Unit 9 Technical and Environmental Integration

Part 1 Case Study: Waterloo City Farm - Feilden Fowles

Intro
Site Analysis
Structural Strategy
Envelope strategy
Interior and exterior situation
Thermal resistance of insulation
Daily safety and accessibility
Construction
RIBA sustainability outcomes
Fragment

Part 2: Studio Study" Back on Fort"———OSCillator

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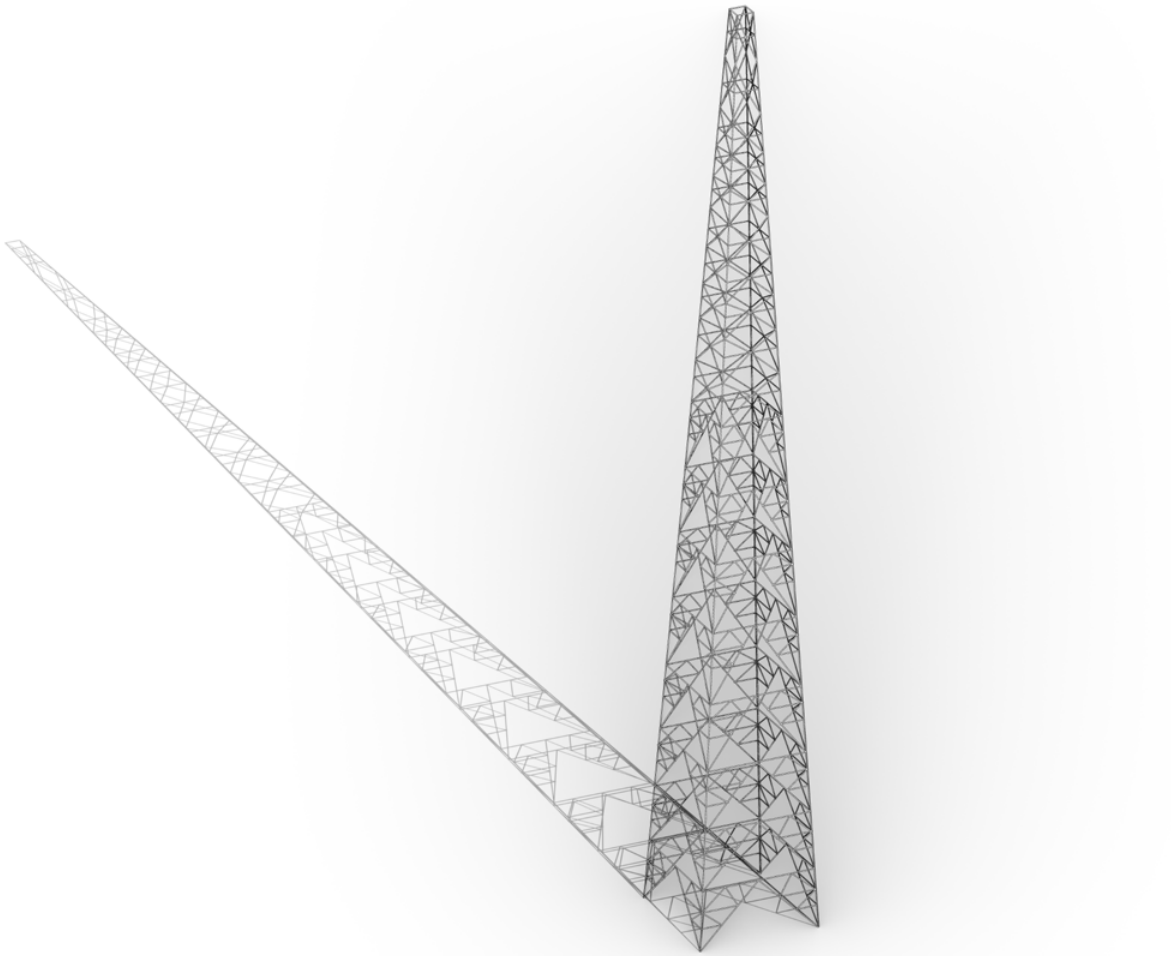
Part 3: *Fragment*



Waterloo City Farm

Waterloo City Farm is in the heart of London, on the South Bank of the Thames. As a community farm, it offers a respite from the city's hustle and bustle, fostering spaces for community interaction. The farm is designed to facilitate opportunities for engaging with and learning from nature, promoting an interest in food production and ecosystems. Additionally, the timber-framed barn on the farm serves as a low-carbon, cost-effective case study through which I aim to explore design strategies emerging from the cyclical nature of the building and the use of sustainable materials in construction. By examining scenarios inside and outside the building, I intend to summarise and reflect on general knowledge applicable to technical strategies for designing public buildings in the studio.

Waterloo City Farm is a temporary installation designed by Feilden Fowles Architects and facilitated by two charities, Jamie's Farm and Oasis Community Hub. The site hosts teaching activities for a neighbouring school and recruits volunteers for day-to-day operations. The main block includes a teaching barn, animal sheds, greenhouses, open gardens, and studios. The I-shaped landscape follows a linear and coherent narrative, fully immersing users in an idyllic ritual from start to finish. The site is conceived as a multifunctional space, maximising the use of prefabricated timber frame structures, allowing for easy dismantling and reconfiguration at the end of the property.

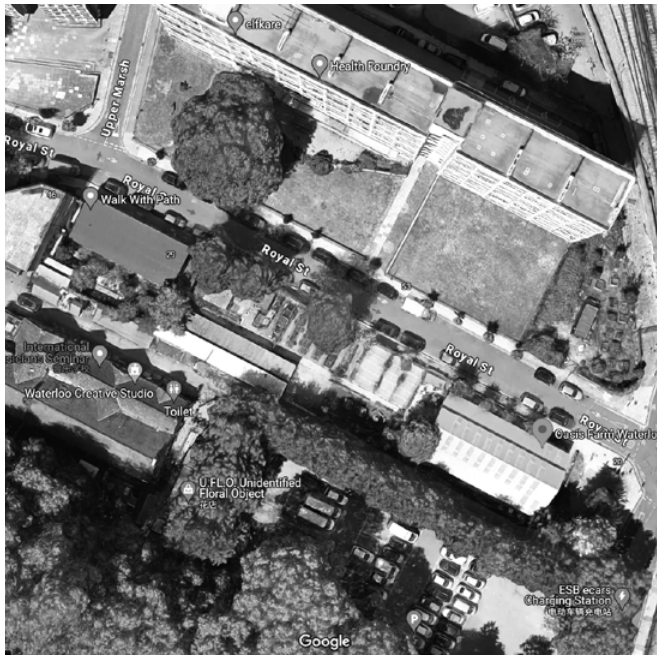
The translucent roof structure inside the barn allows natural light variations to engage the senses, effectively conserving light energy. The studio's proximity in the northwest corner to the street ensures good light and privacy management by elevating the ceiling tiles and strategically positioning the wall windows. During the daily cycle, the farm organises educational programs and community events to demonstrate horticultural practices to the public. Through effective water management and the use of organic fertilisers, the project continues to provide benefits to the local community.

Site Analysis

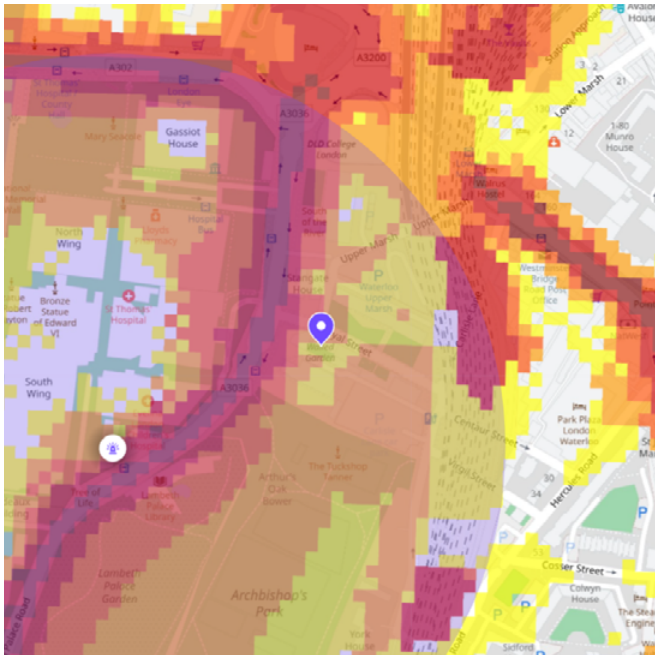
Located in Waterloo, Lambeth, central London, Waterloo City Farm was originally a disused car park. The site is bordered by a school, a residential area to the northwest, and an elevated rail link to the east. The farm is partially leased to a local architectural practice, and its quieter attributes integrate well with the local community.

The farm is situated at the junction of a main road and a path, a location that can impact mental health due to frequent train and large lorry traffic and being within the influence zone of a nearby hospital's alarms. To mitigate pollution and noise, the designers planted a ring of evergreen trees around the perimeter, creating an appropriate buffer zone for the building's occupants. The dense foliage protects against wind and sand and absorbs echoes. Studying the sun's path reveals that light enters from the south side of the building for most of the day. This may explain the retention of trees to the north of the barn. With the sun shining towards the south, the polycarbonate frosted roof panels filter and soften the summer glare while increasing indoor temperature during winter. This design reduces the barn's reliance on artificial lighting, saving energy and balancing the sense of context information inside and outside the building.

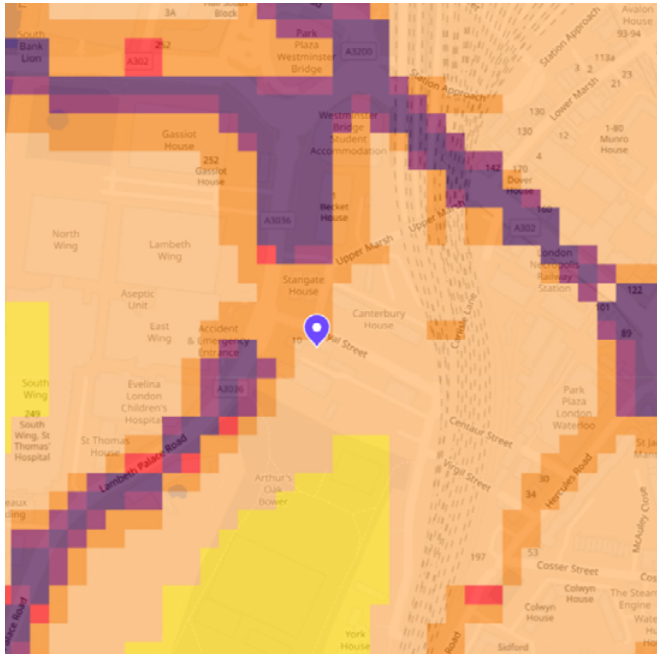
According to the Flood Risk Assessment, which uses local water levels and flood defence data to model flood risk for 40 different scenarios, the site is in Flood Risk Zone 3, only 300 meters from the River Thames. The overall flood risk to the building is low compared to other areas of central London. However, the building must consider rainwater channelling measures to address ponding issues in the planted areas.



Sun position at 12:00 in January



Noise level and ambulance alarm impact area (purple)



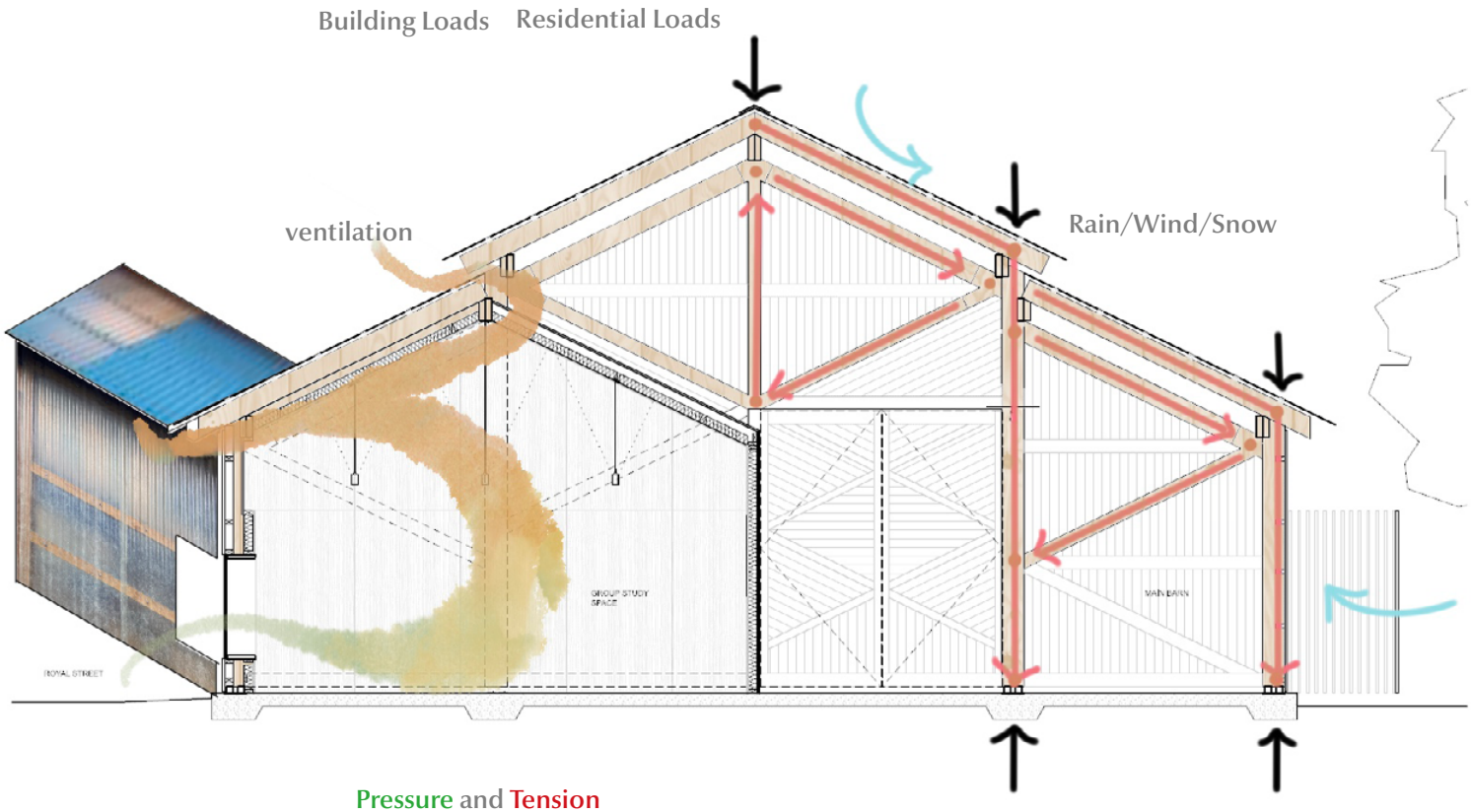
NO2 pollutant level, CrystalRoof, Ltd.

Flood Risk Assessment - Low

Structural Strategy

The design of Waterloo City Farm considers the necessity of dismantling at the end of its life cycle. **The project uses Douglas fir trusses and steel joints** to minimise unnecessary waste, **creating** a simple and efficient **tensioning structure**. Initially, steel base and shear keys were pre-embedded for the concrete foundation, followed by the assembly of primary structural pine columns and a tensioned secondary structure for stability, simultaneous assembly with purlins. Finally, the remaining components were assembled, with all dead weight being transmitted to the vertical pine columns through a stable triangular tensioning force.

The nearly 30-degree sloping waterproof roof efficiently channels rain and snow to the surrounding street storm drains. The **secondary openwork** covering the structure of the eaves **mitigates the wind wall effect**, and the **symmetrical overall structure ensures no deflection in the building's centre of gravity**. This **waterproof and ventilated roof design prevents** the interior wood structure from **becoming mouldy**. Overall, the building's timber structure is resilient to environmental loads and damage, aligning with the sustainability program. **This ensures that materials can continue to be used** and innovated at the end of the lease.

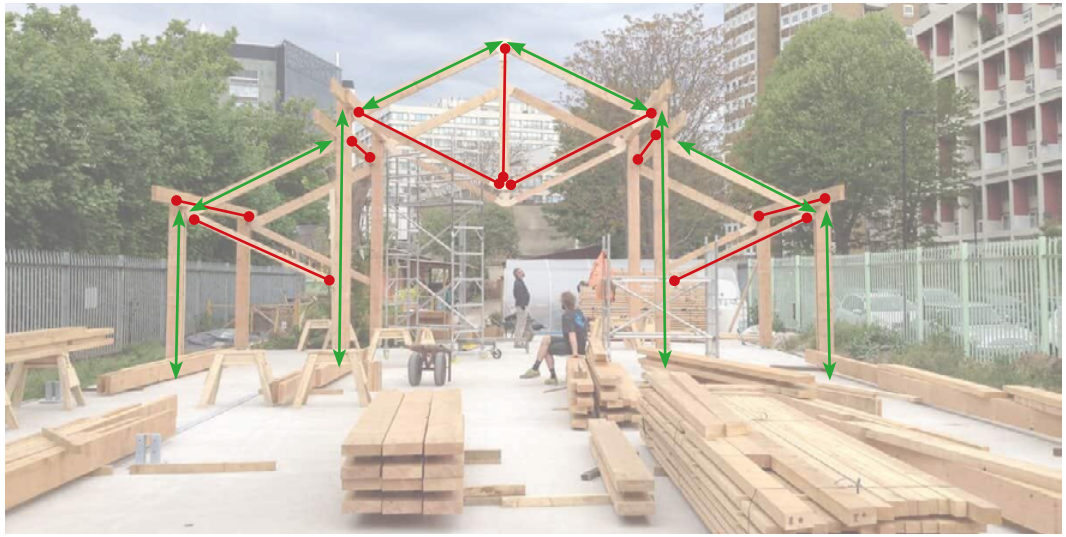



Mature Douglas Fir


Lathe turning and cutting


Assembling

Pressure and Tension



Primary structure (Douglas fir posts 300 x 60 C24)
Wooden columns attached to the foundation with removable steel plinths150mm reinforced concrete slab
Concrete footing

Impact of the envelope strategy on the internal environment

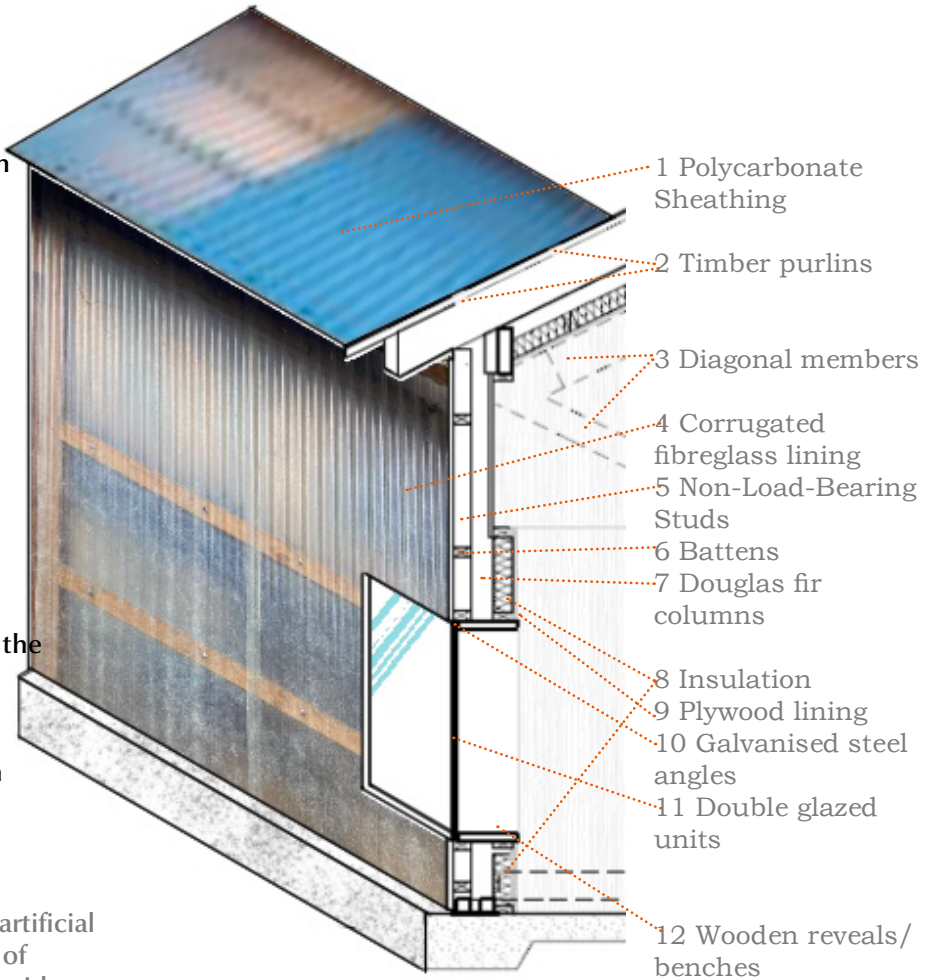
The barn at Waterloo City Farm was designed with features that bring children closer to nature, such as educating them about animal habits and incorporating a plantation. Maintaining the natural balance of the internal space throughout different seasons was, therefore, vital. The barn maximises borrow the sunlight, mainly through polycarbonate roof, which capture solar energy while isolating UV rays. Although contamination over time may reduce light intensity, the low roof easy accessibility allows the maintenance team to clean, wax, and waterproof it regularly. Additionally, the sloped roof might enables the collection of grey water, which is reused for washing farm animals and irrigation.
The façade, made of translucent GFRP (Glass Fiber Reinforced Plastics), helps lighten and illuminate the interior, reducing the need for artificial lighting. As a result, the building requires minimal artificial lighting, with only a few light bulbs needed.
Ventilation is facilitated by the internal truss structure and the double-layer roof, which allows hot air to escape while cooler air enters. Both sides of the building feature casement windows and doors to promote cross ventilation. The open-plan design allows odours to escape easily with ventilation.
The barn does not require heating since it is an outdoor facility. However, the classrooms, designed to accommodate 30 children, are insulated with an basic 100mm of insulation to ensure comfort.

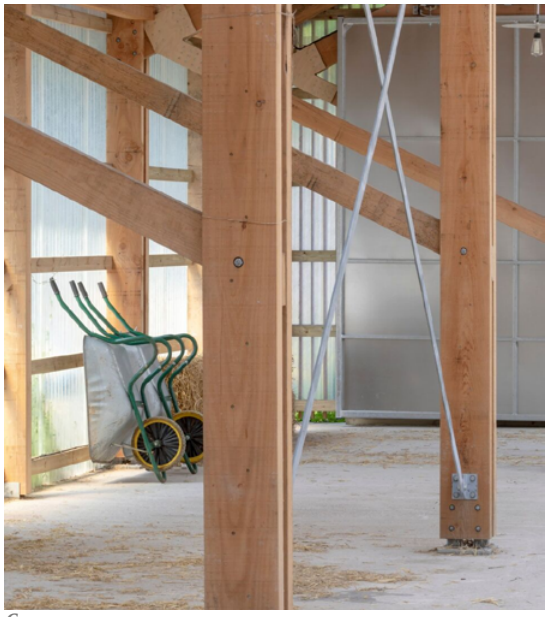
The combination of translucent polycarbonate and tiles allows rainwater to run off onto surrounding plants, ensuring plant growth effectively.

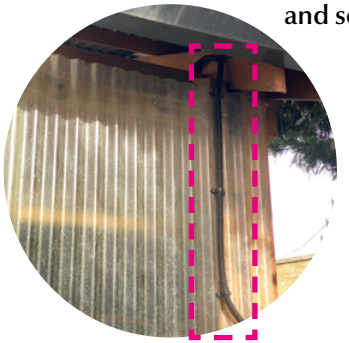
Translucent FRP is used as a façade to allow light to penetrate the space while maintaining privacy and effectively preventing water vapour from entering.

The toughened laminated glass windows in the front section suppress road noise while the user interacts with the neighbours.

Bottom Building Insulation and Breathable Cavity - Maintains thermal envelope and soundproofing.

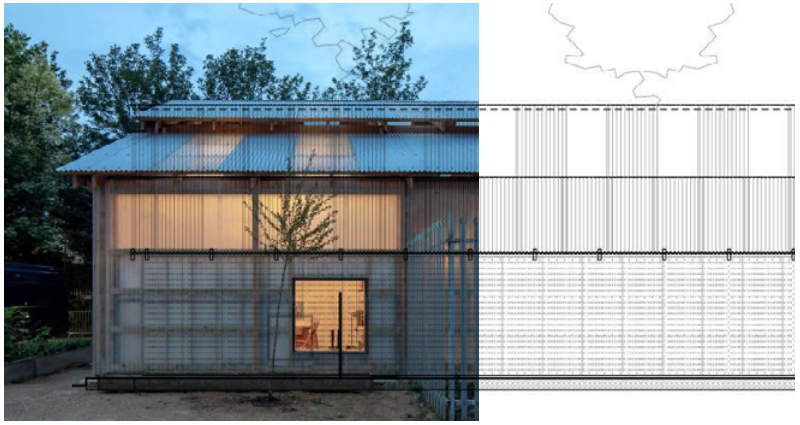






For small amounts of artificial light indoors, instead of clamping the cables inside stud or fluted PVC conduit, as is traditional, the building is stacked in an outer envelope, which facilitates post-construction and overheating of the cables.

Cross Bracing acts between Douglas fir columns to increase the lateral stability and shear strength of the wall.



Interior and exterior situation

A complete fence separates Waterloo City Farm from the surrounding pavement, but the greenhouse and animal sheds in the **centre are open for pedestrians to see**.

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According to the survey, there are **no rainwater wells within the site**. The red areas in the top view represent concrete foundation structures where roofs discharge rainwater to the footpaths on either side. The ground-level gardens in the middle sections of the site have a **primitive layer of soil, allowing rainwater to infiltrate** directly into the ground.

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The **original ground** is preserved in the chicken cages, demonstrating **humanistic care for nature** and giving the animals the right to express their natural behaviours. Replaceable straw and wood shavings are continuously provided to maintain dryness in areas that need to be kept dry.

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The exterior walls of the studio are made of corrugated glass-reinforced plastic (**GRP**), which serves as a solid, rigid structure with excellent corrosion resistance. The lightweight components are **easy to dismantle and recycle** directly after the building's life cycle is complete.

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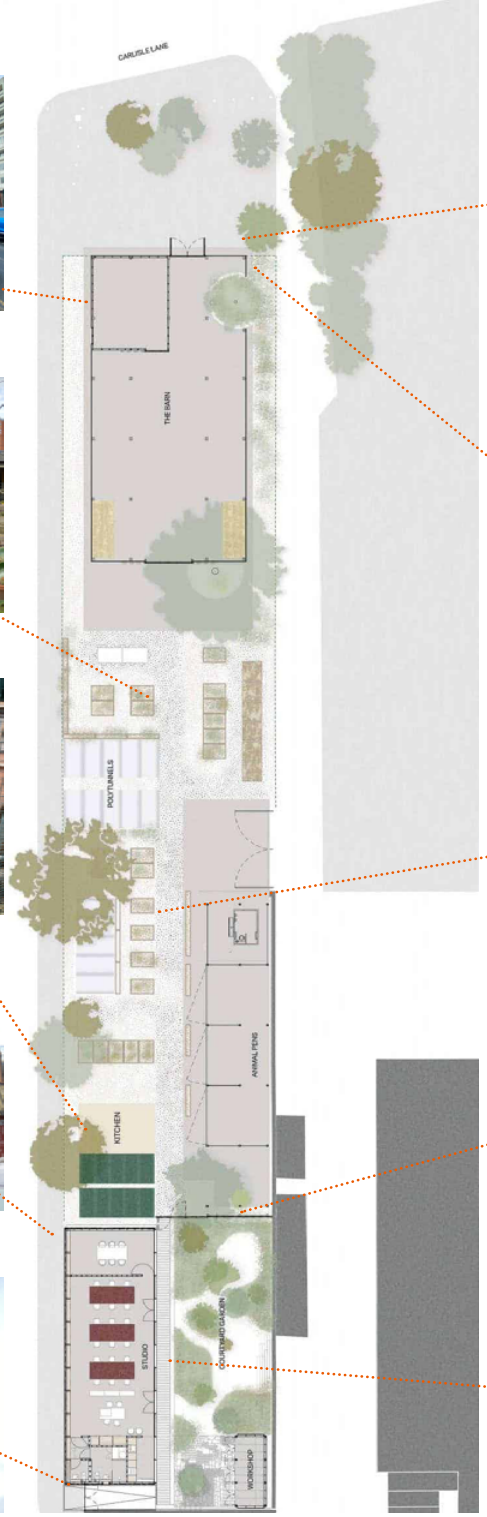
Due to the continuous water **vapour in the temperate maritime climate**, **exposed timber panels** will inevitably become mouldy and unusable as a building material. Completely broken parts will be cut up and **landfill**ed, while **failed parts** will be broken up and **reassembled into plywood panel**s. This approach **ensures the sustainable utilization** of materials.



The building's waterproofing features include **eaves extending 300mm outwards to prevent direct exposure** of the timber façade to rainwater. **Poly**carbonate **sheathing, with a lifespan of 10-15 years,** effectively covers the whole lifespan of the building.

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The south corner of the building houses a **composting area**, where community volunteers collect organic waste and soil from the farm for harmless fermentation. This process ultimately produces nutrients for plant growth, **offsetting the carbon footprint of the farm animals**.

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The **conscious introduction of diverse flora** in the garden **enhances** the resilience of the neighbourhood **ecosystem**, ensuring the environment efficiently **sequesters organic carbon matter**.

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Vertically placed wooden beams can carry more weight, and the sloping roof composed of corrugated GRP can collect grey water used for cleaning the farm and irrigation.

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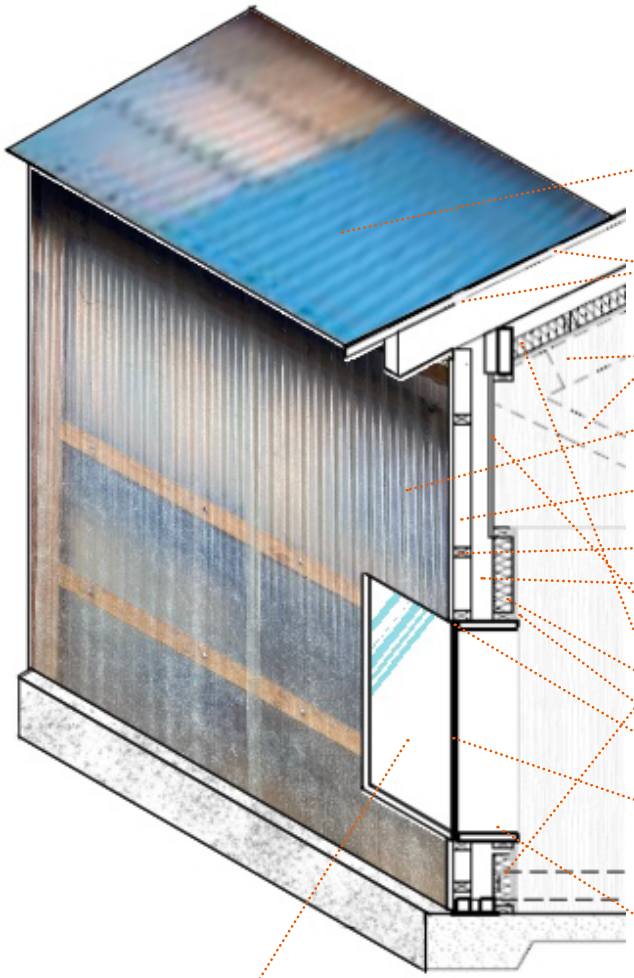
Panoramic floor-to-ceiling windows allow interaction between internal and external scenes, continuously influencing the user's connection with nature and maintaining a **positive living experience.** The window frames are made from recycled wood, creating a warm touch.



1 Polycarbonate Sheathing

2 Timber purlins

3 Diagonal members

4 Corrugated fibreglass lining

5 Non-Load-Bearing Studs

6 Battens

7 Douglas fir columns

8Steel sheet +VacuumInsulationPanel

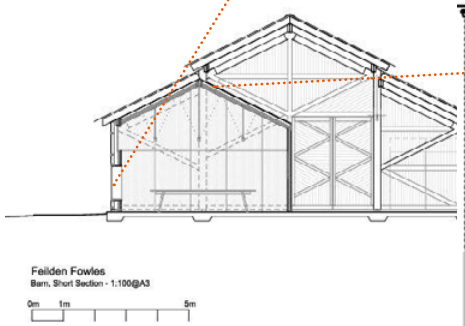
9 Insulation

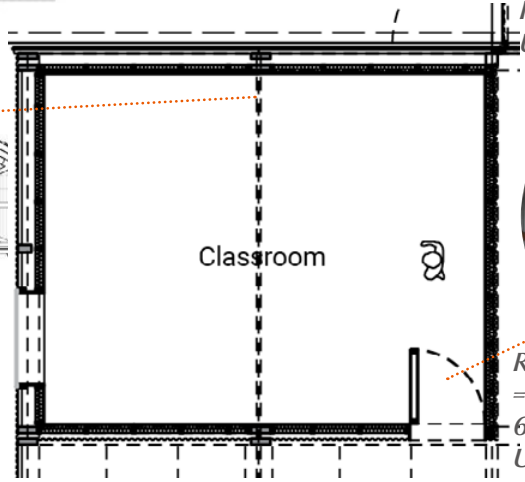
10 Plywood lining

11 Galvanised steel angles

12 Double glazed units

13 Wooden reveals/ benches





$R_{fir} = 0.15m \div 0.12\ W/mk \approx 1.25\ m^2K/W$

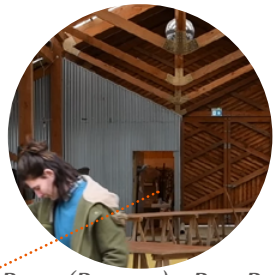
$U_{fir} = 1 \div R_{fir} = 1 \div 1.25 \approx 0.8W/m^2K$

$R_{roof} = 0.02\ m \div 1.5\ W/mk \approx 0.013\ m^2K/W$

$U_{roof} = 1 \div R_{roof} = 1 \div 0.013 \approx 76.9923\ W/m^2K$

$R_{VGRP} = 0.02\ m \div 1.3\ W/mk \approx 0.015\ m^2K/W$

$U_{VGRP} = 1 \div R_{VGRP} = 1 \div 0.015 \approx 66.667\ W/m^2K$



Transmission Values

Rooflight Application	U, value* (Horizontal)	U value (Vertical)
Triple Skin - Site Assembled (Trilite 24 / Cleartherm / Trilite 18	1.5 W/m² K	1.3 W/m² K

$R_{class} = (R_{outer\ shell}) + R_{se} + R_{Galvanised\ steel\ housing} + R_{PIR\ insulation} + R_{Internal\ Air\ Gap} + R_{VIP} + R_{PIR\ insulation} + R_{plywood} + R_{si}$

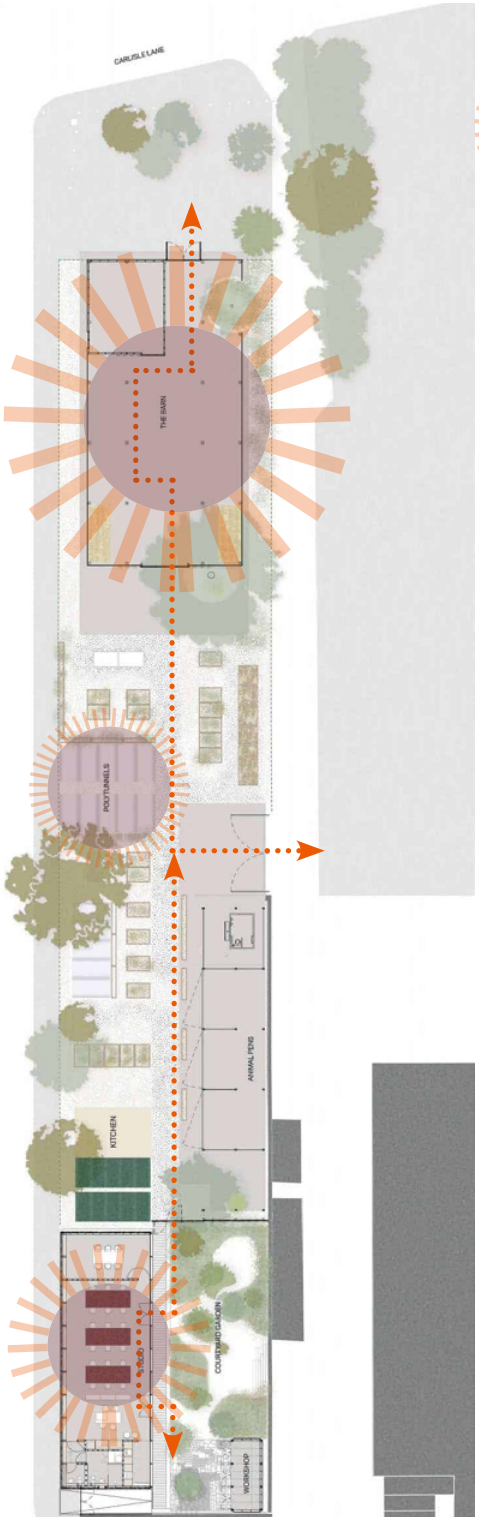
$= (0.013+1.25+0.015)+0.17+0.01 \div 50+0.05 \div 0.022+0.02 \div 0.17+0.02 \div 0.007+0.05 \div 0.022+0.03 \div 0.1$

$6+0.17 \approx 9.326\ m^2K/W$

$U_{class} = 1 \div R_{class} = 1 \div 9.326 \approx \mathbf{0.107\ W/m^2K}$

Thermal resistance of insulation

The building under study is a barn of a communal open nature, the bottom of the door walls on both sides are consciously raised to leave gaps, resulting in a vapour barrier that does not completely enclose the whole building, so I will define it as a naturally heated space. As the shell is corrugated GRP this will result in a high thermal conductivity and typically low thermal resistance, so on a sunny day the greenhouse effect will be significant and the interior temperature will fluctuate considerably. However, inside the barn there is a room with insulation on the east side of the room using 50mm + 50mm polyisocyanurate (PIR) double layer hollow insulation with a λ-value of 0.022 W/mk for the PIR. 2mm Vacuum Insulation Pane (VIP) has a λ-value of 0.002 W/mk. after deductive calculations, the total wall After deduction, the total thermal resistance of the wall is about 9.326 m²K/W, with a U-value of 0.107 m²K/W. This meets the European Passivhaus requirement of U-values of less than 0.15 W/m²-K for building facades.



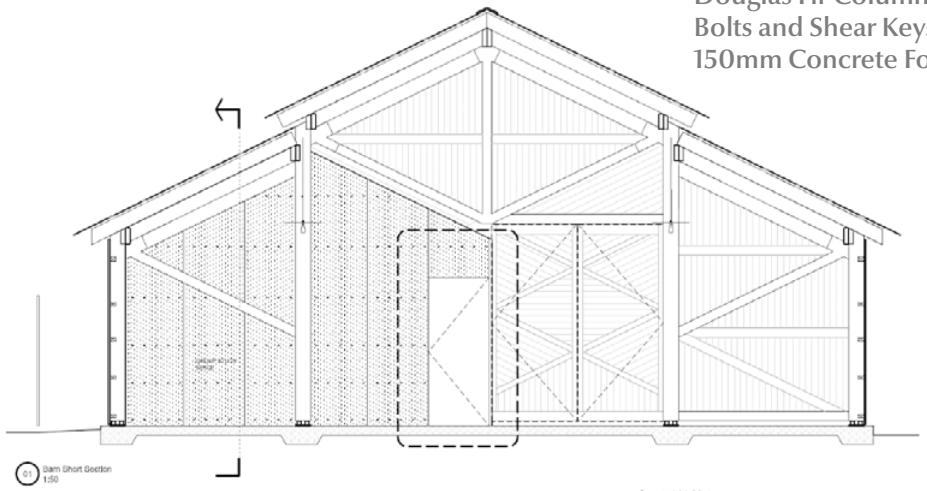
Potential fire locations:
wooden barn
plastic greenhouse
architecture studio

Open escape routes

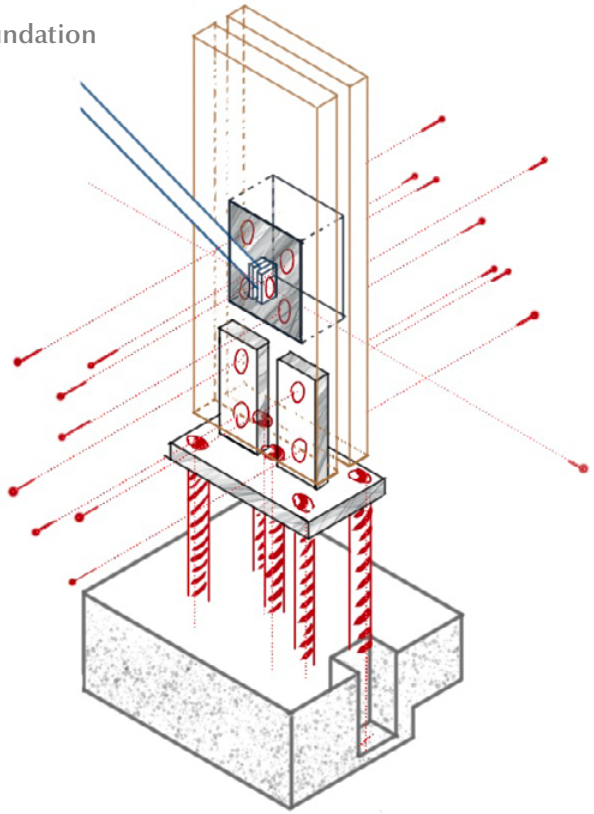
Daily safety and accessibility

Waterloo City Farm chose wood for its structural presence, given that over 90 per cent of wood's main component is carbon (C). When ignited, wood reacts with atmospheric oxygen (O) to produce carbon dioxide (CO_2). When Douglas Fir is exposed to fire, the surface burns and forms a protective carbonized layer. This carbonized layer acts as a barrier, delaying the heating of the inner wood core and providing enough time for evacuation.

Additionally, the joints of the wooden columns have adequate spacing to prevent the accidental spread of sparks. It is also essential to educate visitors on long-term fire prevention measures. Due to the wood's prolonged exposure to a humid environment, it is necessary to install lightning rods at the highest point of the roof and apply fireproof paint to the wood. Smoke alarms should be placed at the highest point under the roof to facilitate the timely detection of smoke.



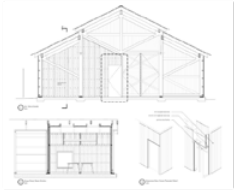
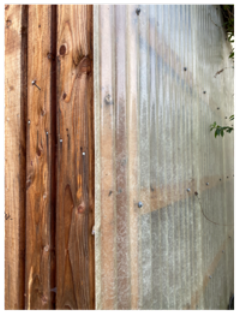
Cross Bracing
Douglas Fir Columns
Bolts and Shear Keys
150mm Concrete Foundation



An outdoor functioning barn, which is used for classes on observing nature for students on specific open days, and normally used as storage.

Waterloo City Farm

Construction

- Material collection
  - Machining Douglas Fir
  - Plywood cutting
  - Accessory Statistics
  - 
- bedding construction
  - 
  - Checking the construction plans and measuring the elevation
  - Mechanical excavation, manual excavation and grading, pile driving
  - Erection of moulds, pouring of concrete, maintenance, dismantling of moulds
- foundation construction
  - Reinforcing steel reinforcement for bearing platforms, positioning of the column reinforcement
  - Pre-embedded utility lines
  - earthwork backfill
- main construction
  - 
  - reserve a ditch
  - Erection of external shelves
  - Application of prefabricated facades
- Env
- Demolition of recycled materials
  - 
- Owner-occupancy period
- Acceptance
  - specific verification
  - Records Archive
  - deliveries
- Structural construction
  - 
  - waterproofing
  - insulation layer
  - Keel and suspended ceilings
- Envelope Installation
  - 
  - masonry work
  - plastering
  - plumbing
- facades

8. Consider modular off-site construction systems

5. Minimise materials with high embodied energy impacts

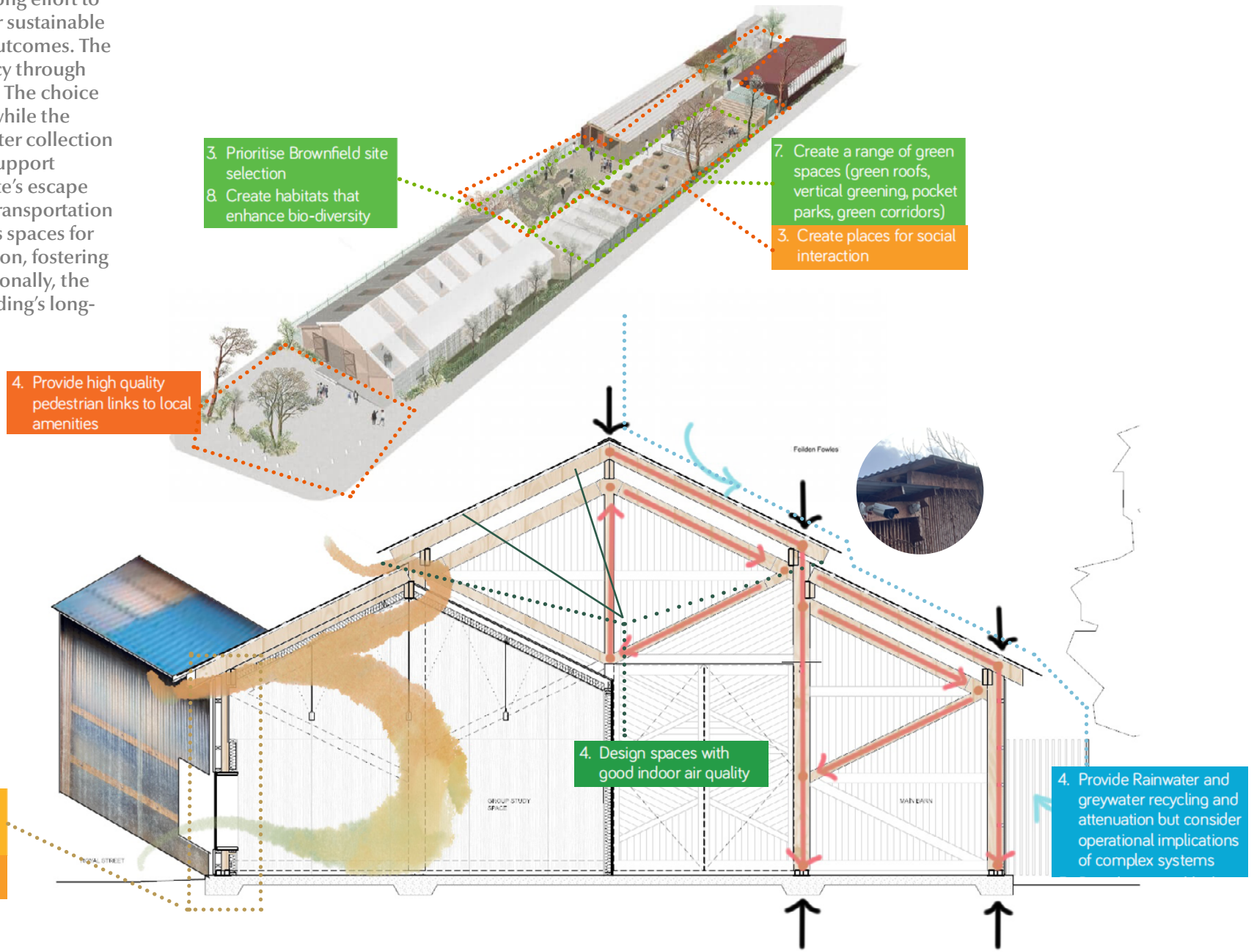
2. Carry out Soft Landings Graduated to Handover and aftercare
4. Measure management and maintenance costs

10. Design building for disassembly and the circular economy
11. Offset remaining carbon emissions through recognized scheme

5. Design spaces with good indoor daylighting, lighting and glare control

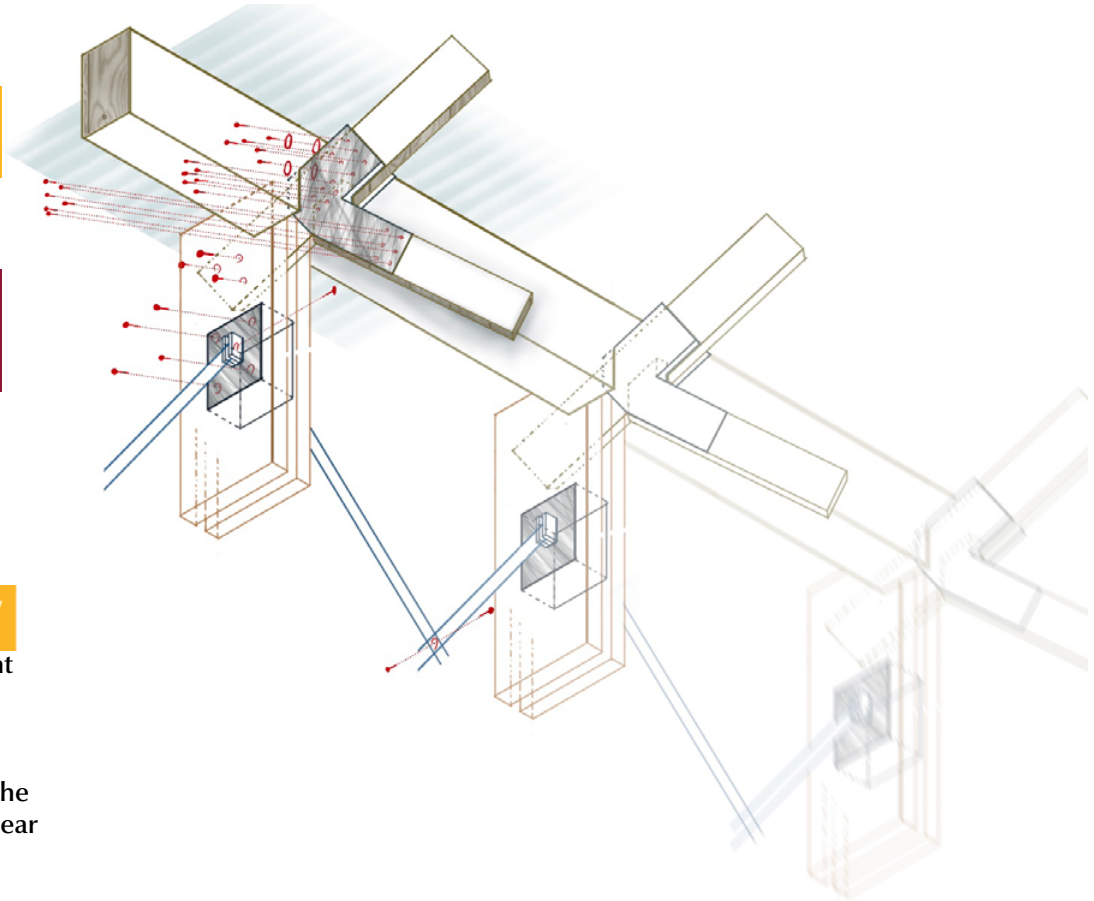
Based on the RIBA Sustainability Study,

I fully recognize this project as a strong effort to align with industry requirements for sustainable practices and effective economic outcomes. The barn adheres to a zero-carbon policy through a comprehensive recycling strategy. The choice of timber helps sequester carbon, while the pitched roof efficiently manages water collection and rainfall. The exposed gardens support groundwater protection, and the site's escape routes seamlessly connect to local transportation networks. These routes also serve as spaces for community education and interaction, fostering well-being and engagement. Additionally, the low-energy design ensures the building's long-term sustainable operation.



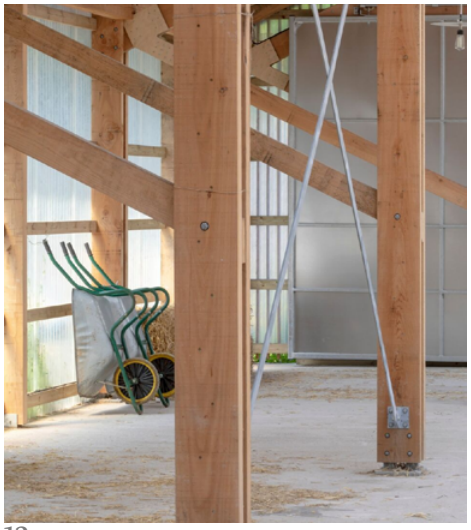
9. Offset remaining carbon through recognized scheme

2. Carry out Soft Landings Graduated to Handover and aftercare
3. Measure energy costs



5. Specify ultra low energy sufficient appliances

#Low-energy LED light source
 # Cross Bracing acts between Douglas fir columns to increase the lateral stability and shear strength of the wall.

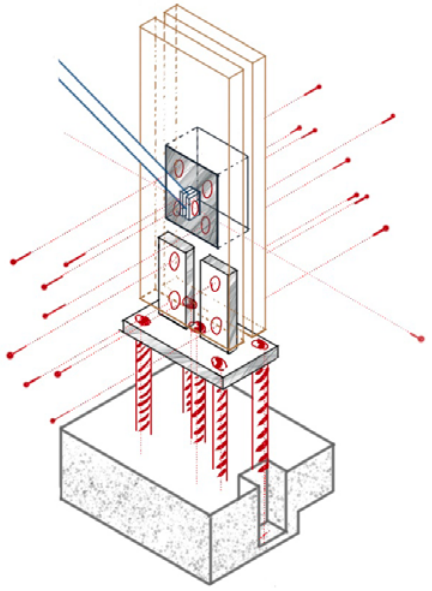


Fragment Study

Wooden farm structures, much like solid steel structures, offer lightweight solutions while ensuring adequate seismic performance. These structures are relatively simple to fabricate and construct, and their design allows for dismantling and reuse at the end of the building's life cycle. This necessitates post-construction demolition, as traditional methods such as concrete foundations and plastered walls may not be reusable in the future.

The components of these wooden structures are joined together using bolts and screws, enabling on-site assembly and immediate use, eliminating the extended curing time required by traditional concrete pours. Additionally, the use of wood helps reduce the carbon footprint and conserves water and fuel resources when compared to concrete and steel structures.

The accompanying image illustrates the method of connecting cross-steel bracing and timber elements. It shows how nails and modern adhesives are used to permanently fix truss steel joint connections on the pitched roof, as well as how the secondary structure is attached to the primary columns to transmit gravitational forces. To ensure the true sustainability of the timber, all woods must be smoked and treated for insect resistance.



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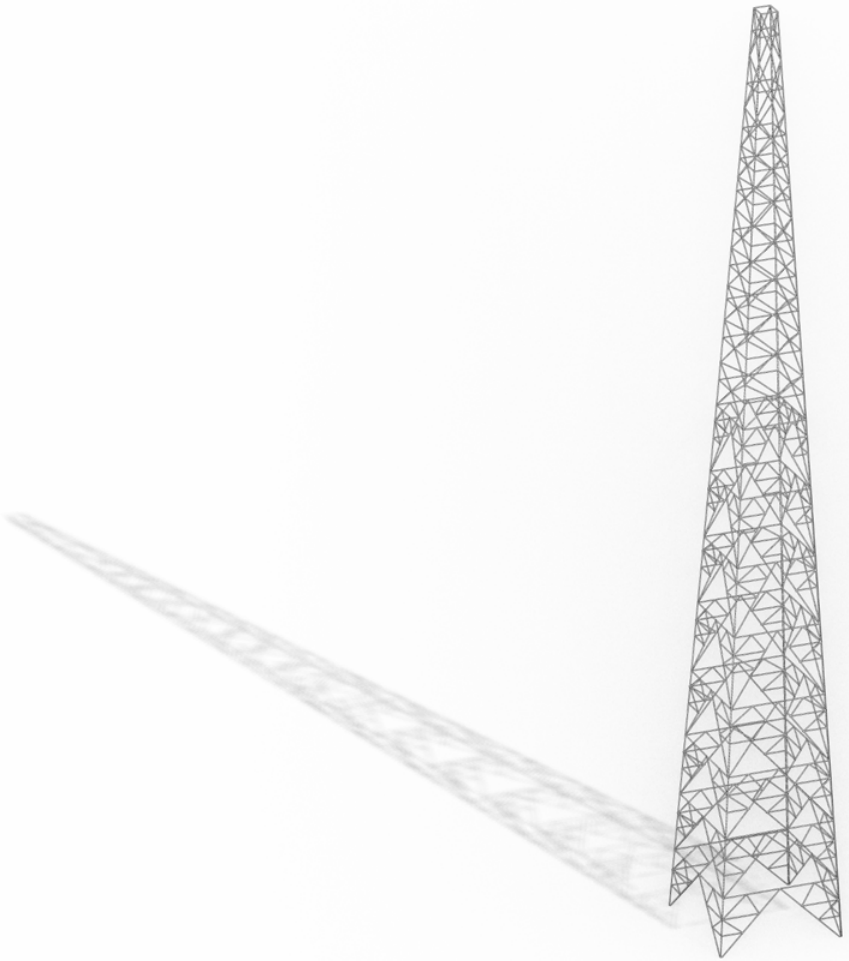


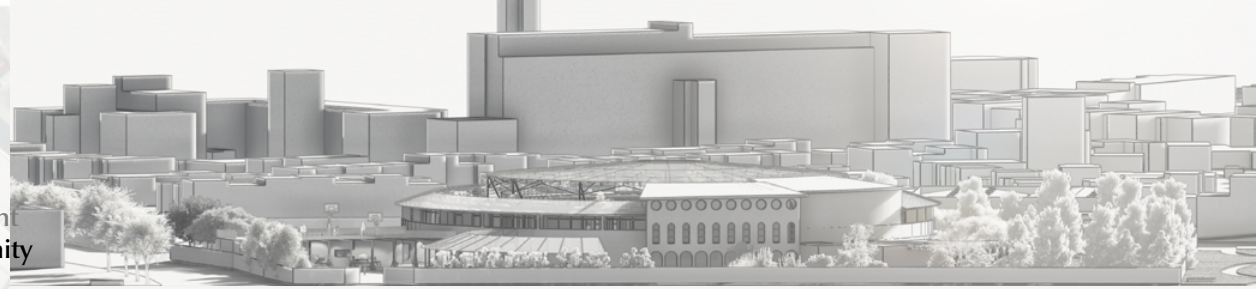
OSCillator set under relics

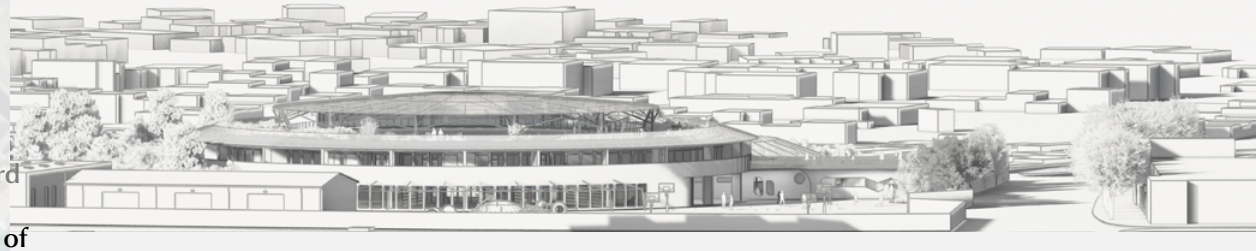
The site of **the former Mitcham Gas Works** has been in production since 100 years ago, and with advances in gas storage technology and the **removal of redundant storage tanks by the National Grid in 2022**, a private redevelopment of the site, which has been vacant for many years, is imminent. **As an opportunity to** work for the benefit of the local community, the project will consider the daily lives of grassroots organisations as they **engage with each other** and propose a place where they can gather and collectively practice their **daily rituals** for the common good of the grassroots organisations.

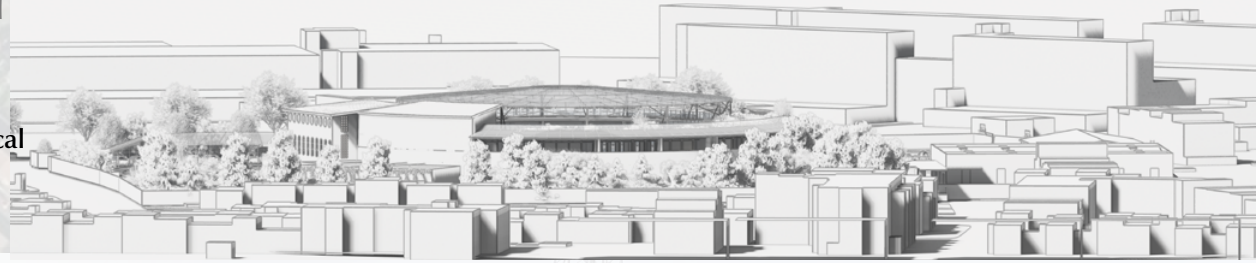
As a Fort hub for the youth, my project is named **OSCillator**, which is derived from the word 'oscillation', meaning a physical phenomenon in which a state changes repeatedly over time. OSC **is a place for young people to take extracurricular interest classes.** As an informal learning space, it provides a third role as a companion to others outside of the student and the child at home, where people of the same age meet, and **OSC hopes to cultivate the curiosity of the next generation through the medium of interest-based education.** Thereby, the emerging power of the youth and the local cultural shock is amplified and perceived by the outside world.

In the final reasoned plan, the site will be **designed as a long-term building (expected to last 50 to 70 years)**, with OSC as an open space that will bring **local businesses and teachers** to work and **provide diverse commercial spaces.** The buffer zone between the main road and the entrance will house a **café with** a first-floor observation **deck**, and upon entering the main circular building, the ground floor atrium will become a communal **courtyard surrounded by a canteen, gym, nursery, teachers' offices, exhibition space and lounge**. On the first floor, **ten classrooms** will be opened for various interest class programmes, which can accommodate more than 300 children. In order to meet the state of student and visitor mobility, OSC has created a **quieter annexe** on the west side to provide self-study, and the third floor serves as an **open-air balcony** with a 360° view of all that surrounds the OSC. At the same time, the **herb garden** features Mitcham's traditional lavender and other herbs. Visitors can learn planting techniques and listen to the story of the earth beneath their feet while they stay.

On the north side of the OSC is a **sunken theatre** built in response to a large pit left by the gas tank site and a rain-sheltered structure made of ETFE(Ethylene tetrafluoroethylene) film, like the ground floor atrium, which provides a conducive environment for informal gatherings of local organisations. The east side has a **non-powered park** for parents and children to play safely **and a mixed playground** for ball games. To the south, the **planted landscape** will act as an important buffer element, **gently placing the vibrancy of the OSC within the surrounding residential neighbourhood.**

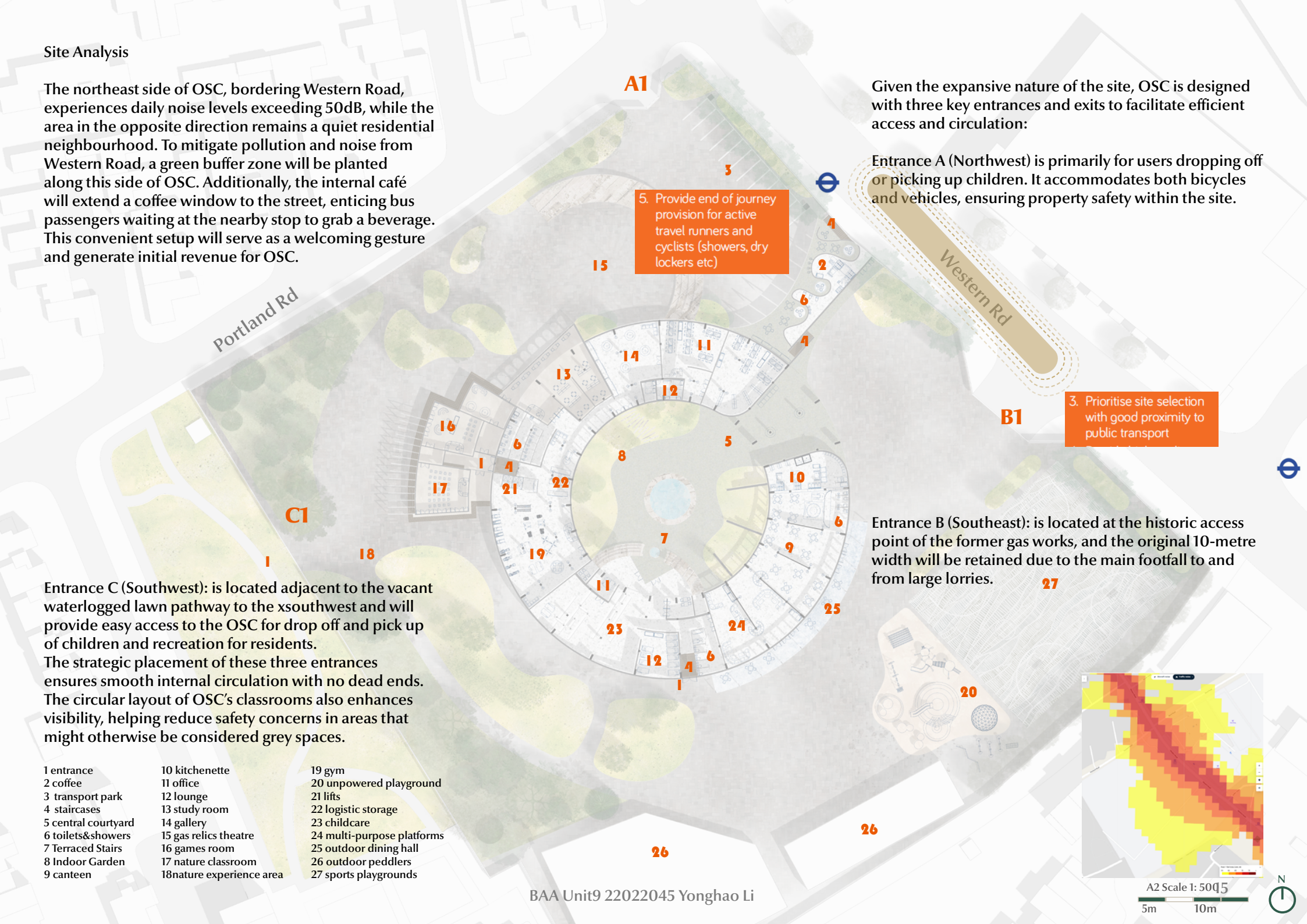






Site Analysis

The northeast side of OSC, bordering Western Road, experiences daily noise levels exceeding 50dB, while the area in the opposite direction remains a quiet residential neighbourhood. To mitigate pollution and noise from Western Road, a green buffer zone will be planted along this side of OSC. Additionally, the internal café will extend a coffee window to the street, enticing bus passengers waiting at the nearby stop to grab a beverage. This convenient setup will serve as a welcoming gesture and generate initial revenue for OSC.



Given the expansive nature of the site, OSC is designed with three key entrances and exits to facilitate efficient access and circulation:

Entrance A (Northwest) is primarily for users dropping off or picking up children. It accommodates both bicycles and vehicles, ensuring property safety within the site.

Entrance B (Southeast): is located at the historic access point of the former gas works, and the original 10-metre width will be retained due to the main footfall to and from large lorries.

Entrance C (Southwest): is located adjacent to the vacant waterlogged lawn pathway to the xsouthwest and will provide easy access to the OSC for drop off and pick up of children and recreation for residents.
The strategic placement of these three entrances ensures smooth internal circulation with no dead ends. The circular layout of OSC's classrooms also enhances visibility, helping reduce safety concerns in areas that might otherwise be considered grey spaces.

1 entrance
2 coffee
3 transport park
4 staircases
5 central courtyard
6 toilets&showers
7 Terraced Stairs
8 Indoor Garden
9 canteen
10 kitchenette
11 office
12 lounge
13 study room
14 gallery
15 gas relics theatre
16 games room
17 nature classroom
18nature experience area
19 gym
20 unpowered playground
21 lifts
22 logistic storage
23 childcare
24 multi-purpose platforms
25 outdoor dining hall
26 outdoor peddlers
27 sports playgrounds

A2 Scale 1: 500 5m 10m

Structural Strategy

In line with reducing carbon emissions associated with excessive concrete use in large-scale buildings, OSC's structure has been designed for sustainability and recyclability post-demolition.
The building's primary materials will consist of steel and timber, complemented by aluminium alloys and steel cables for the ETFE roof and cable dome systems.
The circular structure of OSC is composed of solid web steel columns and I-beam chord boards forming the primary framework. Within this, lighter timber chord boards and diagonally galvanized steel web members create the secondary structure, functioning as joists. The load from floor-level furniture and occupants is evenly distributed through the steel floor system supported by these joists.
The circular, radially symmetrical design of OSC is intended to minimize the effects of shear stress and wind pressure from all directions, ensuring the building's structural stability. The cable dome roof sustains the tensioned ETFE membrane, which slopes in various directions to channel rainwater toward dedicated pipes on the rooftop balcony.

Minimizing Dust and Noise During Construction

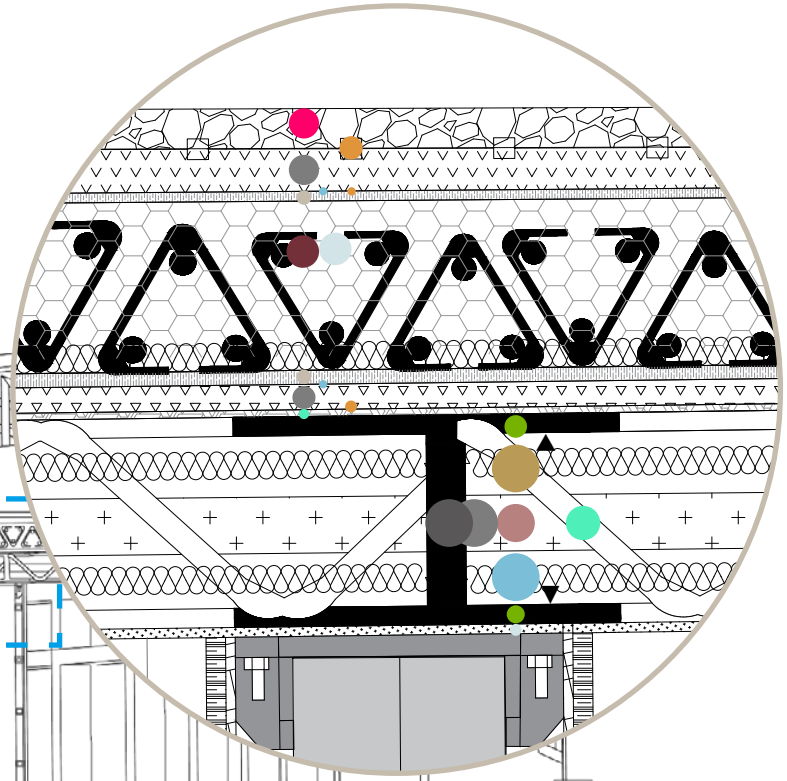
To build this new character with minimal dust and noise, much of the construction process is shifted to off-site factories. The steel structure will be bolted and permanently welded in a manner that allows for future removal if needed. Pre-fabricated steel and timber components offer a practical alternative, as most elements can be pre-assembled in the factory. Materials will be supplied by Mitcham Builders Merchants, which is the building materials factory next door to the site. Pre-positioned timber trusses and cut steel sections will be delivered to the site, where labourers will handle the final assembly, welding, and fitting.
The cavities within the frame will be filled with insulation and various pipes.

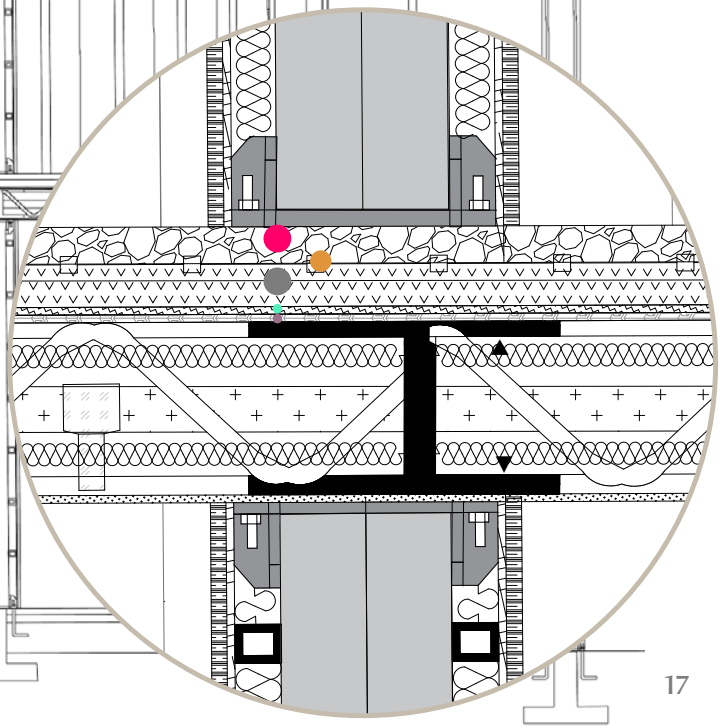
London- Coleman Street truss and floor slab construction

Colli Truss and Frame

Rooftop process:
Terrazzo
Divider strips
Cement self-levelling
Cement mortar
Waterproof vapour permeable membrane--interface agent
Asphalt felt
Steel purlin --expanded perlite concrete
Asphalt felt
Waterproof Vapour Barrier Membrane
Cement levelling layer
Interfacial agent
Steel floor joist-screws

▲ I-beam - top chord boards
Rock wool insulation
I-beam - joint - steel pipe purlin ---
Diagonal galvanised steel Web Members
Rock wool insulation Water and Electricity Piping
▼ I-beam - Lower Chord Boards
Plasterboard Ceiling

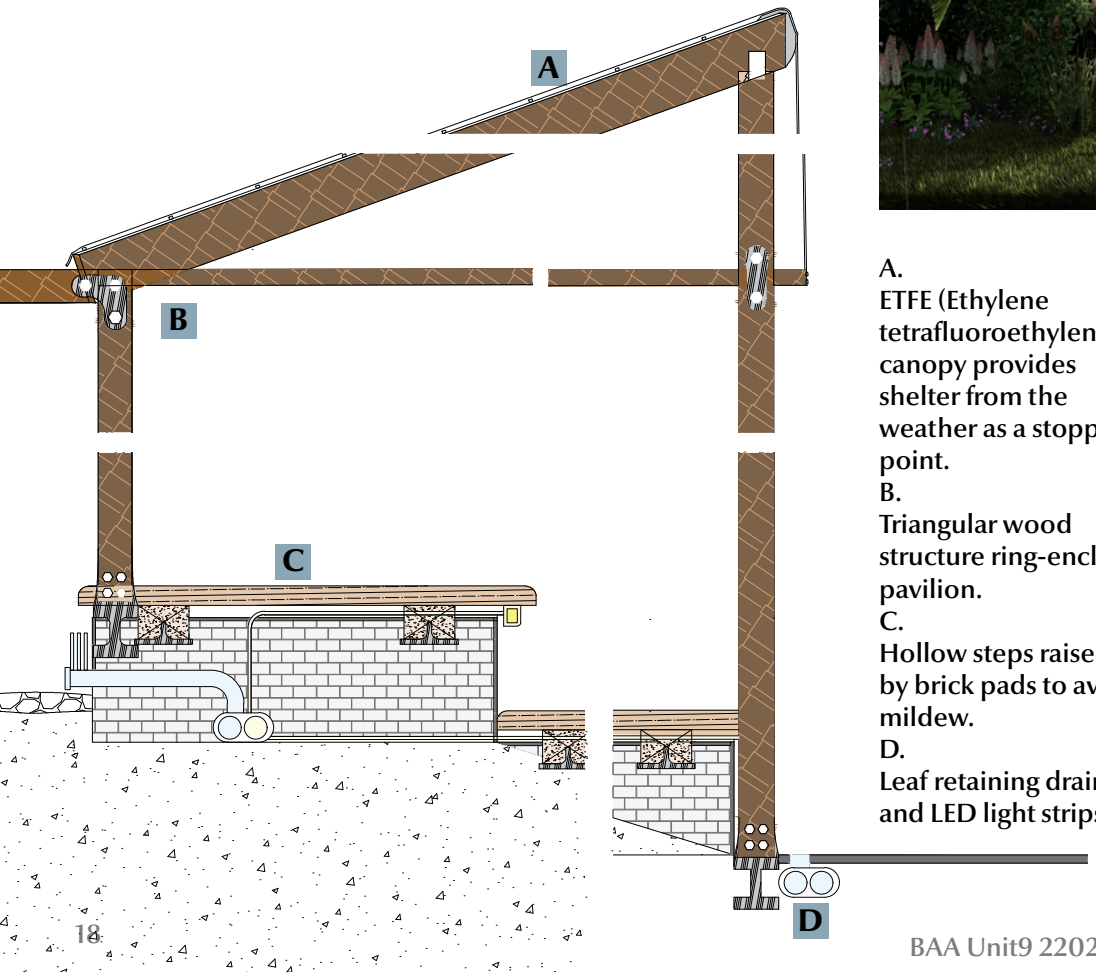




In typical mesh steel structures, cross-bracing members help mitigate shear stresses. However, OSC's circular design allows the radiating walls and keel plates to naturally fulfil this function, reducing the need for additional cross members. This design focuses more on vertical force transmission. The floor slabs are constructed on trusses, which evenly distribute the building's weight across load-bearing columns, aiding stability.
In alignment with sustainability goals, materials like terrazzo, sandblasted paint, and water- and fire-resistant coatings are chosen for the outer skin to maintain structural dryness and protect the inner layers. The trusses are fully removable, allowing the entire steel structure to be disassembled and reused at the end of the building's life cycle. After dismantling wall panels and removing insulation materials like rock wool and gypsum boards, all trusses and steel columns can be efficiently repurposed in future construction cycles.

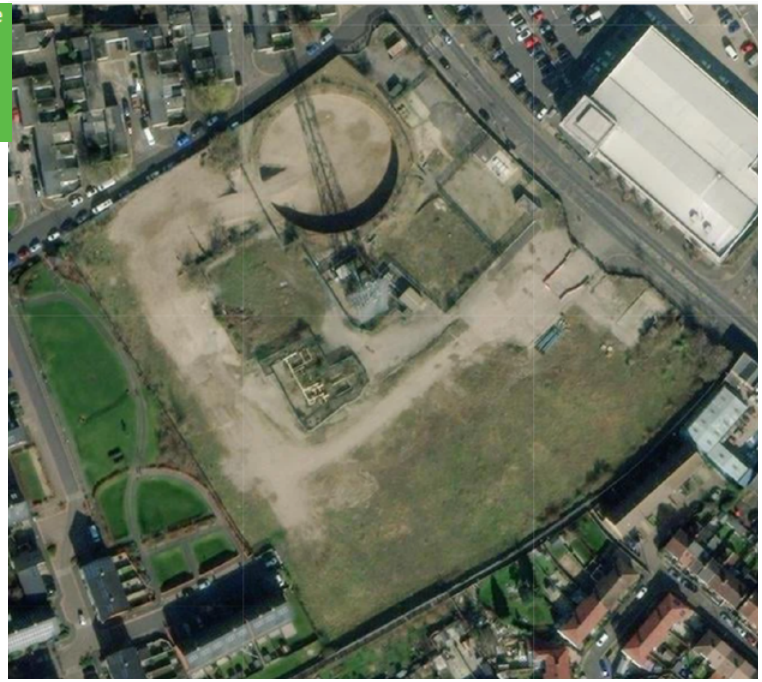
Site Flooding and Drainage Strategy

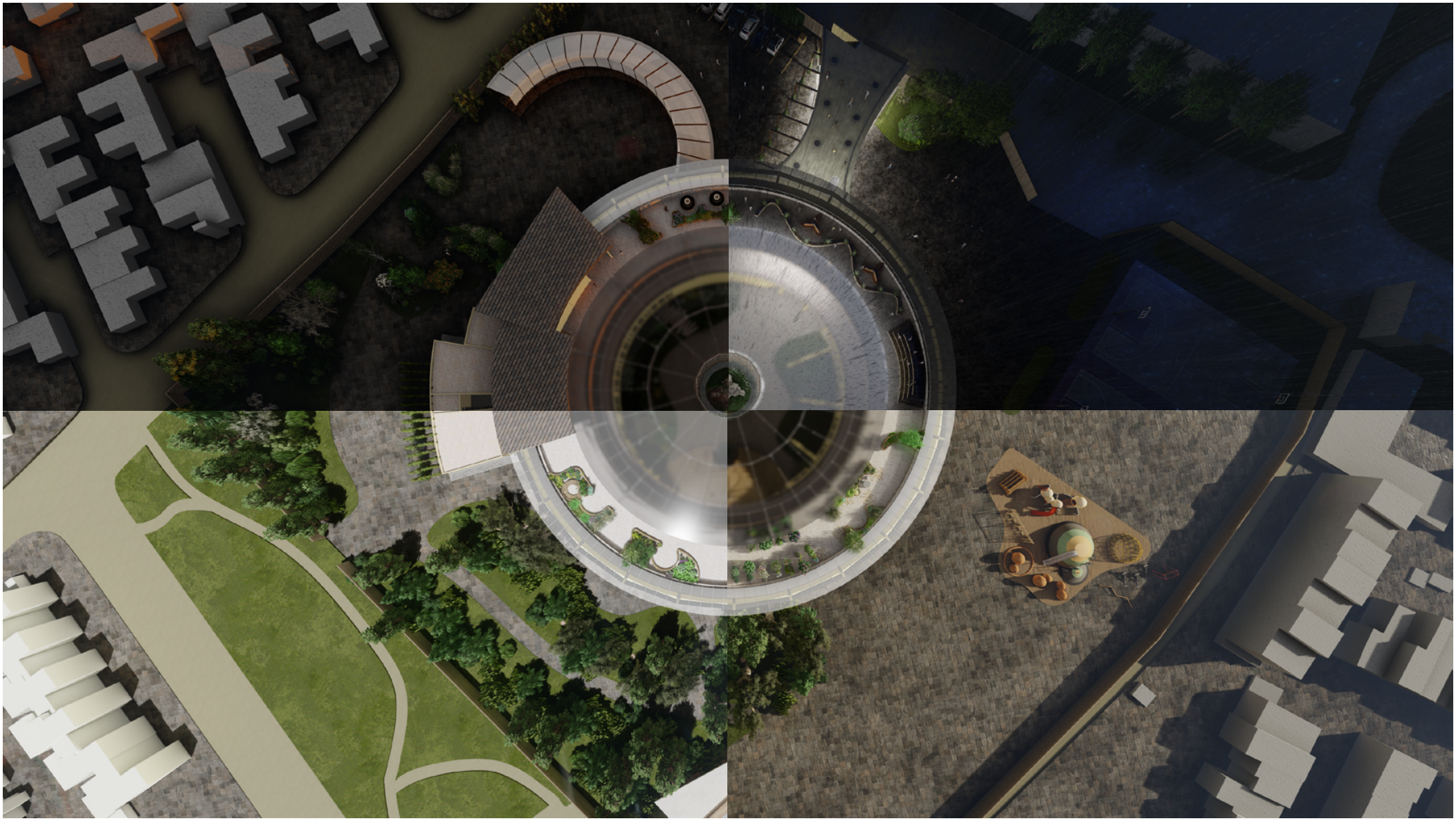
The uneven terrain typical of brownfield sites often leads to random puddles and increases the risk of flooding. To mitigate these issues, OSC integrates permeable bricks throughout the site, allowing rainwater to seep into the ground naturally. Additionally, strategically placed rainwater wells at lower elevations help manage excess water by guiding it away from the site, effectively reducing the risk of flooding and ensuring that surface water is efficiently absorbed or redirected.



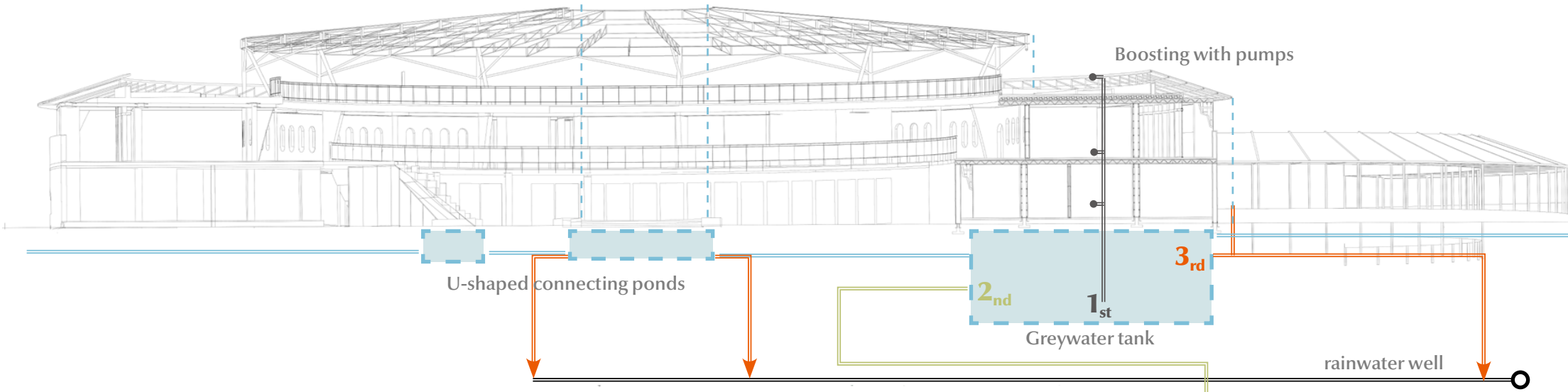
A.
ETFE (Ethylene tetrafluoroethylene) canopy provides shelter from the weather as a stopping point.
B.
Triangular wood structure ring-enclosed pavilion.
C.
Hollow steps raised by brick pads to avoid mildew.
D.
Leaf retaining drains and LED light strips

3. Prioritise Brownfield site selection
4. Carry out sustainable remediation of site pollution





The rainwater will flush the sludge from the top floor and discharge into the rainwater wells around the OSC, and the middle section of the ETFE membrane will direct the rainwater to the pond landscape in the middle of the ground floor



Structural Strategy for Rainwater Management

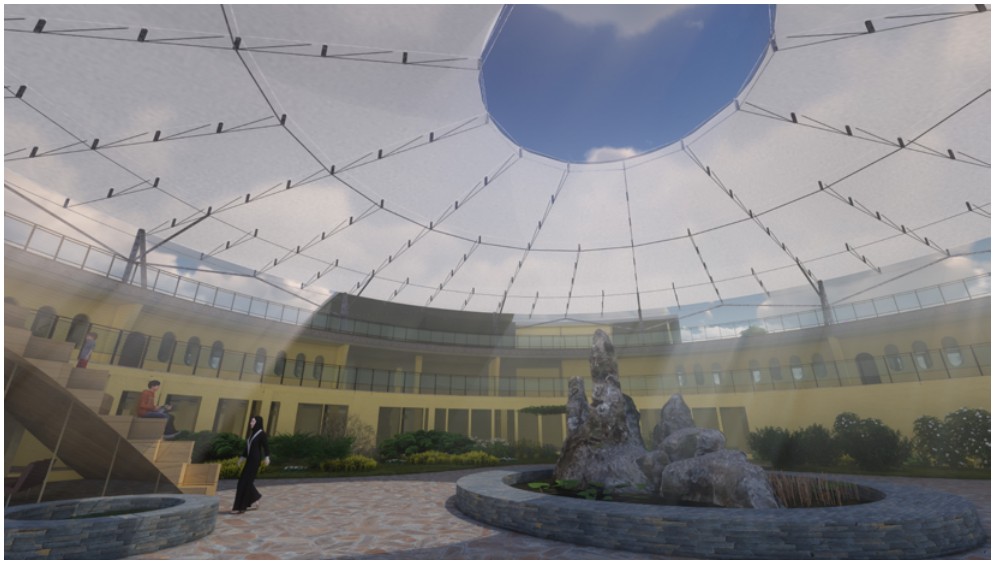
The atrium of the OSC will benefit significantly once the remnants of the signal tower are removed from the site. In London's temperate oceanic climate, maintaining a dry and welcoming open space is a challenge due to frequent rainfall and overcast skies. Prolonged rainy weather, while beneficial for rainwater harvesting and reducing carbon emissions, can also negatively impact mood and the overall user experience. Therefore, selecting a material that is both environmentally friendly and invites natural sunlight is essential for creating a positive living environment.
The atrium of the OSC is enclosed with an ETFE (ethylene tetrafluoroethylene) membrane, known for its high light transmission and durability while being lightweight and self-cleaning. To address London's rainy conditions, the building's eaves are integrated with an active rainwater harvesting system. The entire structure, in conjunction with the atrium's membrane, is designed to collect rainwater, directing it into an underground cistern. After initial filtration and sedimentation, the harvested greywater will primarily be used for toilet flushing and irrigating rooftop gardens.

Pre-embedded permeable pipe for road re-construction

4. Provide Rainwater and greywater recycling and attenuation but consider operational implications of complex systems

and the abundant portion will be directed to a pre-built wetland landscape within the site. The excess will be directed to a pre-built cistern in the site's wetland landscape, which will enable the use of sponge city strategies to regulate the city's microclimate through evapotranspiration in a global warming scenario. If a complete surplus is encountered, it will flow into a dedicated rainwater well planned by the city.

Filters large particles and leaves

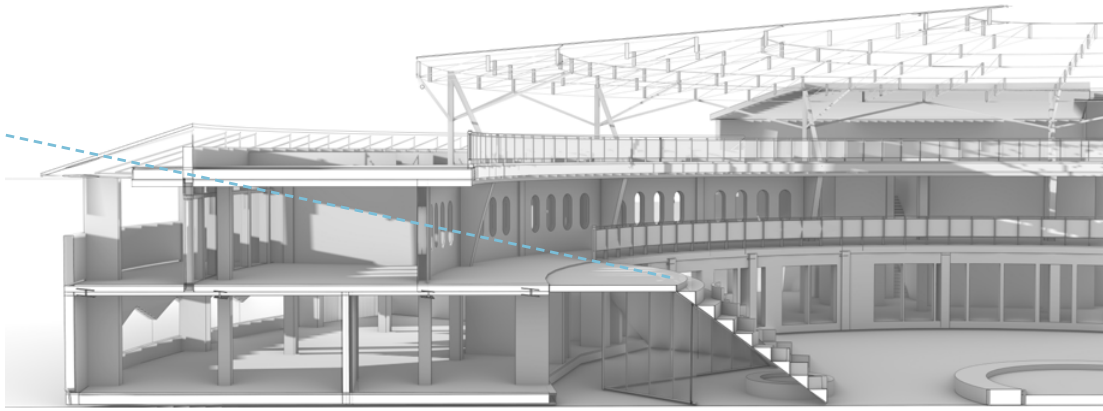


Light Environment

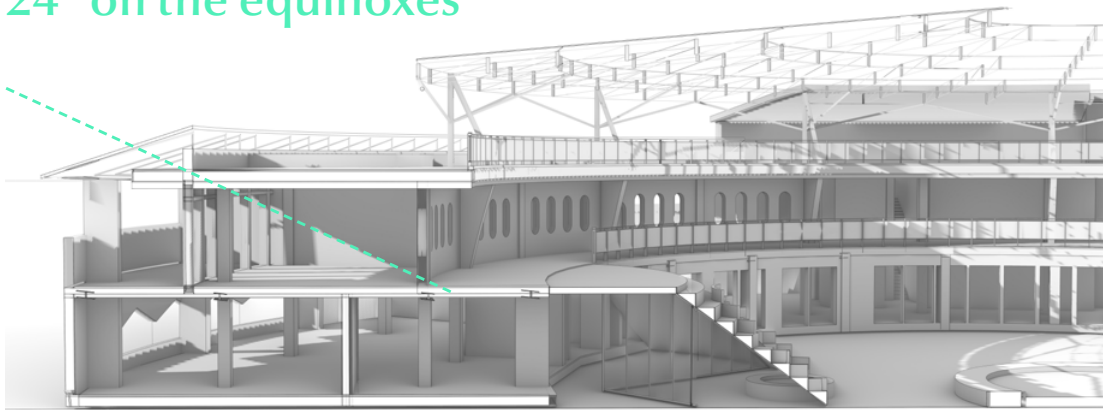
Natural lighting not only elevates room temperatures but also reduces electricity consumption. In OSC's second-floor classrooms, acoustic insulation is critical to maintaining privacy. The walls between adjacent classrooms are constructed from double-layered asbestos, providing effective soundproofing and contributing to the privacy of each classroom balcony. To enhance the natural light in these classrooms, the third-floor perimeter has been set back by 1.5 meters and fitted with light-transmitting ETFE canopies. This design increases light intake in the second-floor classrooms, which is especially beneficial during winter when sunlight is more limited.

For instance, the four south-facing classrooms do not receive direct sunlight at midday during summer; instead, light is diffusely reflected from the floor up to the ceiling, creating a bright but comfortable environment. However, in winter, direct sunlight penetrates deeper into the classroom, providing warmth and natural light. On the top floor, the retracted walkway is a safety measure and a functional design feature. The sloping OSC perimeter film creates a 1.2-meter-high and 1.4-meter-deep triangular void space, which can be used for storage or to house air-conditioning units while preventing children from venturing too close to the edge. Additionally, the 1.5-meter retraction of the third-floor perimeter results in an extended membrane roof over the atrium, allowing for a larger sheltered area below.

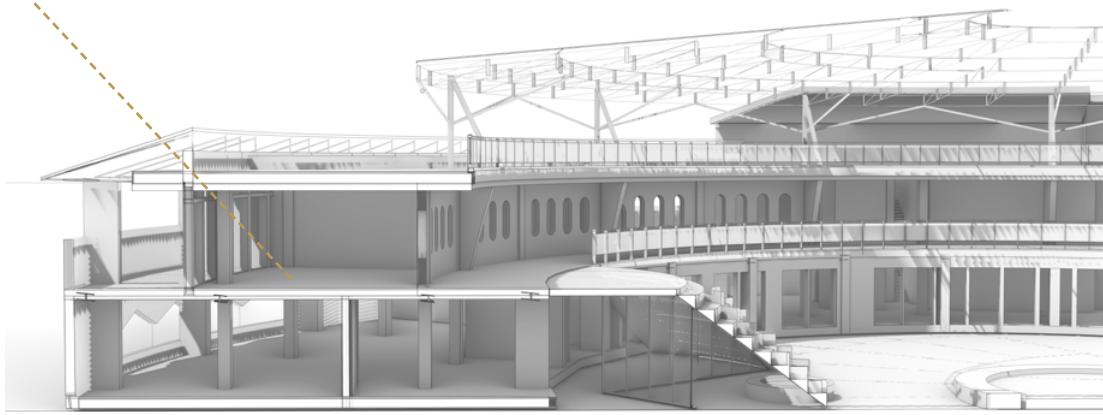
16° on the winter solstice



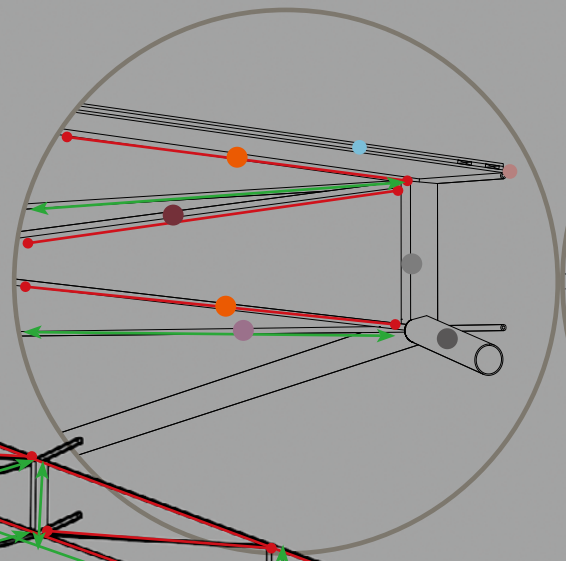
24° on the equinoxes

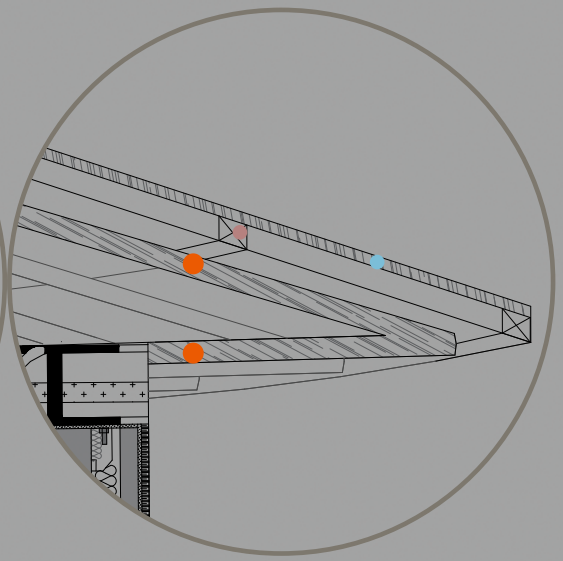


62° on the summer solstice



Cable dome process:
- Main ridge cable
- Grid cable
- ETFE membrane
- Steel purlin
- Compression ring
- Cable shell
- Hollow steel pipe supports

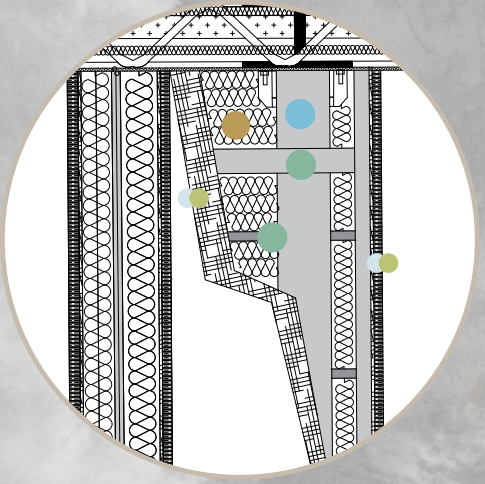




Pressure and Tension

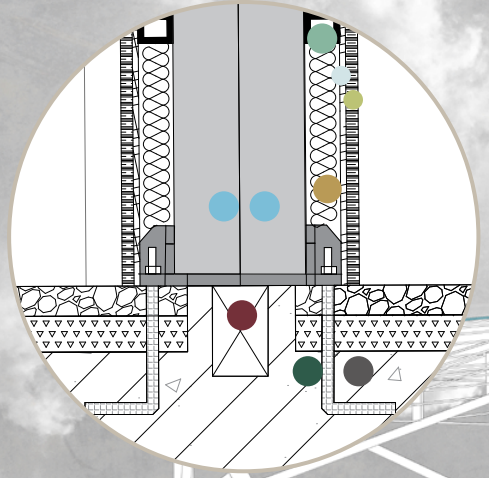
Tensile Structure Design

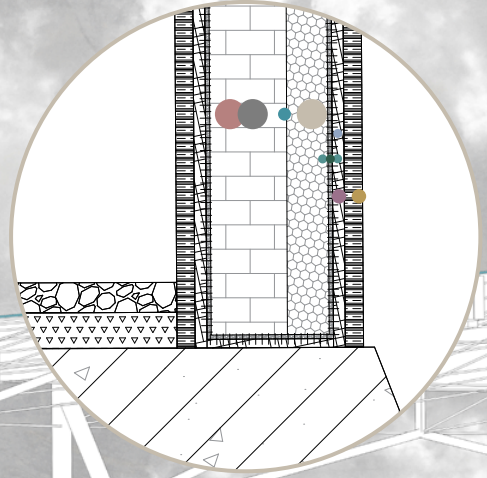
The overall tensile structure of OSC maintains equilibrium through the axial support provided by aluminium rods and the tension applied by steel cables. The dome is elevated by incrementally lifting the rods via these cables, creating a stable, step-by-step rise. The use of ETFE for the dome offers excellent self-cleaning properties and allows for the creation of a large covered space without incurring excessive costs. This efficient setup supports a spacious and functional environment while minimizing construction expenses. According to the observation, replacing the lower Main ridge cable with an aluminium rod to generate support pressure can further improve stability.



Bearing wall process:
- Solid web steel columns
- Rock wool
- Shear keys
- Ground corner anchor bolts
- Concrete foundation

- Light steel keel
- Plasterboard
- lime mud





Thermal insulation facade process:
- Foundation wall
- Cement mortar levelling layer
- Insulation layer--
- Bonding layer
- Expanded polystyrene board
- Protective layer--
- Plastic expansion anchor
- Anti-cracking mortar
- Alkali-resistant glass fibre mesh
- Crack-resistant mortar
- Ornamental facing layer--
- Flexible water-resistant putty
- Sandblasted wall

Activity area
5-24℃ / 60,000 Lux

Separate balcony
8-22℃
10,000 Lux

Interest-oriented class
23℃ - requires heating in winter/ 600 Lux

Circular corridor
8-22℃
10,000 Lux

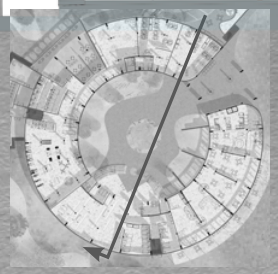
Terrace platform
5-22℃
10,000 Lux

recreation areas

Trusteeship Fortress
24℃ - requires heating in winter/ 500 Lux

Waiting Zone
20℃ - requires heating in winter/ 400 Lux

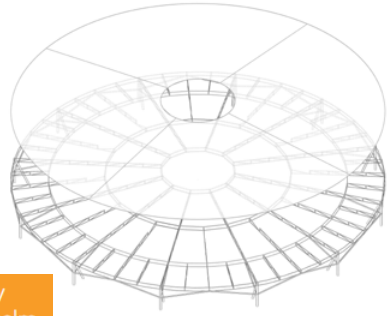
meditation pond



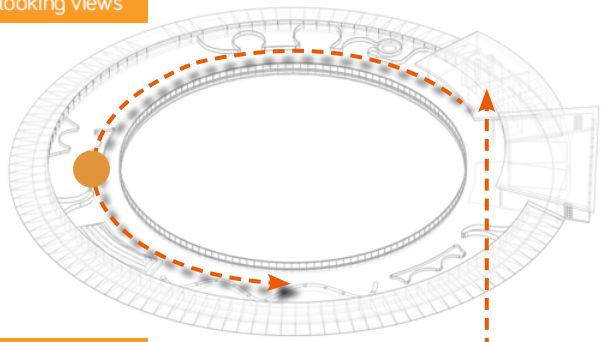
$R_{childcare} = (R_{Foundation\ wall}) + R_{Expanded\ polystyrene\ board} + R_{Breathable\ Membrane} + R_{Flexible\ water\text{-}resistant\ putty} + R_{Sandblasted\ wall} + R_{Rock\ wool} + R_{Internal\ /external\ Air\ Gap} + R_{Gypsum\ Board}$

$= 0.25 \div 0.222 + 0.2 \div 0.77 + 0.02 \div 0.17 + 0.05 \div 0.17 + 0.25 \div 0.222 + 0.002 \div 0.25 + 0.03 \div 0.77 + 0.2 \div 0.04 \approx 7.971 m^2K/W$

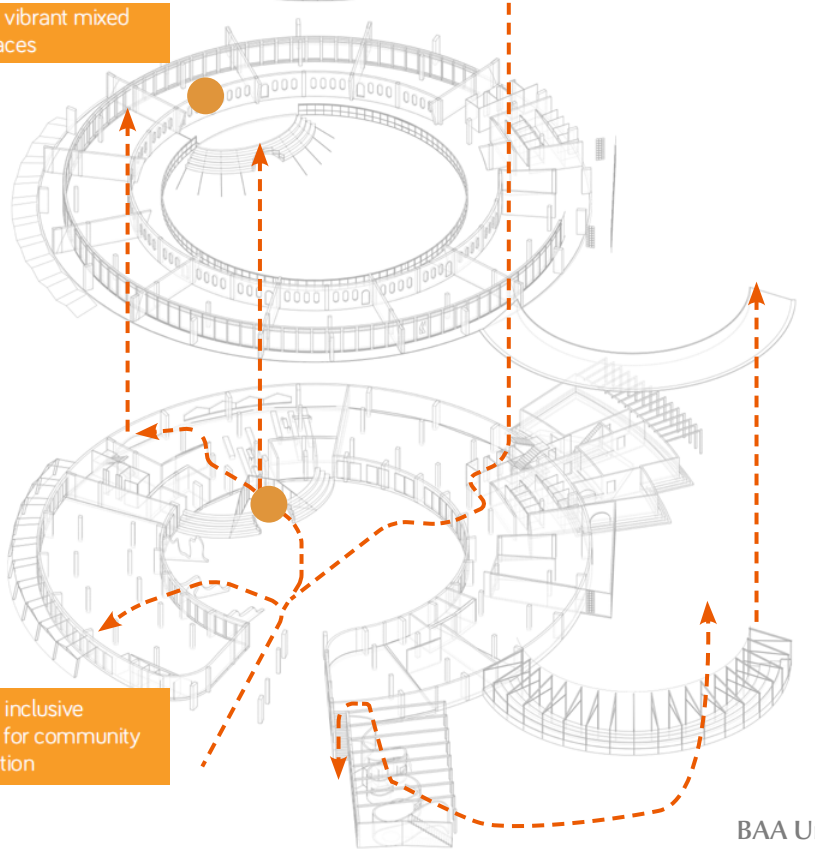
$U_{childcare} = 1 \div R_{childcare} = 1 \div 7.971 \approx 0.125\ W/m^2K$ Meet the UK standard for classroom U-values below 0.15



6. Provide High quality pedestrian public realm
8. Create Secure Places with overlooking views



4. Create vibrant mixed use places



7. Create inclusive Places for community interaction

A rooftop potting garden protects the building from water vapour,reduce the urban heat island effect and lower daytime temperatureswhile attempting to bring historic local herbal gardening into daily life.

7. Create a range of green spaces (green roofs, vertical greening, pocket parks, green corridors)

Small class instruction, for different situations is interested in proposing flat management, low density space and relative windows allow for quick regulation of ventilation.

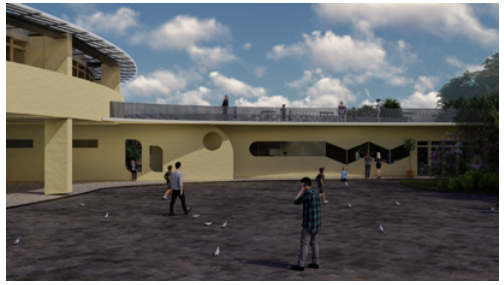
3. Design spaces with appropriate occupant density for activity

The ground floor has an accessible nursery and community library on the residential side, where children can stay safely in professional care and in the company of neighbours.

2. Create secure places for privacy
1. Provide spaces with strong visual connection to outside

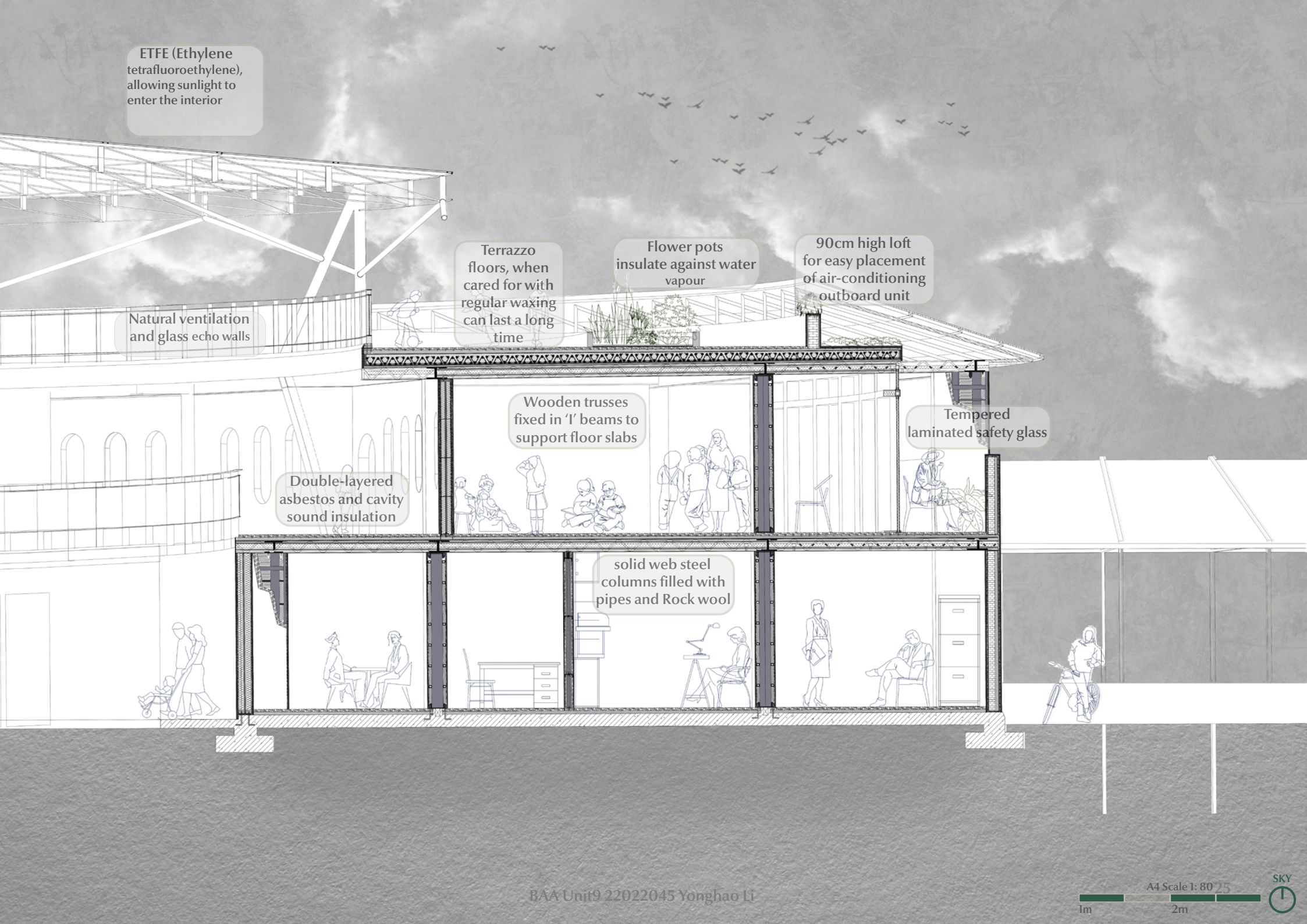
At the junction of the terraced platforms on the first and first floors, in the transition zone between public and private spaces, where parents take a rest.

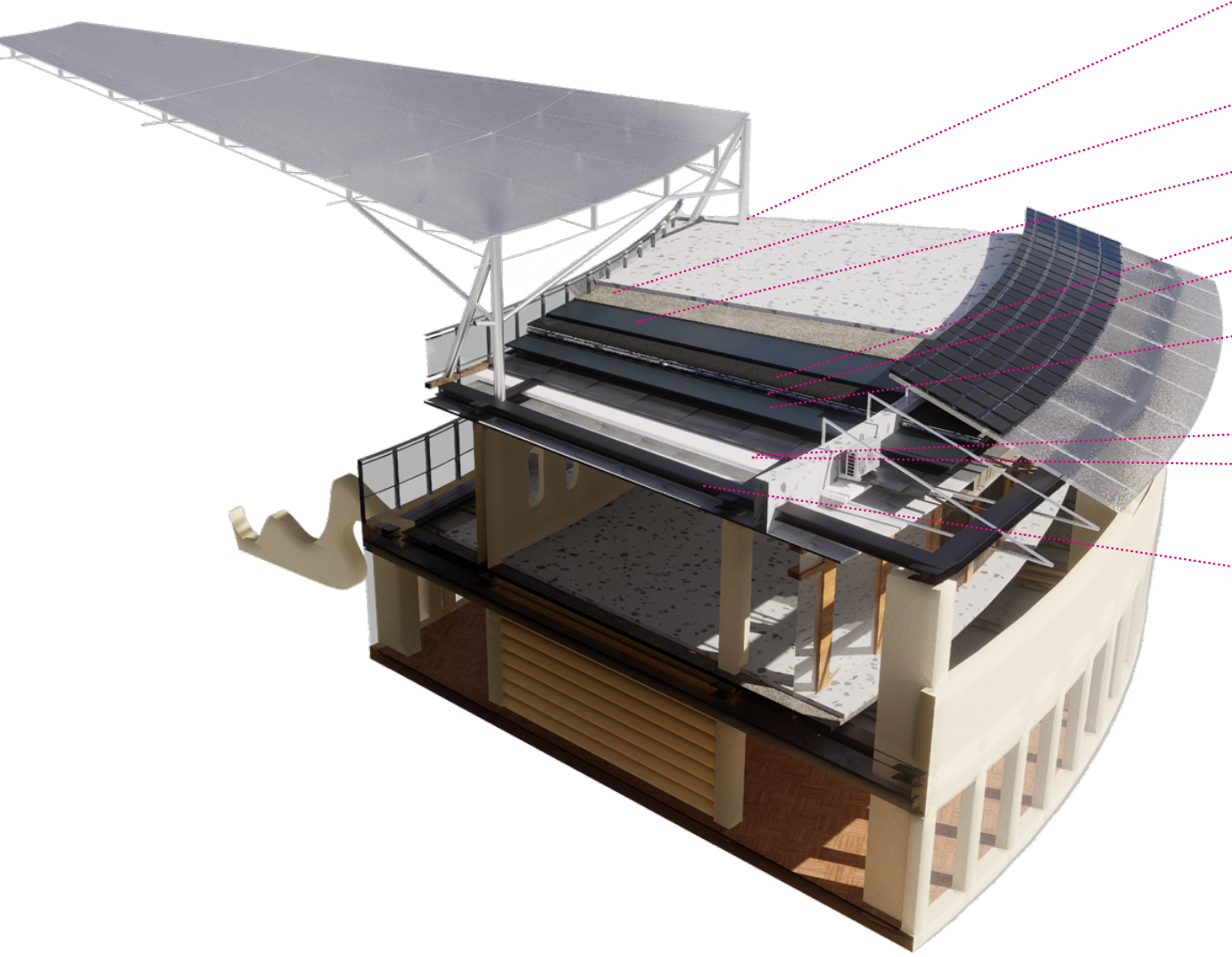
5. Design spaces with good indoor daylighting, lighting and glare control



The OSC does not block any of paths, with access through the building to the rear side residential area, a café terrace staircase leading directly to the sunken theatre, and accessible lifts provided within the building.

8. Design spaces that are inclusive and universal accessible


ETFE (Ethylene tetrafluoroethylene), allowing sunlight to enter the interior
Natural ventilation and glass echo walls
Terrazzo floors, when cared for with regular waxing can last a long time
Flower pots insulate against water vapour
90cm high loft for easy placement of air-conditioning outboard unit
Wooden trusses fixed in 'I' beams to support floor slabs
Tempered laminated safety glass
Double-layered asbestos and cavity sound insulation
solid web steel columns filled with pipes and Rock wool
SKY
A4 Scale 1: 80
1m
2m



Rooftop process:
20mm Terrazzo
Divider strips

5mm Cement self-levelling

Waterproof vapour permeable membrane-- interface agent
Asphalt felt
10mm Cement mortar
60mmSteel purlin -- expanded perlite concrete
Asphalt felt
Waterproof Vapour Barrier Membrane

Cement levelling layer
Interfacial agent
1mmSteel floor joist-screws

200mm
▲ I-beam - top chord boards
150mm Rock wool insulation
I-beam - joint - steel pipe purlin ---
Diagonal galvanised steel Web Members
Rock wool insulation ---- Water and Electricity Piping
▼ I-beam - Lower Chord Boards
Plasterboard Ceiling

In this detail study, I understood that the different materials of the building interact with each other and mutually achieve a perfect and rigorous thermal resistance layer. At the same time, I gained a better understanding of the integral tensioned structure

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