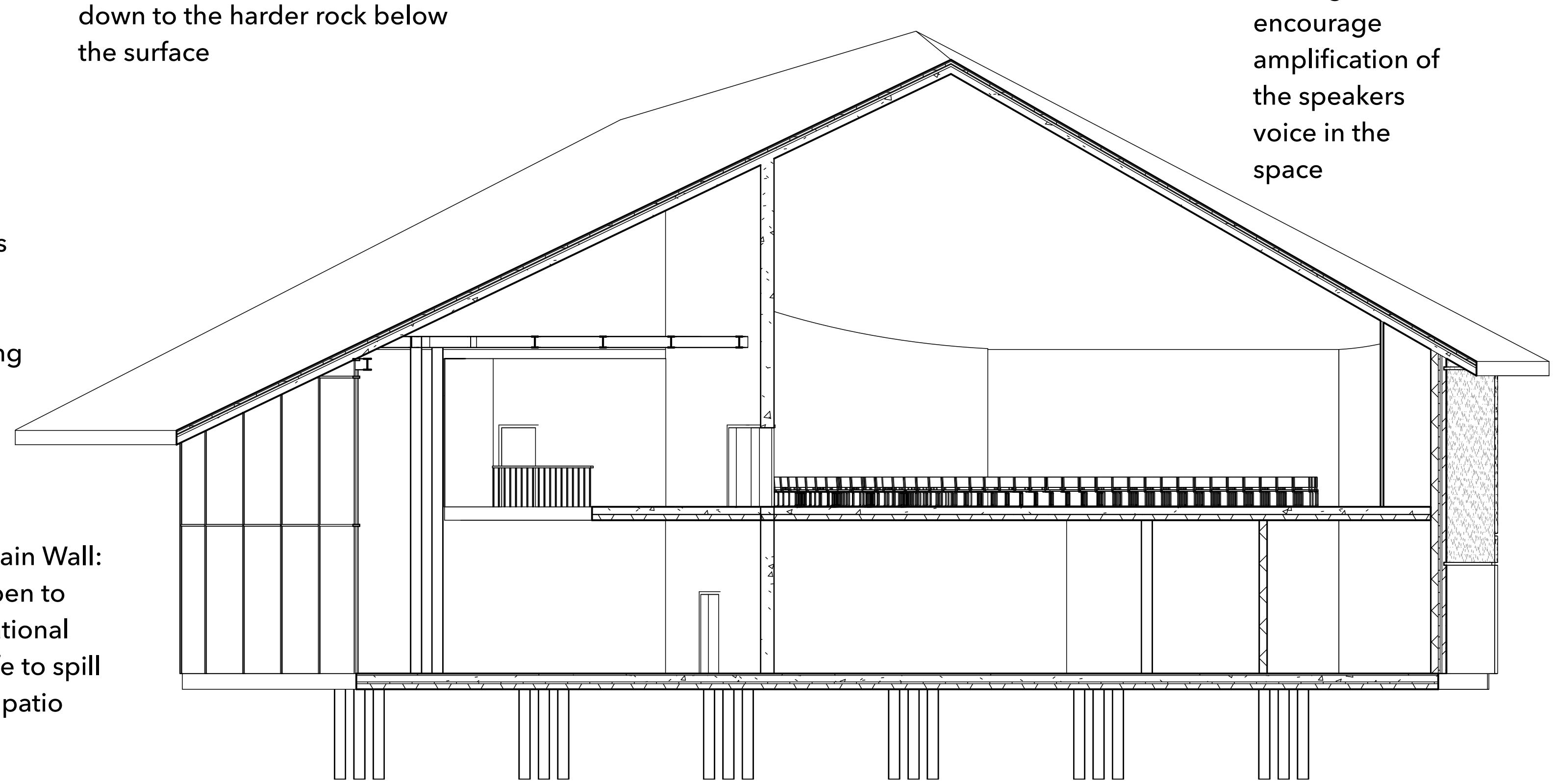
1 : 200

Piled Raft Foundation:
Spreading the building's load evenly over the whole area and down to the harder rock below the surface

Lecture Hall:
walls and roof are angled to encourage amplification of the speakers voice in the space

Solar Shader: prevents the sun from entering the glazed wall in the summer, whilst allowing it in the winter sun

Glazed Curtain Wall:
is able to open to allow recreational space of cafe to spill out into the patio



2 West Section

1 : 200

5m 20m

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No.	Description	Date

UP2068014

University House Lecture Hall

Sections

Project number	0001
Date	14.01.2024
Drawn by	Max Trott-Fenning
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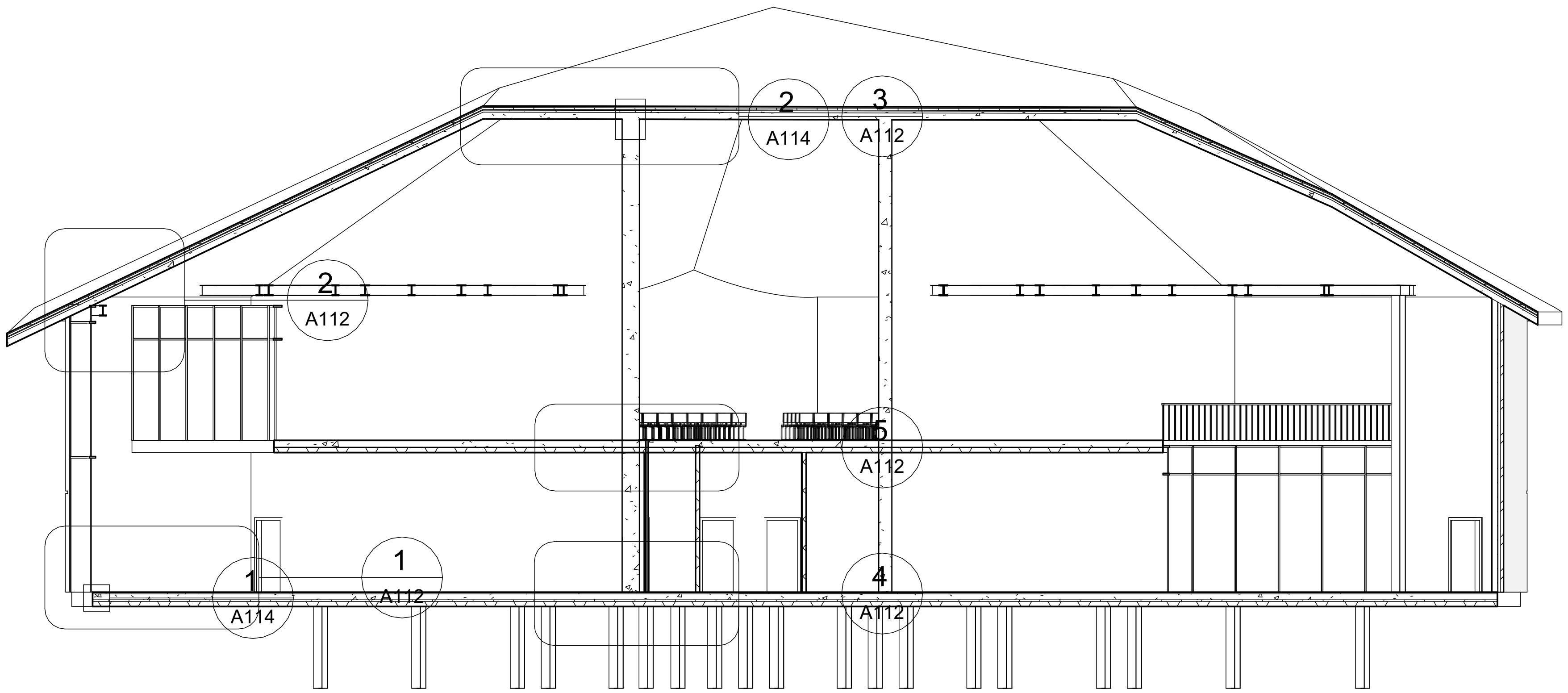
A106

Scale @ A3 1 : 200

29/01/2024 13:57:42



5m
20m

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No.	Description	Date

UP2068014

University House Lecture Hall

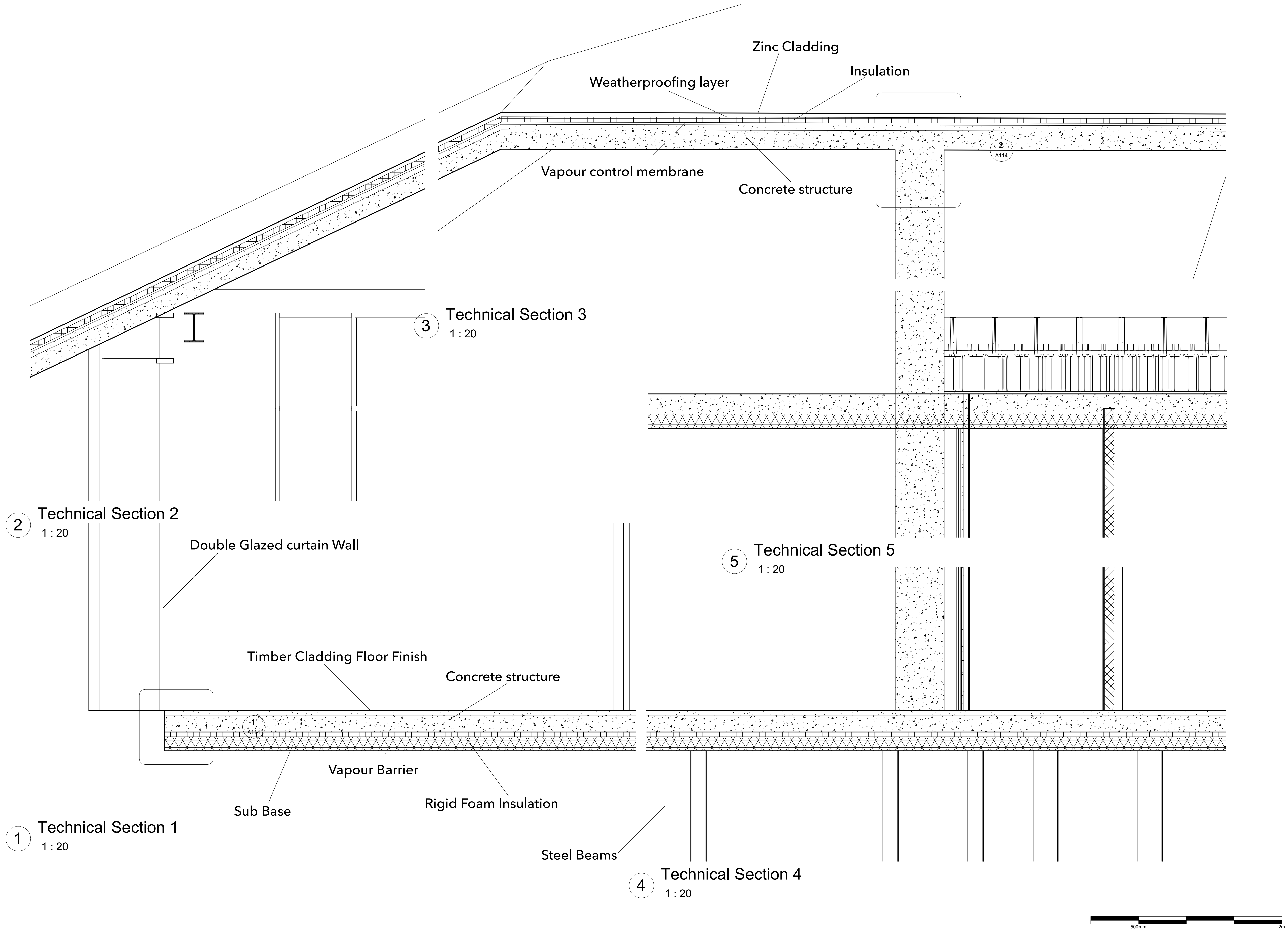
Technical Section Reference

Project number	0001
Date	14.01.2024
Drawn by	Max Trott-Fenning
Checked by	Checker

A116

Scale @ A3 1 : 200

29/01/2024 19:16:32



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No.	Description	Date

UP2068014 University House Lecture Hall

Technical Section

Project number	0001
Date	14.01.2024
Drawn by	Max Trott-Fenning
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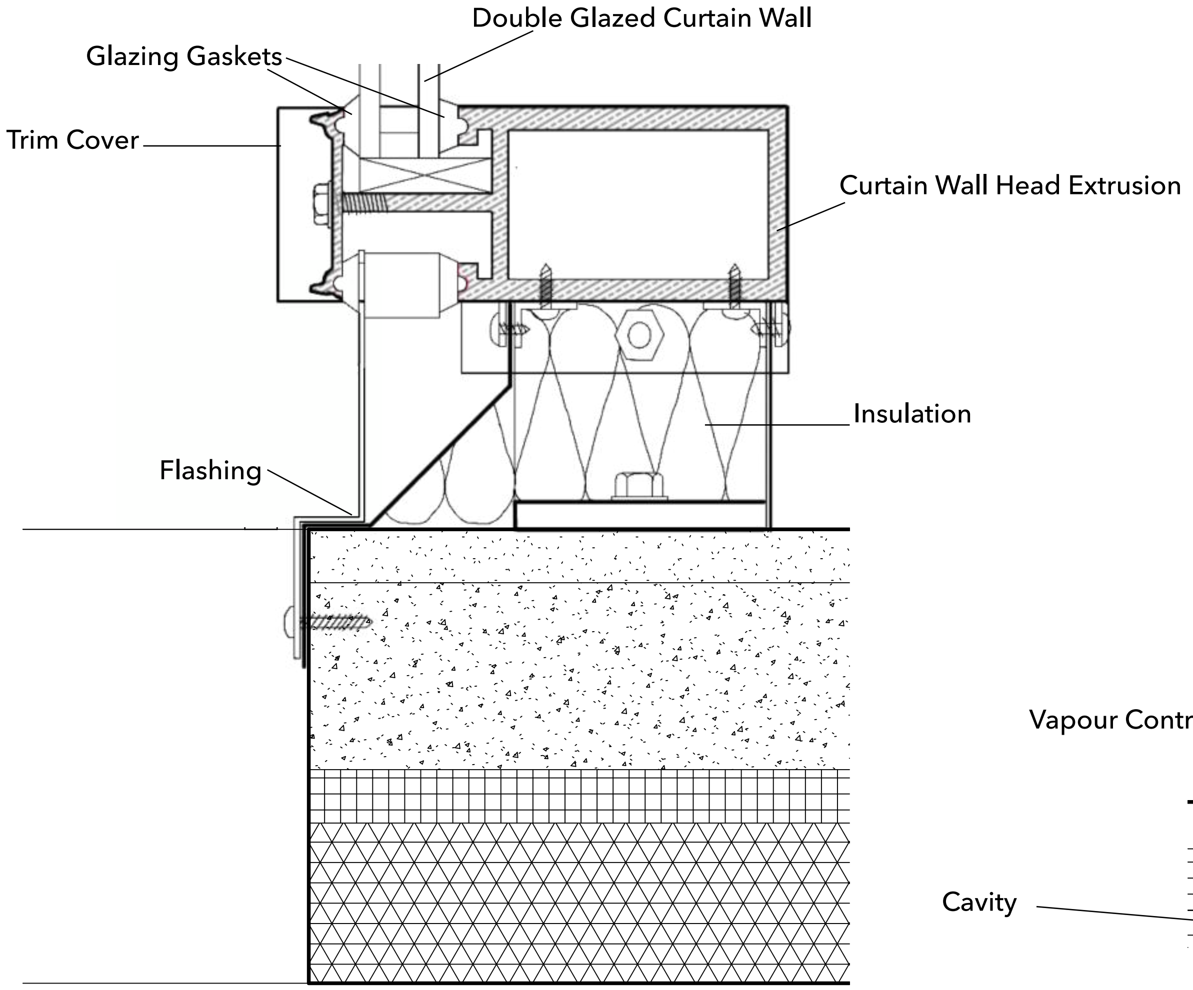
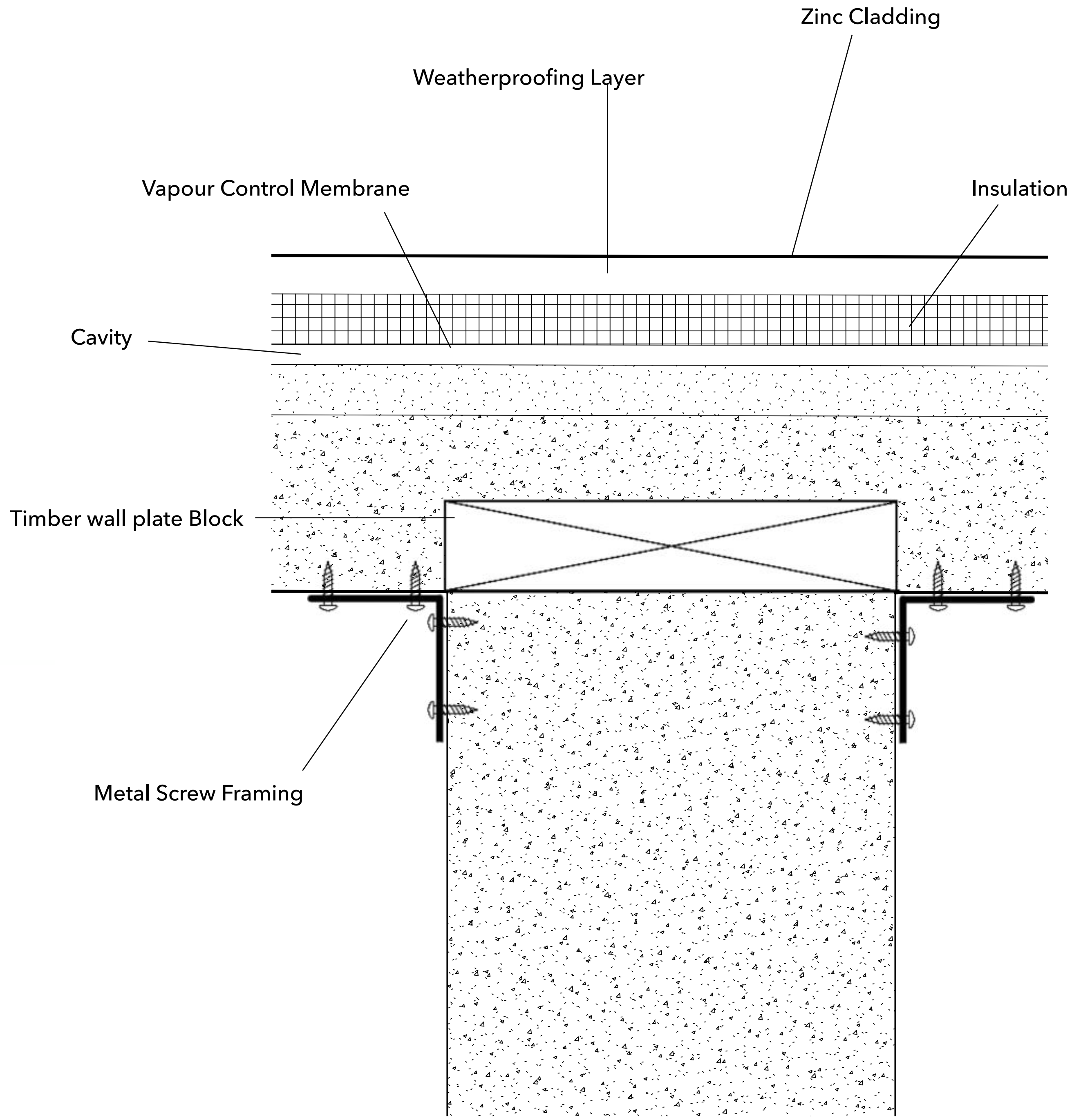
Scale @ A1	1 : 20

29/01/2024 19:16:50





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No.	Description	Date

UP2068014
University House Lecture Hall

Detailing

Project number	0001
Date	14.01.2024
Drawn by	Max Trott-Fenning
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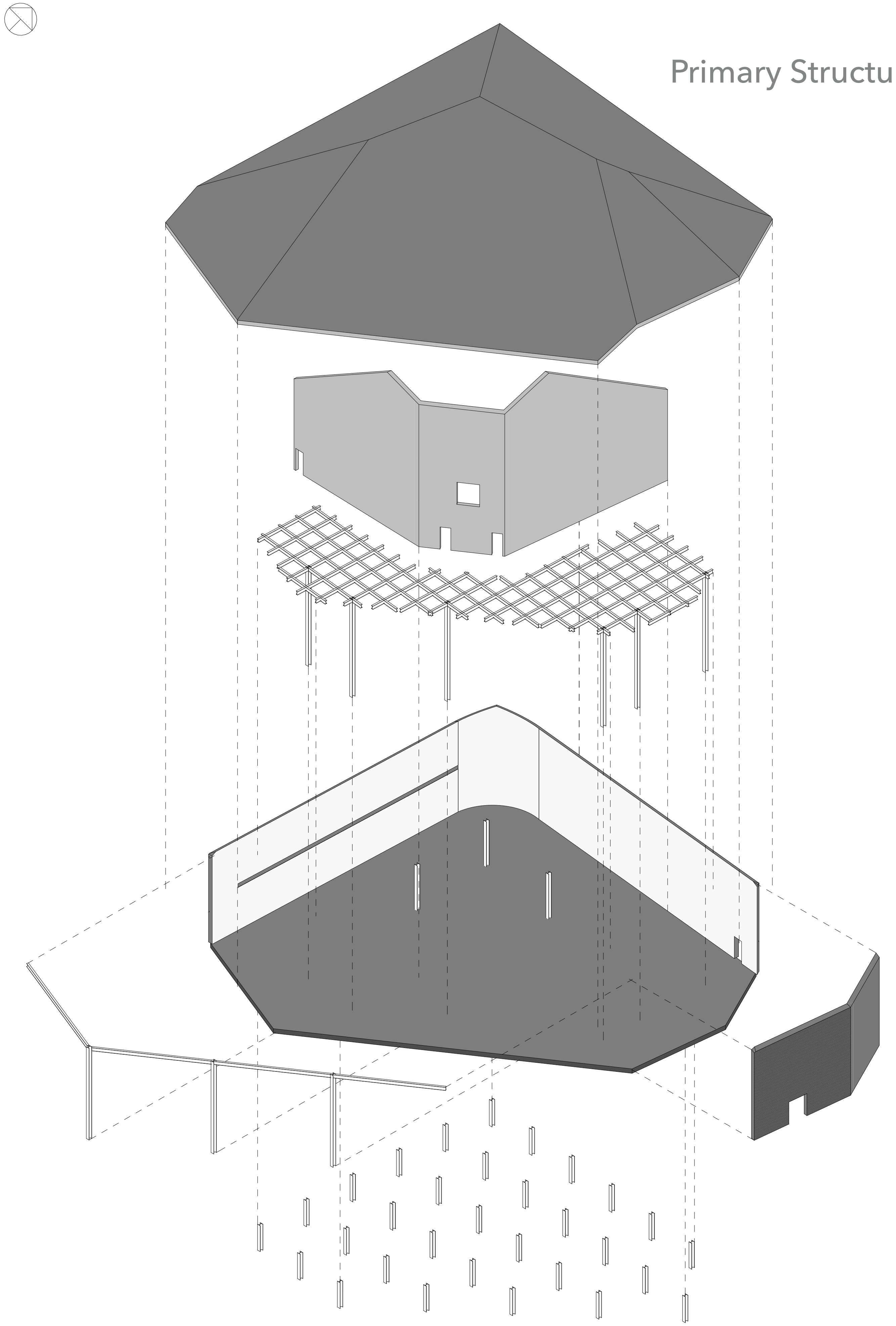
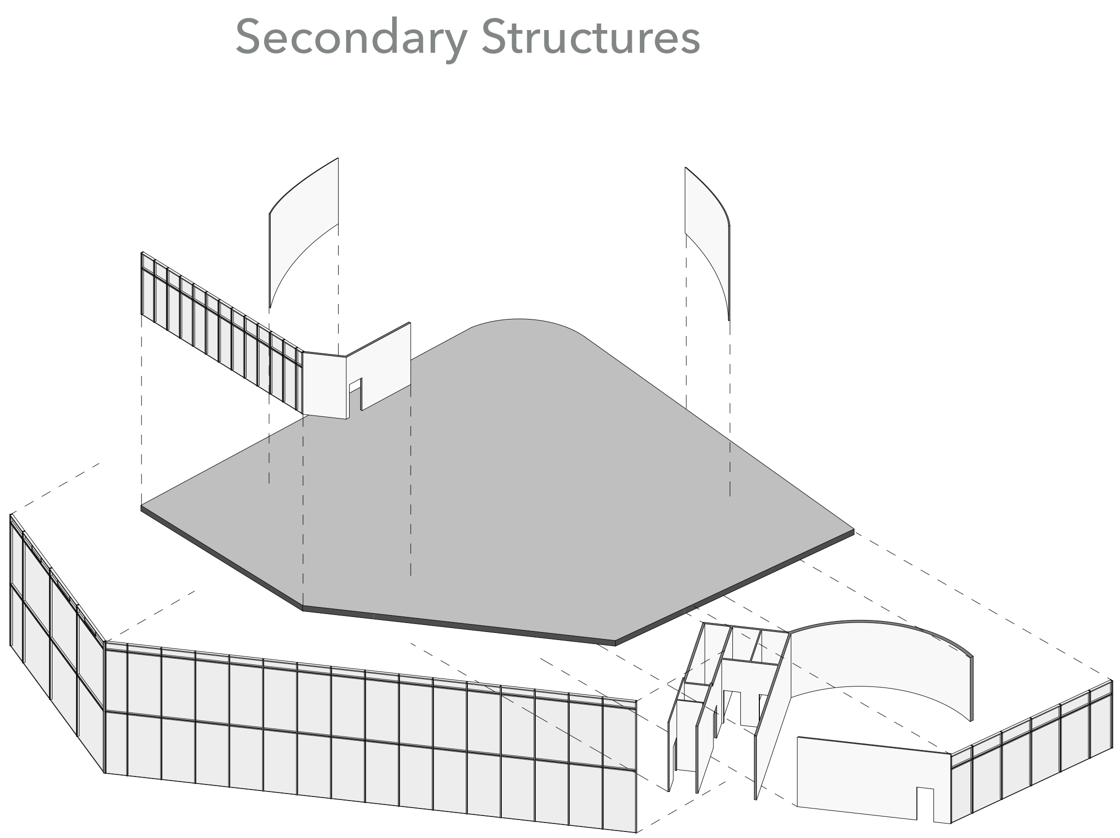
A114

Scale @ A2	1 : 5

29/01/2024 19:17:05





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No.	Description	Date

UP2068014
University House
Lecture Hall

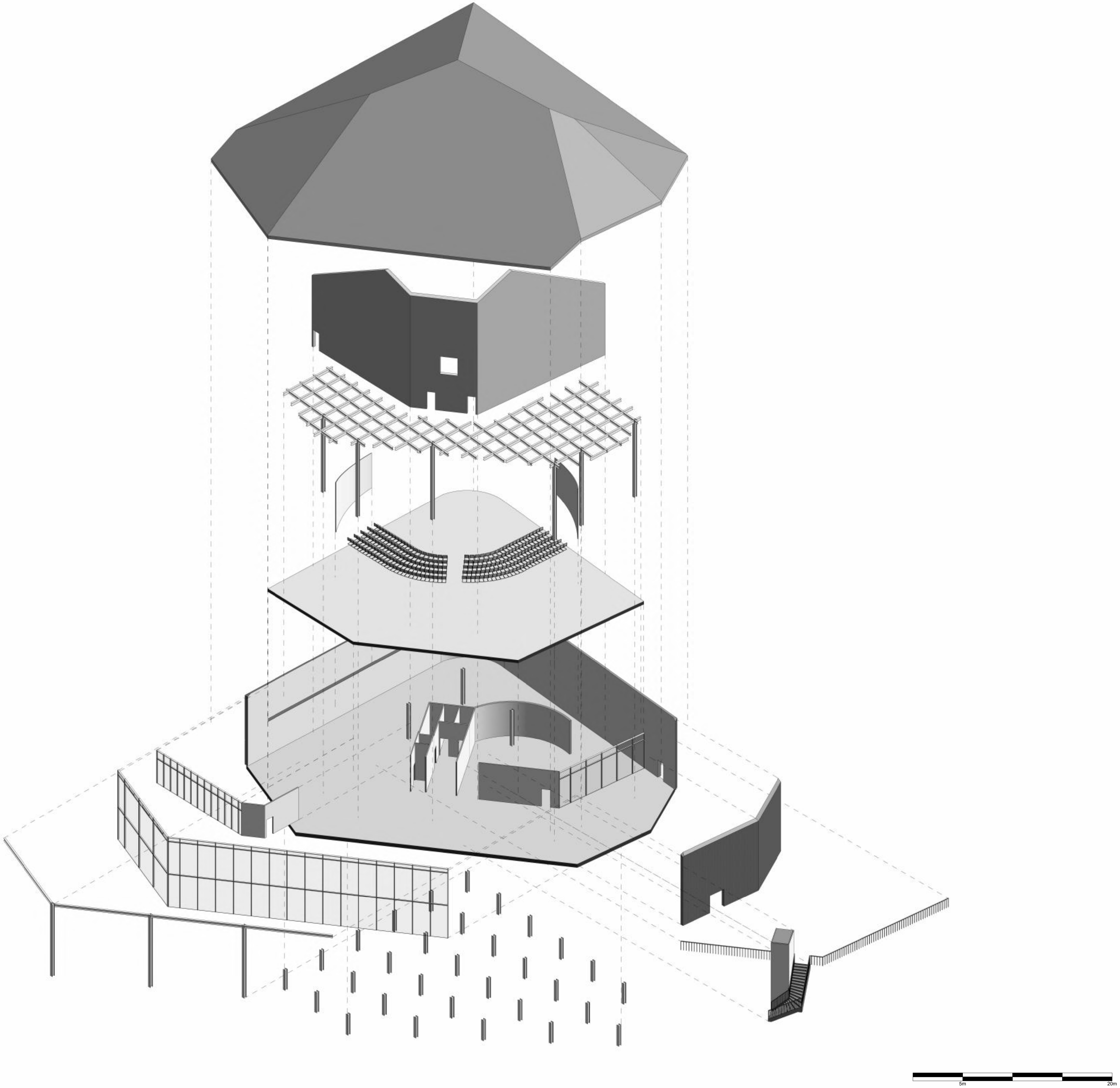
Primary & Secondary
Strucutre

Project number	0001
Date	14.01.2024
Drawn by	Max Trott-Fenning
Checked by	Checker

A119

Scale @ A1 1:200

29/01/2024 13:58:54



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No.	Description	Date

UP2068014 University House Lecture Hall

Exploded Isometric

Project number	0001
Date	14.01.2024
Drawn by	Max Trott-Fenning
Checked by	Checker
A115	
Scale @ A1	1:200

29/01/2024 14:01:34

COSTING ANALYSIS

WINSTANLEY COLLEGE

BCIS®

Teaching Block, Winstanley College, Winstanley Road - #22663

Rebased to 1Q 2026 (415; forecast) and Hampshire (107; sample 337)

Summary	
Project title:	Teaching Block, Winstanley College, Winstanley Road
Location:	Wigan, Greater Manchester
Date:	7-Oct-2003
Building cost:	£3,388,713 rebased
Cost/m²:	£2,368 rebased
Floor area:	1,431m^2
Main construction:	Steel framed
Storeys:	2
Level of analysis:	Elemental

DETAIL	
Building function:	722. Colleges
Type of work:	New build
District:	Wigan
Grid reference:	SD5805
Receipt date:	7-Oct-2003
Base date:	4-Oct-2003
Date of acceptance:	24-Oct-2003
Date of possession:	11-Nov-2003
Project details:	2 storey college teaching block with staff facilities together with external works including macadam paving, landscaping, services, drainage and work to existing building.
Site conditions:	Level car park site with moderate ground conditions. Excavation above water table. Restricted working space and access.
Client:	Winstanley College

30-Jan-2024 00:22 © BCIS 2024 Page 23 of 72

BCIS®

Areas	
Basement:	0m^2
Ground floor:	716m^2
Upper floors:	715m^2
Gross floor area:	1,431 m^2
Dimensions	
Number of units:	1
Floor area percentages	
2 storey	(100.00%)
Credits	
Submitted by:	Bradshaw Gass & Hope
Client:	Winstanley College

Elements (BCIS Standard Form of Cost Analysis (1973 revision)) rebased

Element	Total cost	Cost per m^2	Element unit qty	Element unit rate	Percent age
1 Substructure	£185,660	£130			5%
2A Frame	£300,406	£209			8%
2B Upper floors	£53,918	£37			1%
2C Roof	£239,845	£167			6%
2D Stairs	£45,785	£33			1%
2E External walls	£300,188	£209			8%
2F Windows and external doors	£197,815	£137			5%
2G Internal walls and partitions	£277,386	£193			7%
2H Internal doors	£100,856	£70			3%
2 Superstructure	£1,516,200	£1,060			40%
3A Wall finishes	£71,852	£51			2%
3B Floor finishes	£208,511	£146			5%

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Elements (BCIS Standard Form of Cost Analysis (1973 revision)) rebased

Element	Total cost	Cost per m^2	Element unit qty	Element unit rate	Percent age
7 Preliminaries	£375,623	£263			10%
Total (less Contingencies)	£3,589,472	£2,507			94%
8 Contingencies	£213,776	£149			6%
Contract sum	£3,803,248	£2,658			100%

Specification

Element	Specification
1 Substructure	RC raft foundations.
2A Frame	Steel column and beam frame.
2B Upper floors	PCC upper floor.
2C Roof	Steel curved roof with standing seam cladding.
2D Stairs	Undefined.
2E External walls	Rendered block and aluminium cladding.
2F Windows and external doors	Undefined.
2G Internal walls and partitions	Block and metal stud.
2H Internal doors	Flush doors.
3A Wall finishes	Plaster to walls.
3B Floor finishes	Undefined.
3C Ceiling finishes	Undefined.
4 Fittings	Fittings.
5A Sanitary appliances	Sanitaryware.
5C Disposal installations	Soil and waste pipes.
5F Space heating and air treatment	Undefined.
5H Electrical installations	Electric light and power.
5J Lift and conveyor installations	Lift.

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After reviewing the Winstanley College report, I have discovered that my project shares a similar substructure and framing structure. Based on their estimate of £130/m2 for concrete foundation, it can be estimated that my foundation will cost approximately £130,000 for a raft foundation of approximately 1000m2.

As the Winstanley College is the most comparable in size and Gross Internal Area (G.I.A) to my building, I will be using it as a reference point to estimate the adjusted cost, which is projected to be approximately £3,388,000.

LANCASTER AND MORECAMBE COLLEGE

BCIS®

Sports Hall and Classrooms, Lancaster and Morecambe College - #18857

Rebased to 1Q 2026 (415; forecast) and Hampshire (107; sample 337)

Summary	
Project title:	Sports Hall and Classrooms, Lancaster and Morecambe College
Location:	Lancaster, Lancashire
Date:	26-Mar-1999
Building cost:	£3,793,594 rebased
Cost/m²:	£1,981 rebased
Floor area:	1,915m^2
Main construction:	Steel framed
Storeys:	2 (1)
Level of analysis:	Elemental

DETAIL	
Building function:	722.8 Colleges - mixed facilities
Type of work:	Horizontal extension
District:	Lancaster
Grid reference:	SD4761
Receipt date:	26-Mar-1999
Base date:	16-Mar-1999
Date of acceptance:	5-Apr-1999
Date of possession:	26-Apr-1999
Project details:	Sports hall for 4 badminton courts, 43 seat cafe and 4 classrooms and alterations to existing buildings. External works include precast concrete and macadam paving, brick walls, services, drainage and site lighting.
Site conditions:	Level site of sports pitch with good ground conditions. Excavation above water table. Unrestricted working space and access.

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Elements (BCIS Standard Form of Cost Analysis (1973 revision)) rebased

Element	Total cost	Cost per m^2	Element unit qty	Element unit rate	Percent age
Total (less Contingencies)	£4,447,839	£2,324			97%
8 Contingencies	£124,837	£65			3%
Contract sum	£4,572,676	£2,389			100%

Specification

Element	Specification
1 Substructure	Plain concrete foundations, RC beds not exceeding 150mm.
2A Frame	Steel columns and beams, 68.41 tonnes.
2B Upper floors	60m3 troughed RC slabs (603m2).
2C Roof	Steel roof members, Metsec purlins. 1133m2 aluminium standing seam covering; curved with insulation to hall, flat to classrooms. 353m2 elastomeric coating on insulation. 4No Velux roof windows. 7No Coxdome rooflights. Aluminium gutters.
2D Stairs	Contractor designed PCC stairs.
2E External walls	Blockleys Heritage Buff facing brick outer skin with insulated cavity and block inner skin. Aluminium curtain walling.
2F Windows and external doors	5No flush external doors. 2No up and over doors. 1No aluminium roller shutter.
2G Internal walls and partitions	Block; cubicle partitions; 1No sliding/folding partition 8.2x2.8m; 2No specialist fire curtains.
2H Internal doors	62No flush doors in softwood frames.
3A Wall finishes	1804m2 Hardwall plaster; 351m2 render; 333m2 ceramic tiles; 75m plasterboard and skim.
3B Floor finishes	1192m2 paint; 596m2 specialist resilient vinyl sports floor; 572m2 carpet; 297m2 vinyl; 87m2 hardwood sprung floor; 56m2 lino.
3C Ceiling finishes	479m2 mineral fibre and 154m2 fibre cement suspended ceilings.
4 Fittings	Reception desk, seating, lockers, blinds, loose furniture, shelving, mirrors.
5A Sanitary appliances	2No cleaners' sinks, 17No wash basins, 11No WCs, 4No urinals, 2No drinking fountains, 2No shower trays, 1No sink.
5B Services equipment	Provisional Sum £18500 for catering equipment.

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1 storey	(40.99%)
2 storey	(59.01%)
Credits	
Submitted by:	Cumbria County Council
Client:	Lancaster and Morecambe College
Architect/QS/Planning Super:	Cumbria County Council
Structural Engineer:	Curtins Consulting engineers plc
Services Engineer:	John Troughear Associates

Elements (BCIS Standard Form of Cost Analysis (1973 revision)) rebased

Element	Total cost	Cost per m^2	Element unit qty	Element unit rate	Percent age
1 Substructure	£236,198	£123			5%
2A Frame	£344,828	£179			8%
2B Upper floors	£83,302	£43			2%
2C Roof	£453,972	£237			10%
2D Stairs	£58,060	£31			1%
2E External walls	£185,307	£96			4%
2F Windows and external doors	£270,024	£142			6%
2G Internal walls and partitions	£110,581	£59			2%
2H Internal doors	£228,655	£120			5%
2 Superstructure	£1,734,729	£906			38%
3A Wall finishes	£109,311	£59			2%
3B Floor finishes	£167,063	£86			4%
3C Ceiling finishes	£43,197	£22			1%
3 Internal finishes	£319,571	£166			7%
4 Fittings	£220,336	£114			5%

After conducting an analysis of Lancaster & Morecambe College, I have discovered that it also utilises the same structural framing material and upper floor material composed of reinforced concrete slab. Considering that my upper floor space measures approximately 600m2, the estimated cost for this would amount to approximately £25,800.

THE WEB CENTRE

BCIS®

The Web Centre, Bordesley Green - #16609

Rebased to 1Q 2026 (415; forecast) and Hampshire (107; sample 337)

Summary	
Project title:	The Web Centre, Bordesley Green
Location:	Bordesley Green, Birmingham, West Midlands
Date:	1-Nov-1996
Building cost:	£1,513,499 rebased
Cost/m²:	£2,372 rebased
Floor area:	638m^2
Main construction:	Steel framed
Storeys:	2
Level of analysis:	Elemental

DETAIL	
Building function:	722. Colleges
Type of work:	New build
District:	Birmingham
Grid reference:	SP1086
Receipt date:	1-Nov-1996
Base date:	22-Oct-1996
Date of acceptance:	1-Nov-1996
Date of possession:	2-Dec-1996
Project details:	2 storey education centre together with external works including macadam and brick paving, brick walls, steel and timber fencing, landscaping, services, drainage, work to existing building, cycle racks, canopy, bridge and sump.
Site conditions:	Level demolition site with good ground conditions. Excavation above water table. Unrestricted working space and access.

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	£2,469,362 21.1%
Accommodation and design features	
2 storey education centre. Concrete strip/pad foundations, RC ground slab; PCC/timber upper floors; steel and timber stairs. Facing brick/block walls. Steel and timber trussed roof with concrete tiles. Double glazed steel, aluminium and uPVC windows. Block, brick and sliding/folding partitions. Flush doors. Plaster and tiles to walls; vinyl and carpet to floors; plasterboard and suspended ceilings. Fittings. Sanitaryware. Gas LPHW central heating, local ventilation, electrics. Lift. Firefighting, fire and intruder alarms, emergency lighting. Work to existing.	
Dimensions	
Number of units:	1
Functional units	
m2 usable floor area (598)	£2,530.94 rebased
Credits	
Submitted by:	The David Back Group
Client:	East Birmingham College
Quantity Surveyor:	The David Back Group

Elements (BCIS Standard Form of Cost Analysis (1973 revision)) rebased

Element	Total cost	Cost per m^2	Element unit qty	Element unit rate	Percent age
1 Substructure	£90,606	£141			4%
2A Frame	£45,711	£70			2%
2B Upper floors	£24,837	£39			1%
2C Roof	£118,499	£187			6%
2D Stairs	£40,870	£63			2%
2E External walls	£132,507	£208			7%
2F Windows and external doors	£125,676	£197			6%
2G Internal walls and partitions	£167,862	£264			8%
2H Internal doors	£54,955	£85			3%
2 Superstructure	£710,917	£1,113			35%

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Elements (BCIS Standard Form of Cost Analysis (1973 revision)) rebased

Element	Total cost	Cost per m^2	Element unit qty	Element unit rate	Percent age
6B Drainage	£35,010	£56			2%
6C External services	£24,935	£39			1%
6D Minor building works	£51,645	£81			3%
6 External works	£448,395	£704			22%
7 Preliminaries	£154,949	£243			8%
Total (less Contingencies)	£1,999,560	£3,134			98%
8 Contingencies	£38,736	£60			2%
Contract sum	£2,038,295	£3,194			100%

Specification

Element	Specification
1 Substructure	Plain concrete and isolated foundations. RC C30 bed not exceeding 150mm. Asphalt tanking. Visqueen DPM. 50mm urethane insulation.
2A Frame	Structural steel columns and beams.
2B Upper floors	Contractor designed precast concrete beam floor decking 5.35-5.65m span. Dead load 2.96kN/m2, live load 4.00kN/m2, partition loads 1.00kN/m2. 128m2 timber joist and tongued and grooved flooring.
2C Roof	Steel and timber roof trusses with Redland Mini Stonewold concrete interlocking tiles. 12No Velux rooflights. 100mm Rockwool insulation. Aluminium gutters.
2D Stairs	1No timber staircase; 1No straight and 1No spiral steel staircases.
2E External walls	Facing brick (£250/1000) outer skin with contrasting cornices, soldier courses, window surrounds, gable ends and corbelling; cavity insulation and 140mm dense concrete block inner skin. Tower feature 2400x2400x5300mm high.
2F Windows and external doors	Double glazed purpose made steel pivot and uPVC bay windows; window blinds. Hardwood and softwood doors; aluminium entrance doors.
2G Internal walls and partitions	Composite facing brick and block walls; dense concrete block walls; 4No Hufcor sliding/folding partitions.
2H Internal doors	Flush internal doors; softwood frames.
3A Wall finishes	32m ornamental balustrade. Carlite plaster with vinyl silk emulsion. 46m2 ceramic tiles.

After conducting a analysis, I have discovered that The Web Centre utilises a roofing type similar to mine. Considering the size of my roof, which is approximately 1300m2, and the cost of £187/m2, I estimate that the total expense for constructing my entire roof would amount to approximately £243,000.

I opted for a concrete roof due to its superior thermal capacity. However, after considering the expenses associated with obtaining a substantial amount of concrete in the context of a roof, I realise that using steel beams with timber cladding would have been a more cost-effective and weight-efficient alternative.

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