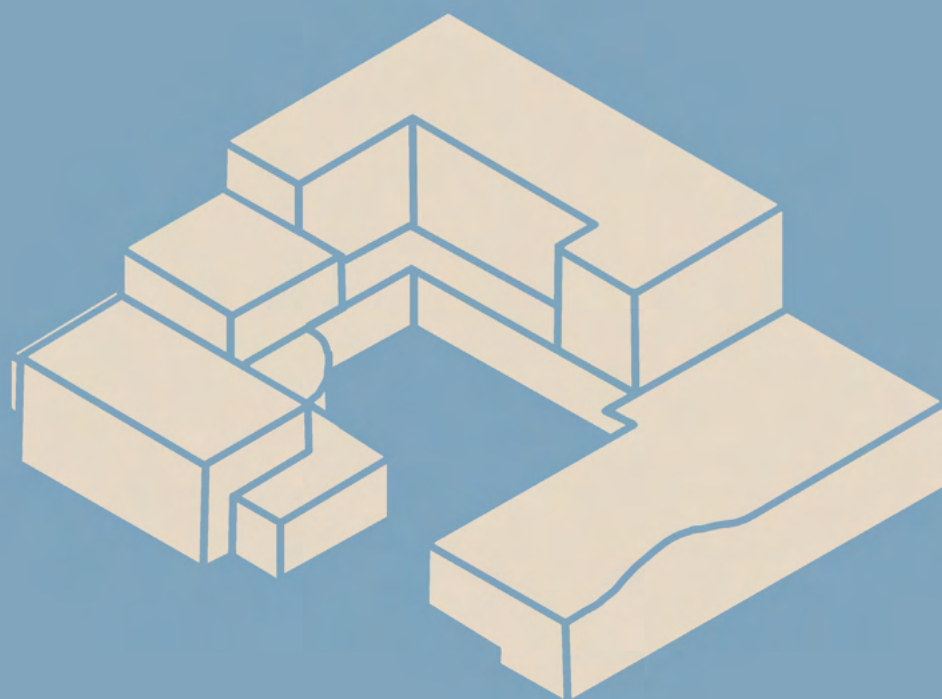


THE
RESONANCE
INSTITUTE



Group 18

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Architectural



Structural



Environmental



Introduction: Analysis & Response

Our institute responds to the surrounding area, reflected in our subject choice of Music and Neuroscience. This provides a new and collaborative approach to learning. Introducing public spaces allows the positive impact of the design to resonate throughout the community around the site.

The Brief

Brief

The brief calls for a new Higher Education 'institute' combined with an industry 'innovation hub' in Swindon which will act as the public face of a regional university and industry collaboration, and support the pull-through of Further Education students into STEAM.

Response

In response, we have designed an institute that invites the public in, to engage, inspire and create a hub for the wider community. Our proposal seeks to provide an inclusive learning environment in order to encourage **innovation, collaboration** and **community**.

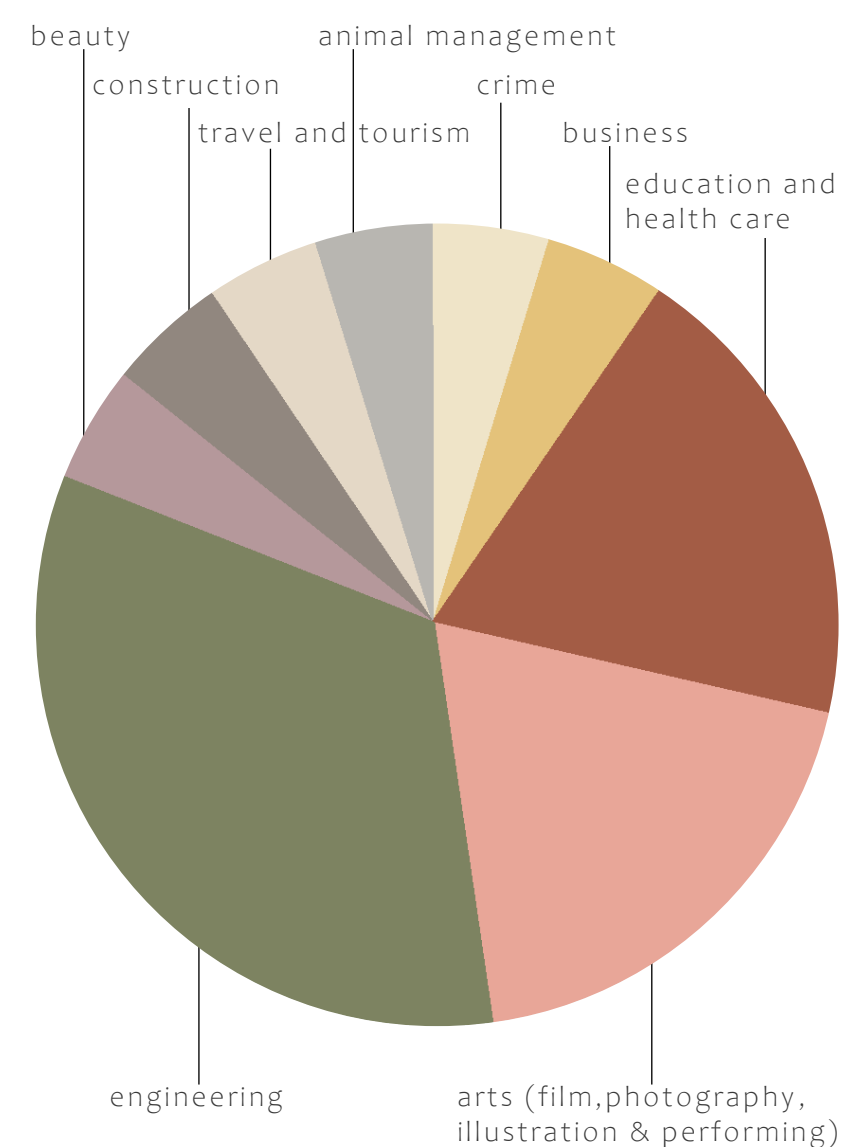
Approach

The teaching spaces for our chosen two subjects, Music and Neuroscience, have been integrated together, challenging traditional educational models, and providing a holistic approach to learning. We made the decision of choosing our two subjects by looking to the town of Swindon, its currently available degrees, its legacy, and the community.

Locally Available Degree Subjects

Oxford Brookes Campus: Nursing

New College Swindon:



A look at Swindon...

Health

Swindon's railway heritage connects directly with the founding of the NHS and Britain's healthcare system.

The GWR Medical Fund Society was formed by employees to help look after workers and their families.

1847

The Medical Fund Hospital was opened with accident and emergency services for staff.

1871

Park House was built as a home and surgery for the GWR's chief medical officer and later used as a medical centre.

1876

The fund opened a dental practice at the Mechanic's Institute.

1887

The Medical Funds Baths and Dispensary was built to bring services together under one roof.

1891

The NHS was fully established, inspired by Swindon's GWR Medical Fund Society and holistic approach.

1948

The GWR Medical Fund Hospital was closed and replaced by The Princess Margaret Hospital, funded by the NHS.

1960

After the closure of the Princess Margaret Hospital, Swindon's Great Western Hospital was opened.

2002

Mental Health

Swindon has a high amount of mental health conditions, with around 15% of people living with mental health disorders, especially anxiety and depression. Swindon's rates of self-harm also rises well above the national average and for people age 15-24, Swindon has the sixth highest hospital admissions for self harm.



Degree Choice

Music

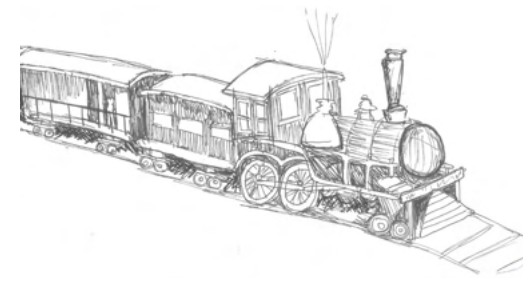
Why Music?

Music can uplift a community, and bring people together. Shared musical experiences ignites creativity and links to improved mood and helping depressive disorders.



Why in Swindon?

When visiting the site, we noticed a sense of emptiness and lack of community. Swindon has poor mental health statistics, and the Swindon Needs Analysis reports Swindon has a poor active and engaged community score, indicating low levels of participation in community life.



How does it help?

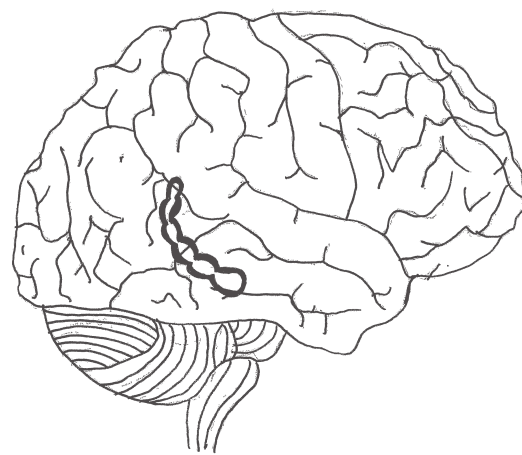
Our music facilities will have public frontages, in which the community are invited in by the students and performances are held. The landscaping will include outdoor performance areas, which passers by can pause and enjoy.



Neuroscience

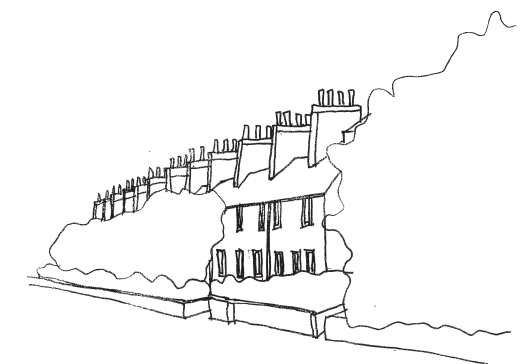
Why Neuroscience?

Neuroscience is rapidly growing due to modern scientific techniques, cooperation among different scientific disciplines, and new innovative learning arrangements. We want our institute to continue this rapid progress in the field and facilitate pioneering research.



Why in Swindon?

Offering Neuroscience as a degree in Swindon, a town which has a legacy in healthcare and is home to the Medical Research Council (MRC), feels logical.



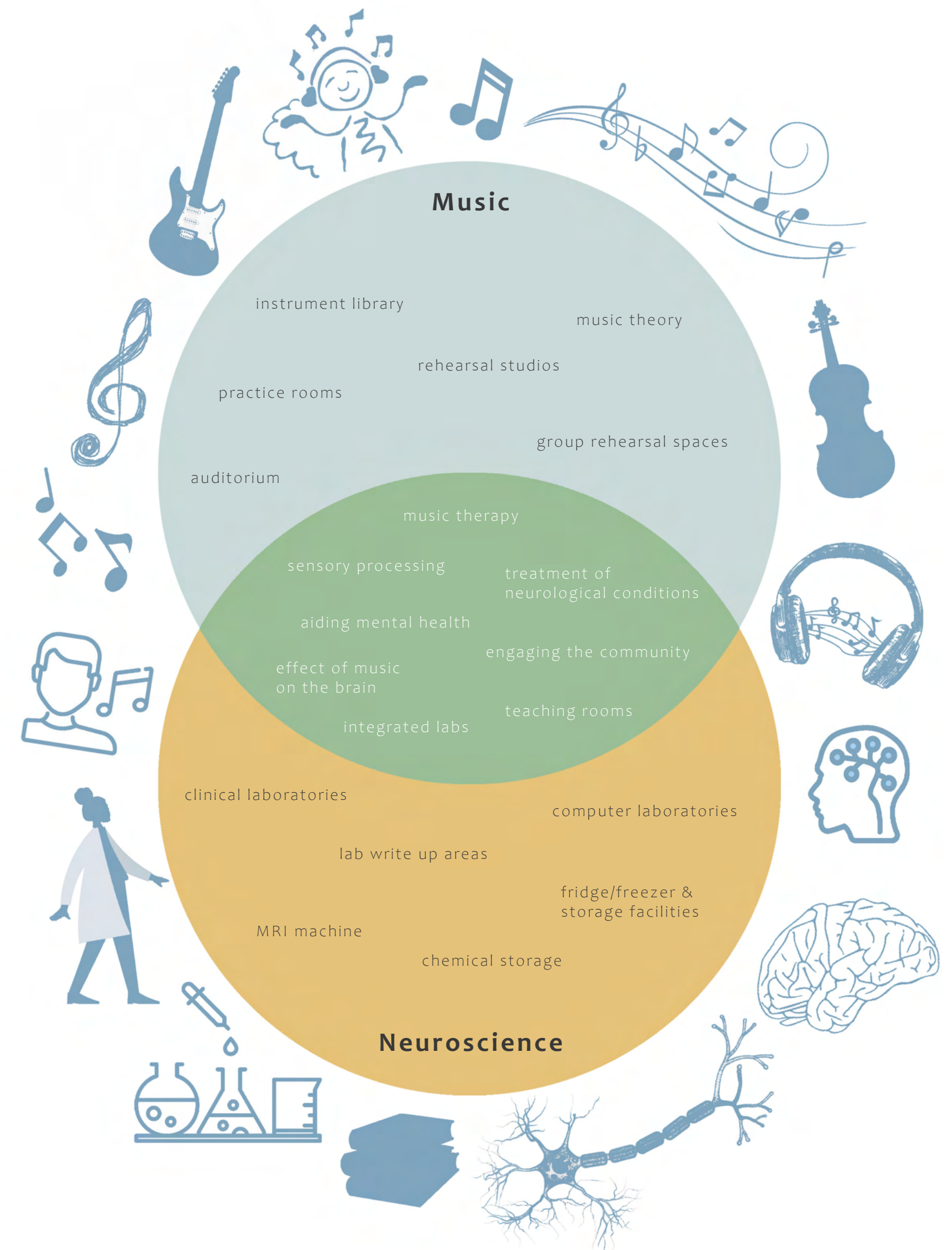
How does it help?

Neuroscience research has led to new treatments and preventions for problems that affect the brain, nervous system and body. Depression, insomnia and Alzheimer's disease are all mental and organic brain disorders that have become increasingly common to Swindon.



The Intersection

Music + Neuroscience



Partners

Who?



The Medical Research Council (MRC), based in Swindon, fund scientific research to prevent illness, develop therapies and improve human health.

Why?

Their science is split into six areas of research, including the area Neuroscience and Mental Health. They support research into disorders of the human nervous system and mental health in order to develop new treatments and interventions.

How?

Much of the MRC's funded research is carried out in universities across the UK. The innovation centre will be a space for them to open up a new MRC Centre for Neuroscience, Music and Health at our institute.

Who?



Ipsum are a Mental Health and Wellbeing Charity supporting Swindon who help address mental, psychological and emotional health issues to promote change.

Why?

They offer a range of therapeutic interventions including Therapeutic Music and Music Therapy Programmes. The four types of music therapy are receptive, improvisation, recreative and composition.

How?

The innovation centre will provide a space for Ipsum to host their Music Therapy Programmes, to be accessible to both students as well as the public.

Innovation Centre for Neuroscience & Music

Purpose

The Innovation Centre aims to catalyse collaboration, providing a space for large multidisciplinary teams to come together and share expertise, data and tools.



Function

The building will feature a large, shared research laboratory for students and scientists in which research into treatment options for neurological diseases will take place, including the option of music therapy.



Use

Upstairs there will be music therapy rooms, allowing clinical work and research to take place together under one roof and creating an active dialogue between people and neurological disorders, their music therapists and doctors.



Aim

The centre aims to bridge the research and treatment of psychological brain conditions and destigmatise psychological disorders, with patients and visitors having a view into the laboratory to promote a better understanding of the industry.



Innovation

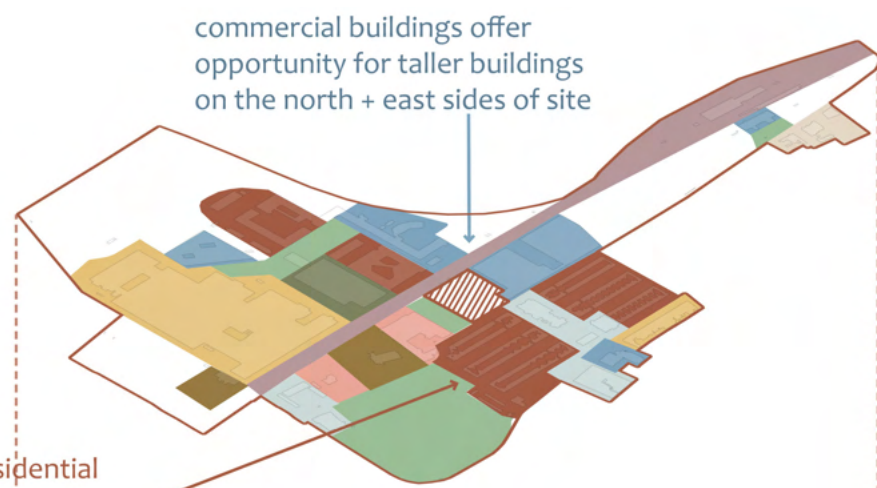
Community

Site Analysis

Key Buildings

- Regeneration
- Green Spaces
- Points of Interest
- Character Buildings
- Site

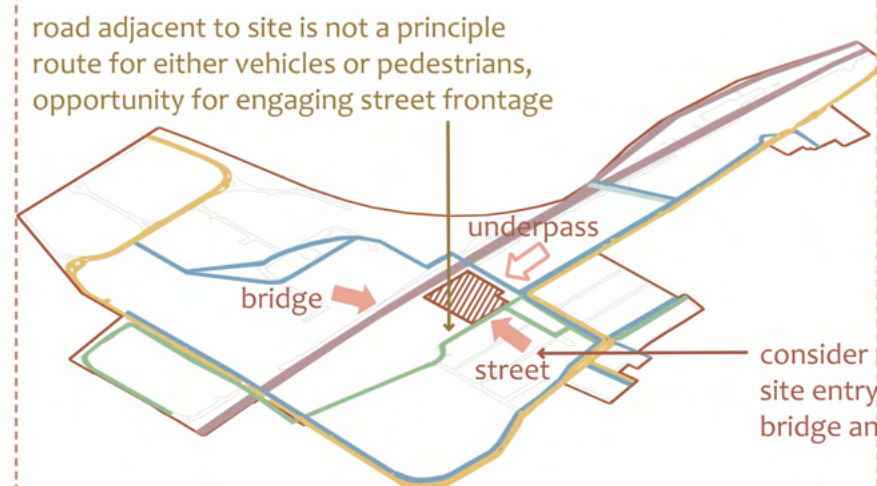
key building uses



- key
- retail
 - public open space
 - commercial
 - recreational/amenity use
 - railway line + station
 - educational
 - residential
 - religious
 - hotel + hospitality
 - museum
 - surface car parking

need to be considerate of residential buildings adjacent to site, perhaps by lower building heights of this side

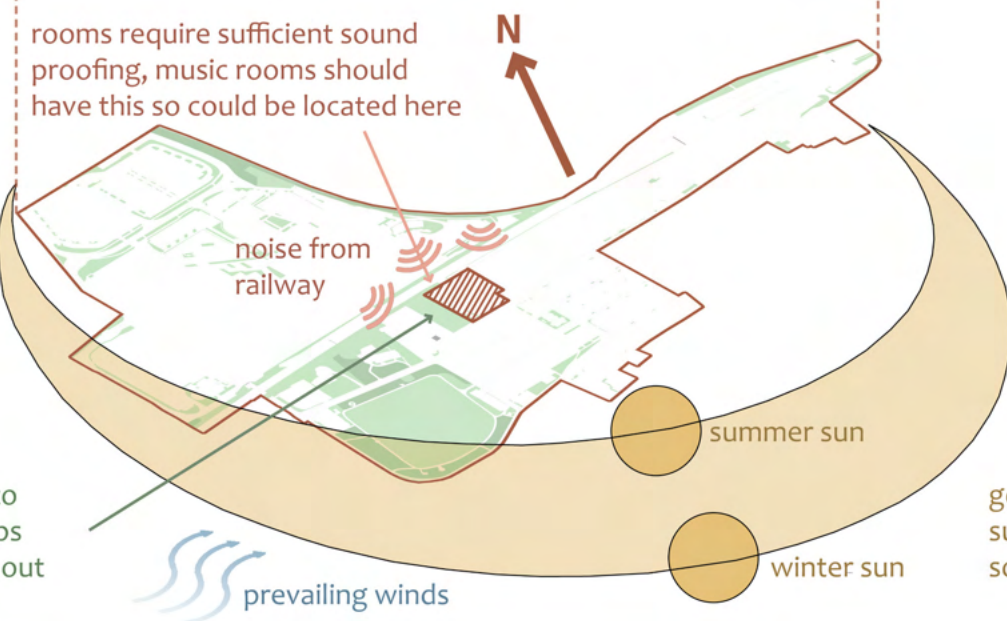
key routes + entry points



- key
- principal vehicular routes
 - route of buses
 - principal pedestrian routes
 - cycle path
 - railway lines
 - points of entry to site

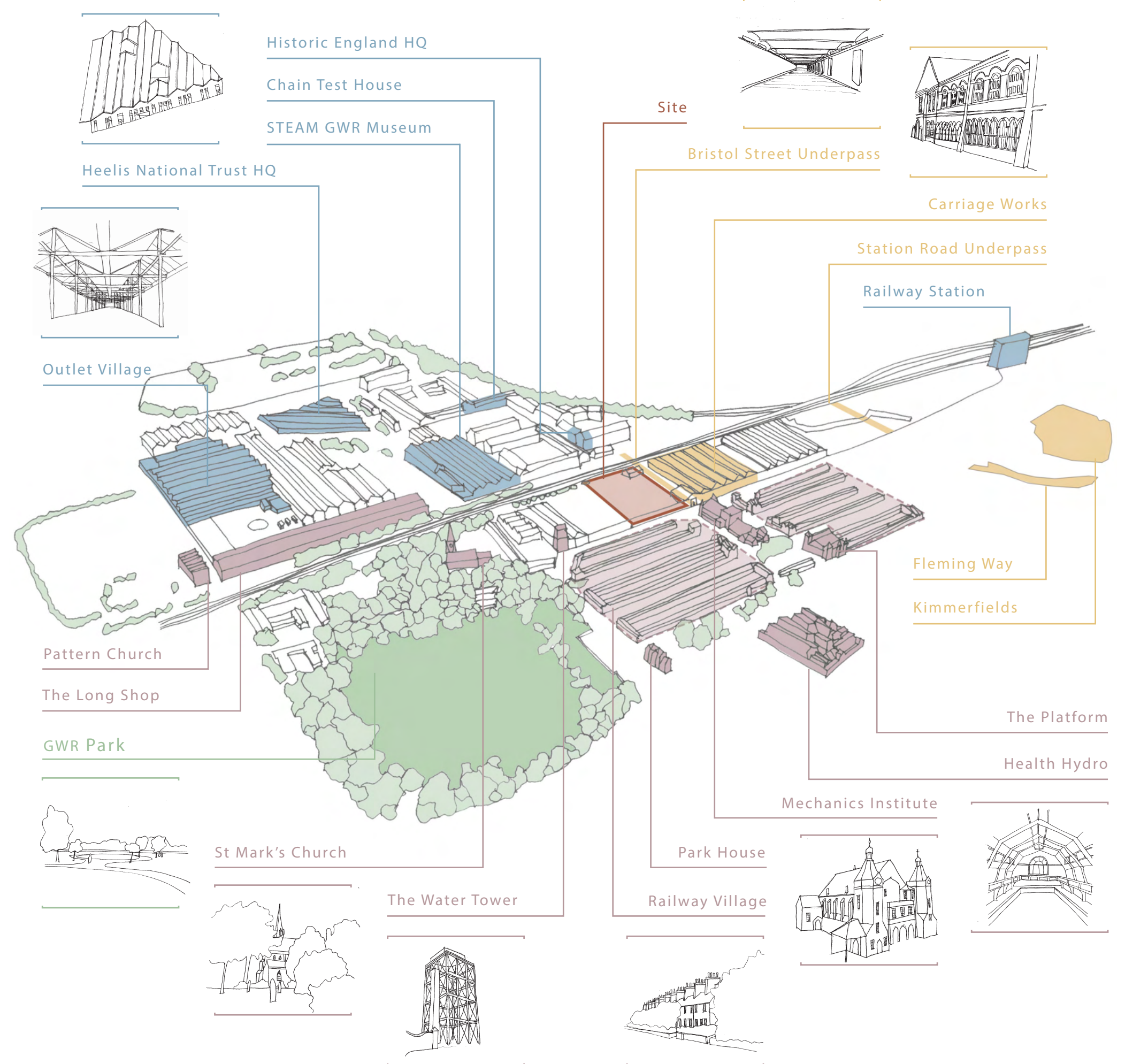
consider main points of site entry, from the street, bridge and underpass

sun, wind, noise + green spaces



opportunity to connect site to adjacent green space, perhaps with an auditorium/cafe spill out

good access to direct sunlight, opportunity for south facing courtyard

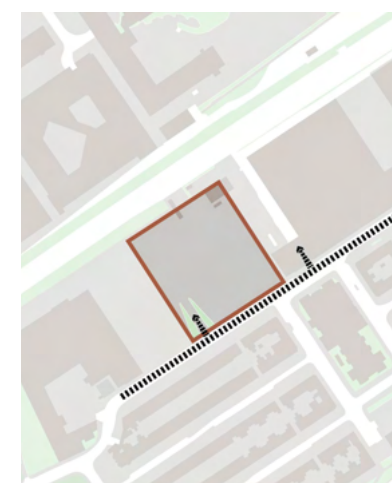


Existing Site Plan



with conservation zone outlined

Existing Connections



Enhance link to adjacent street

Existing Biodiversity



Increase existing green space provision

Existing Noise



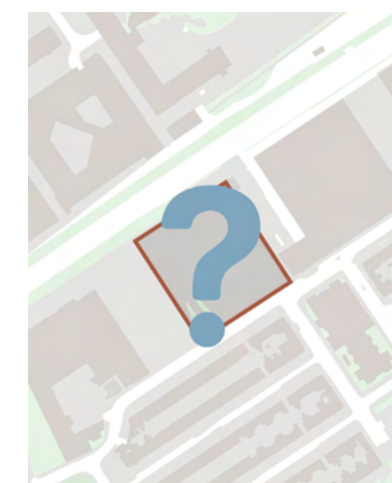
Consider implication of railway noise

Existing Heritage



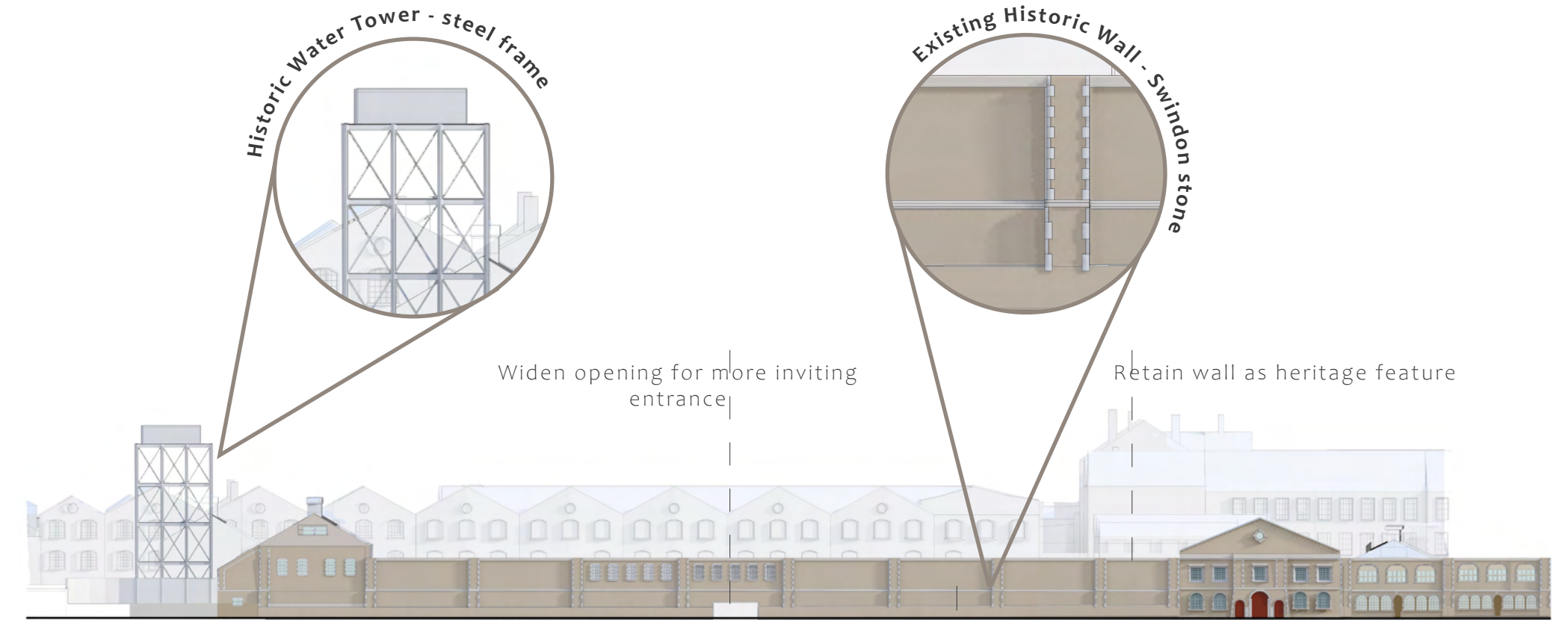
Respectfully restore historic wall

Existing Identity



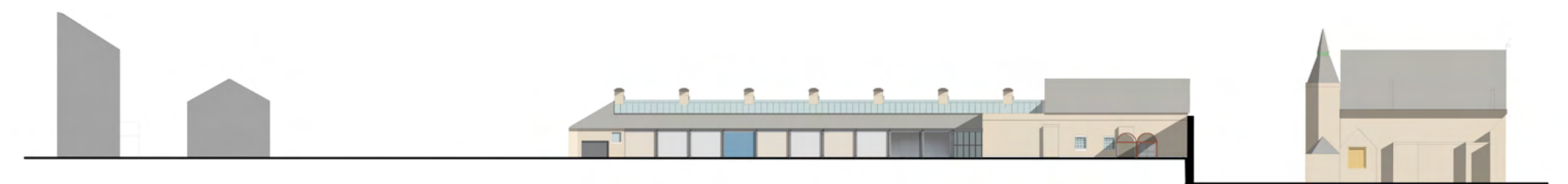
Restore sense of identity and community

Existing Site Elevations



North Elevation

Respectfully introduce windows to improve link to wider community

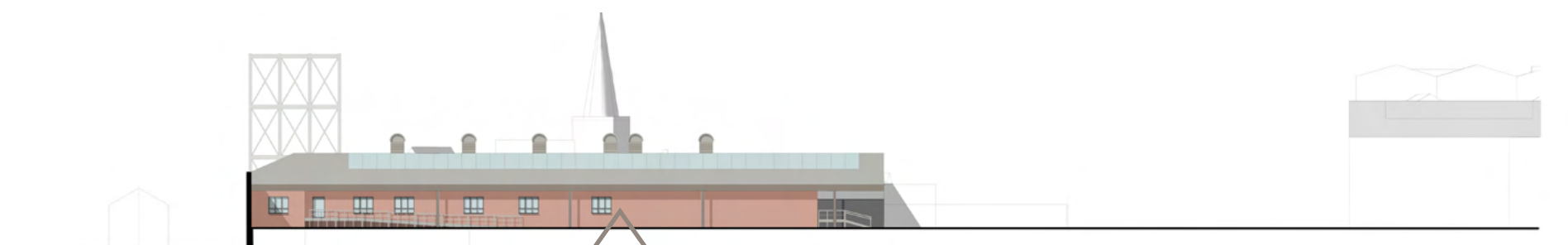


East Elevation

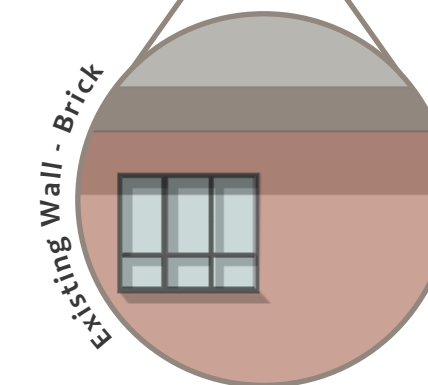


South Elevation

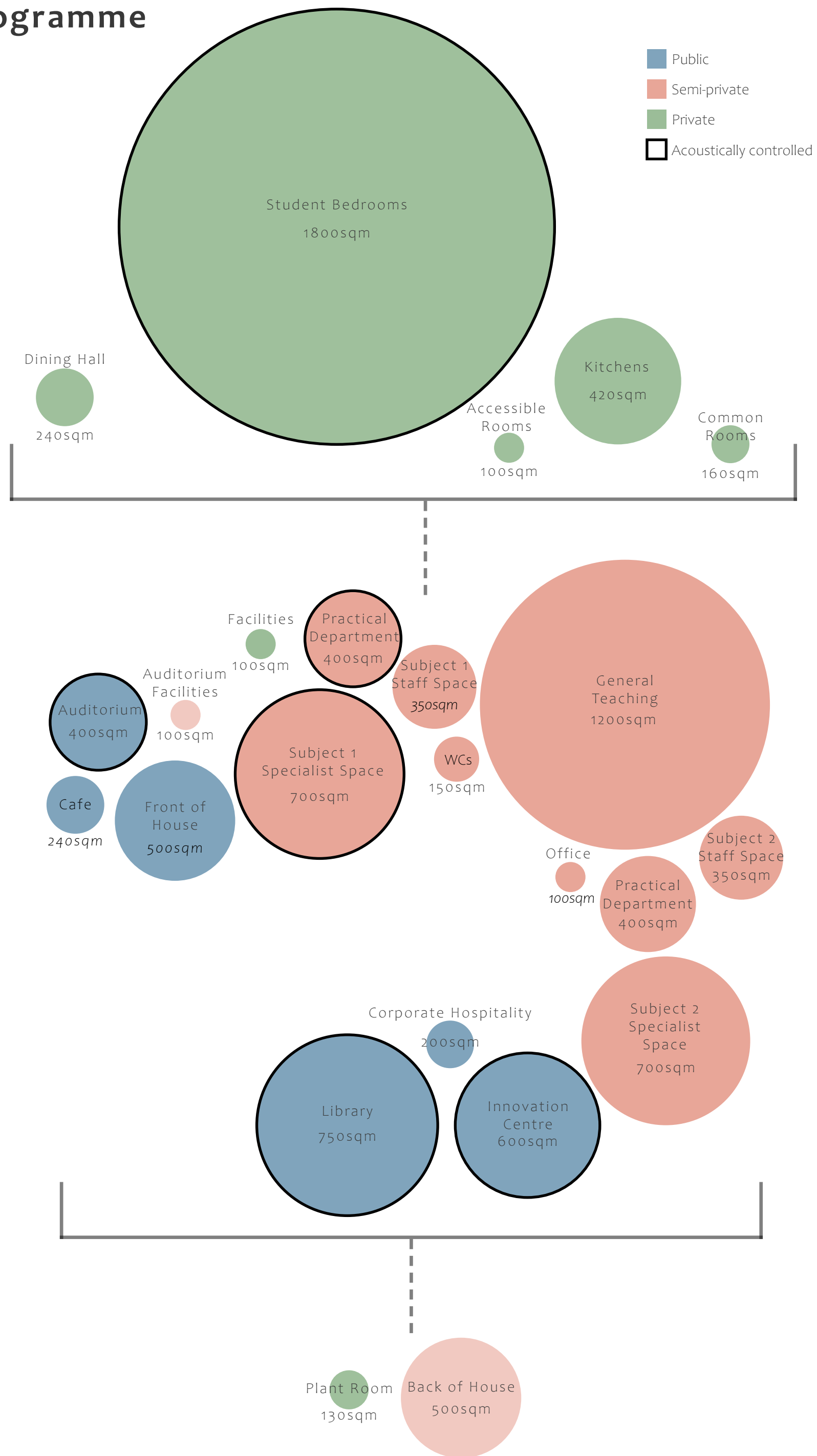
Revitalise community spirit of railway village



West Elevation



Programme



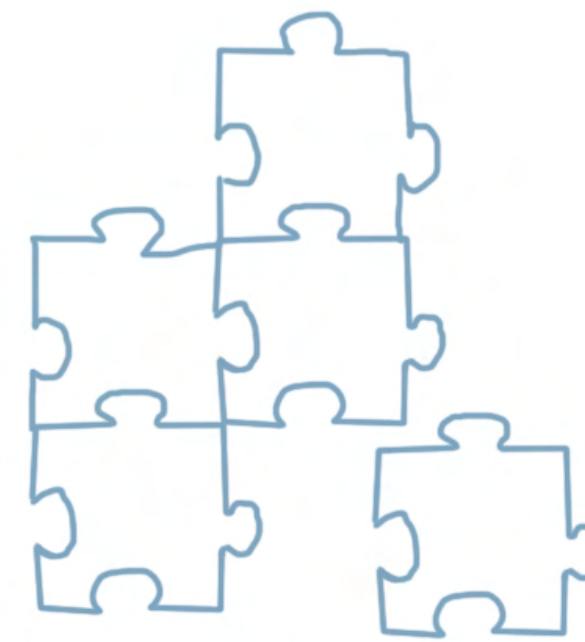
Design Intent



Community

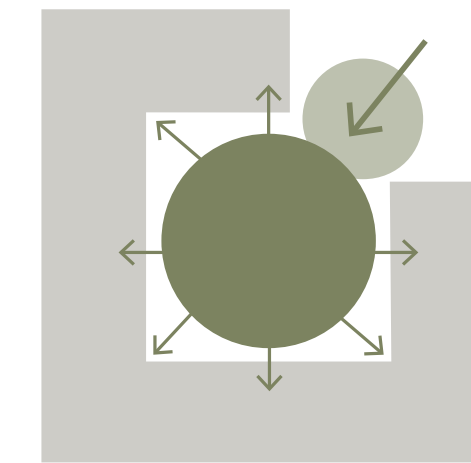


Innovation

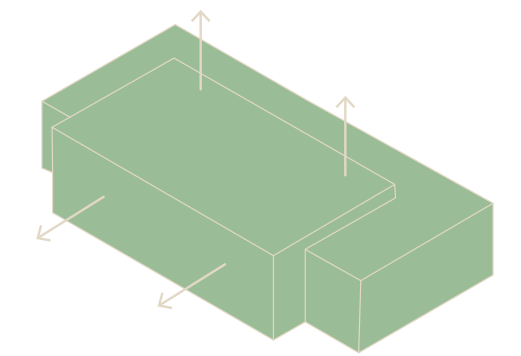


Collaboration

Design Principles



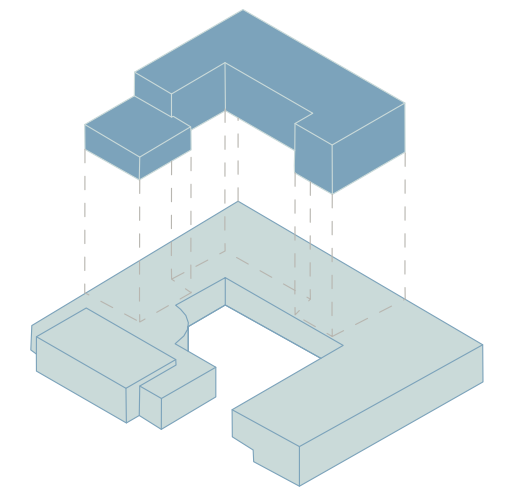
Courtyard as heart of site



Shoebox form as public focus



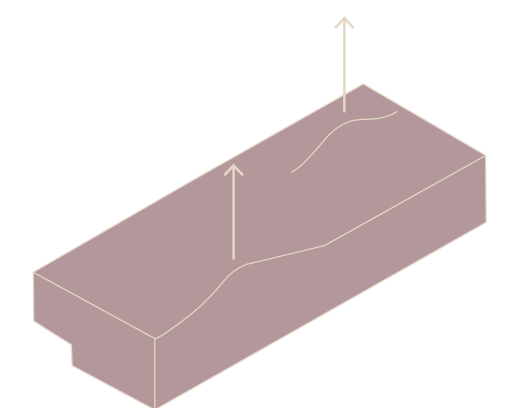
Organic colonnade as threshold



Vertical separation of student village



Zoning of public vs private



Undulating roof as key landmark



Proposal

The Resonance Institute plans to collate the subjects of Music and Neuroscience, creating a collaborative approach to learning. The innovative design engages the surrounding community, and provides a range of learning and living spaces for the students.

Proposed Site Plan

1:500
0 20 50 Metres



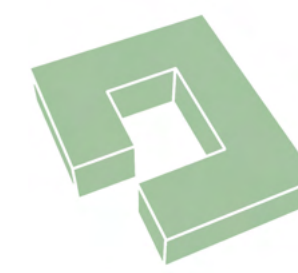
Site Isometric



Solid mass



Central courtyard



Interlocking courtyards



Massing stepping up



Fluid colonnade



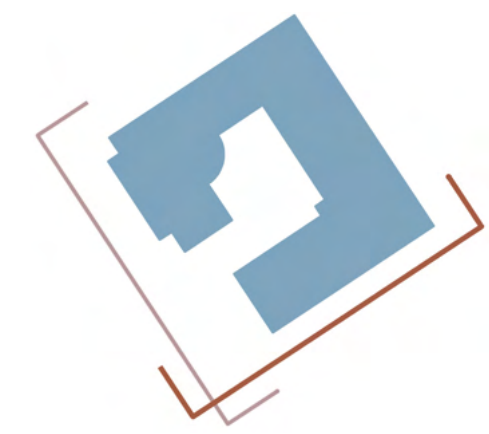
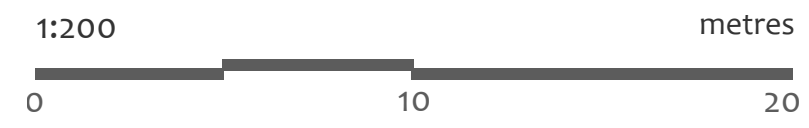
Protruding roofs



Arrival
View from Entrance



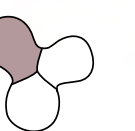
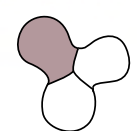
Public-Facing Elevations



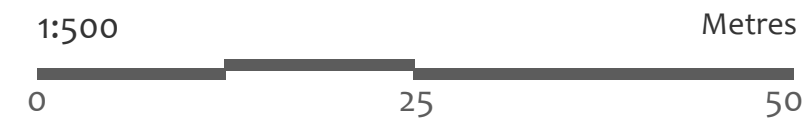
West Facade



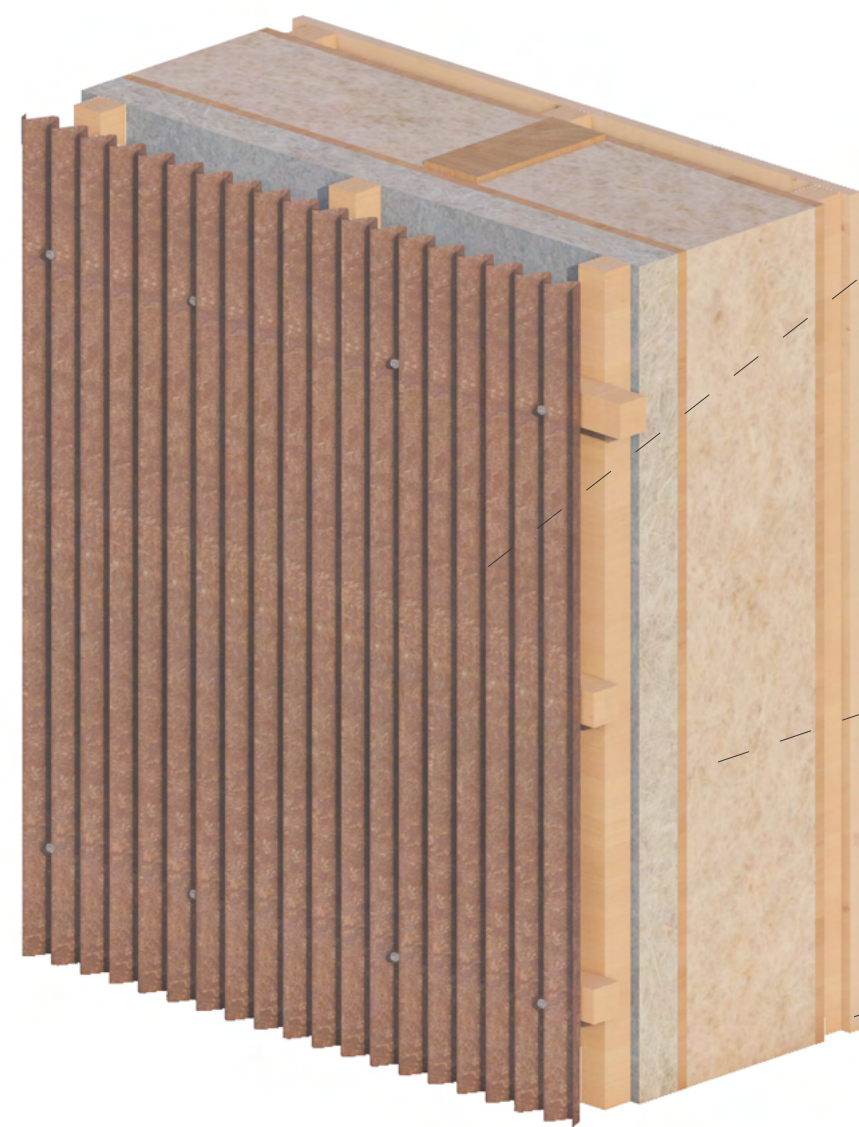
South Facade



Train-Facing Elevation



North Facade



Materials:

Corrugated hemp panels

Grown, processed and manufactured in the UK, this innovative rain screen will clad the student village. Chosen for its sustainability, it consists of a hemp non-woven fibre blended with farm bio waste resin. Hemp is a very fast growing plant, with extremely high carbon sequestration. The high natural cellulose content makes it a perfect alternative to plastic.

It provides a warm and organic feel to the elevations whilst contrasting in texture and colour to the Brimstone fins below.

Hemp insulation

Using very little CO2 in the manufacturing process, it is almost entirely natural fibres. Produced in the UK, it has a low thermal conductivity and high thermal mass.

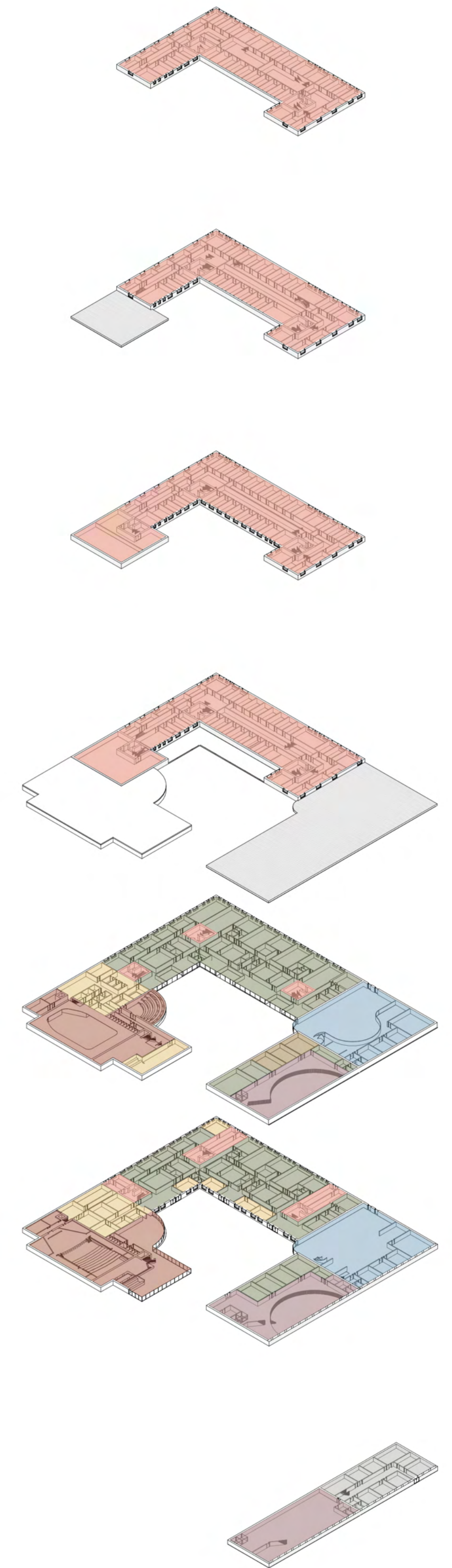
Plywood wall panels

Plywood panel interior cladding is great acoustically, allowing instrument practice in the student rooms. It is also durable and easy to install and uninstall when the space is ready to adapt to future uses. It is sustainable and provides a cosy, warm atmosphere in the space.

Zoning

- Student and Cores
- Teaching
- Auditorium
- Library
- Innovation Centre
- Front of House
- Back of House

Developing from the initial building programme, the Resonance Institute has systematic zoning which places the publically used spaces near the entrance. The semi-private spaces are then integrated together in the lower floors, with the more private space (student accomodation) vertically separated from the public.



Proposed Ground Floor Plan



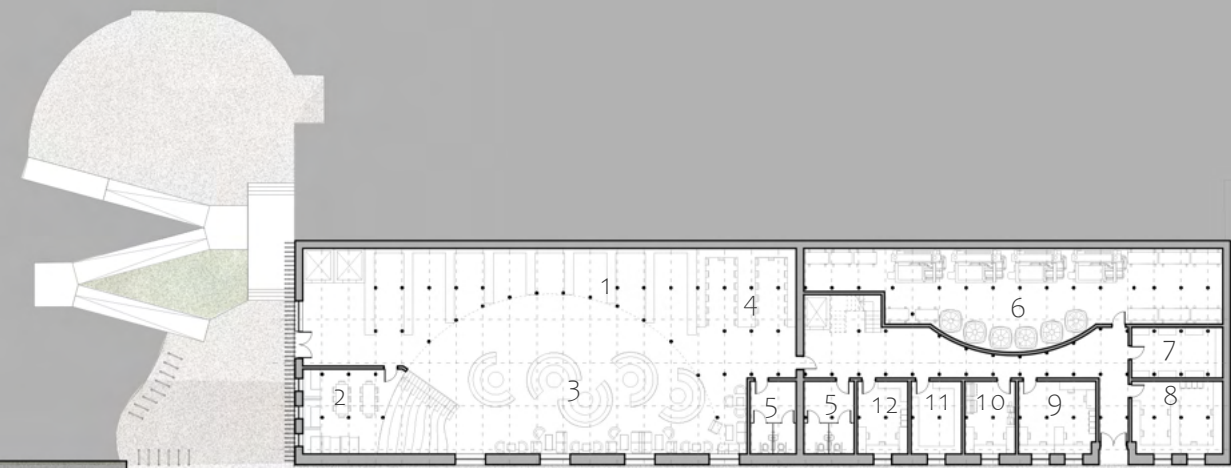
- 1 Foyer
- 2 Reception + Office
- 3 WCs
- 4 Cafe
- 5 Auditorium
- 6 Green Room
- 7 Dressing Room
- 8 Breakout Space
- 9 Staff Offices
- 10 Student Support
- 11 Conference Room
- 12 First Aid
- 13 Circulation Cores
- 14 Student Access
- 15 Bin Store / Laundrette
- 16 Teaching Reception
- 17 Laboratory
- 18 Lab Support
- 19 Tissue Culture
- 20 Music Studios
- 21 Classrooms
- 22 Integrated Lab
- 23 MRI Reception and Waiting Room
- 24 Examination Room
- 25 Store
- 26 MRI with Scan Room
- 27 Library Reception
- 28 Practice Room
- 29 Store
- 30 Open Plan Laboratory

Proposed First Floor Plan

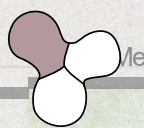
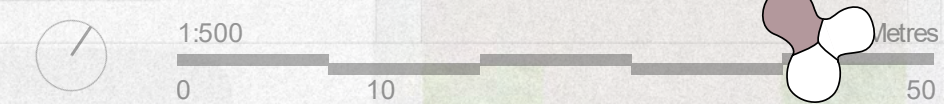
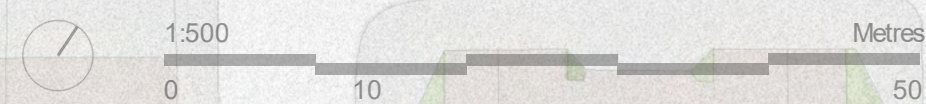


- 1 Auditorium
- 2 Student Association
- 3 WCs
- 4 Small Auditorium
- 5 Green Room
- 6 Dressing Room
- 7 Breakout Spaces
- 8 Staff Offices
- 9 Student Support / Quiet Rooms
- 10 Conference Room
- 11 Store
- 12 Classrooms
- 13 Circulation Cores
- 14 Music Studios
- 15 Laboratory
- 16 Laboratory Support
- 17 Tissue Culture
- 18 Integrated Lab - Music and Lab
- 19 Examination Room
- 20 MRI with Scan Room
- 21 Practice Room
- 22 Music Therapy Rooms
- 23 Waiting Area
- 24 Kitchenette

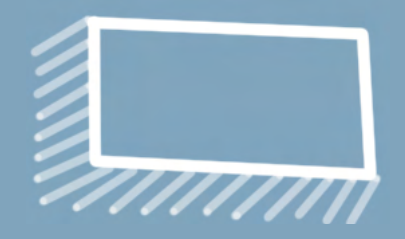
Proposed Lower Ground Floor Plan



- 1 Library
- 2 Private Study
- 3 Group Study
- 4 ICT Suite
- 5 Accessible WCs
- 6 Plant Room
- 7 Store / Porters
- 8 Workshop
- 9 Estates Office
- 10 Reprographics
- 11 Archive
- 12 Data Services



Library



Public frontage



Curve cutting through



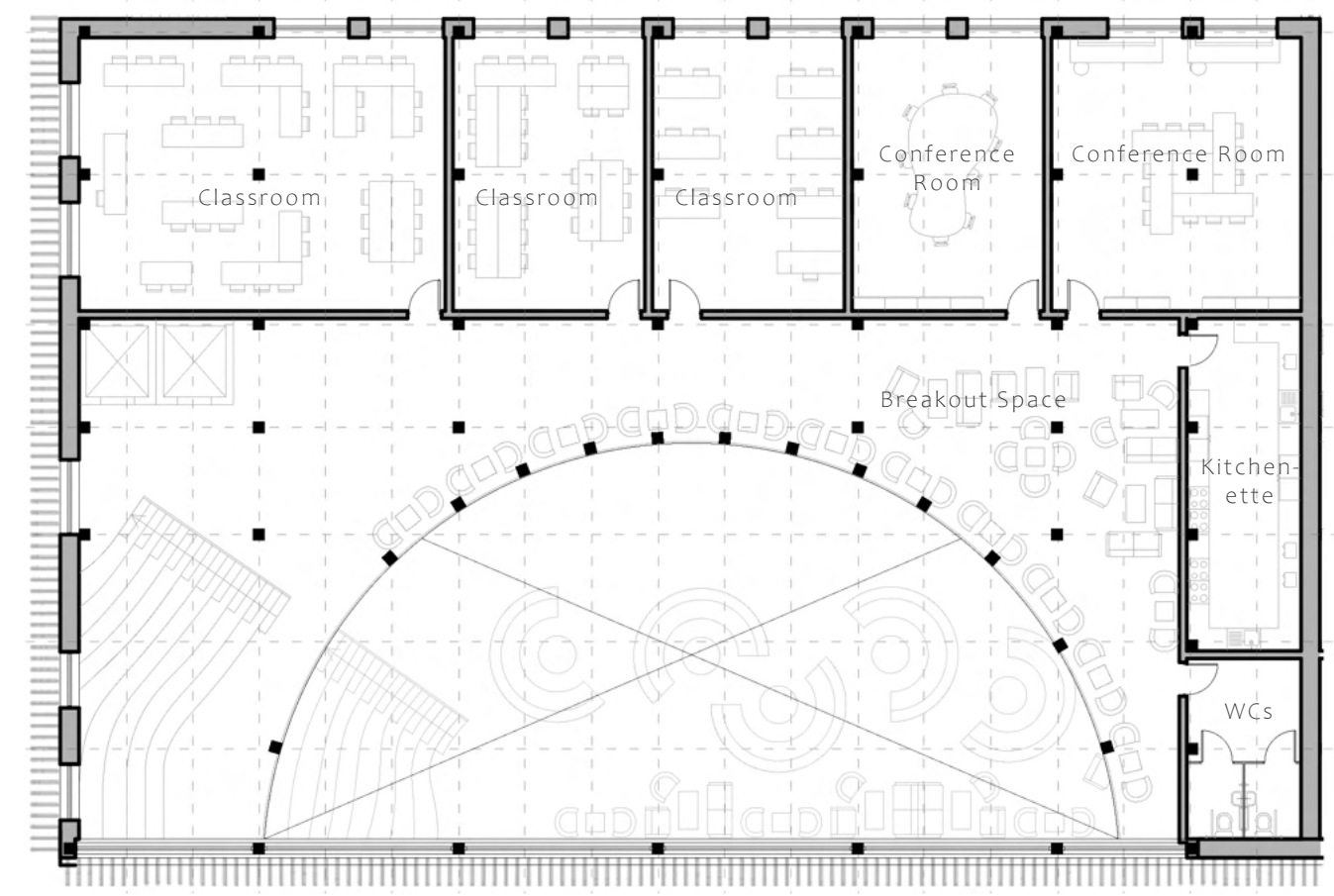
Triple height space



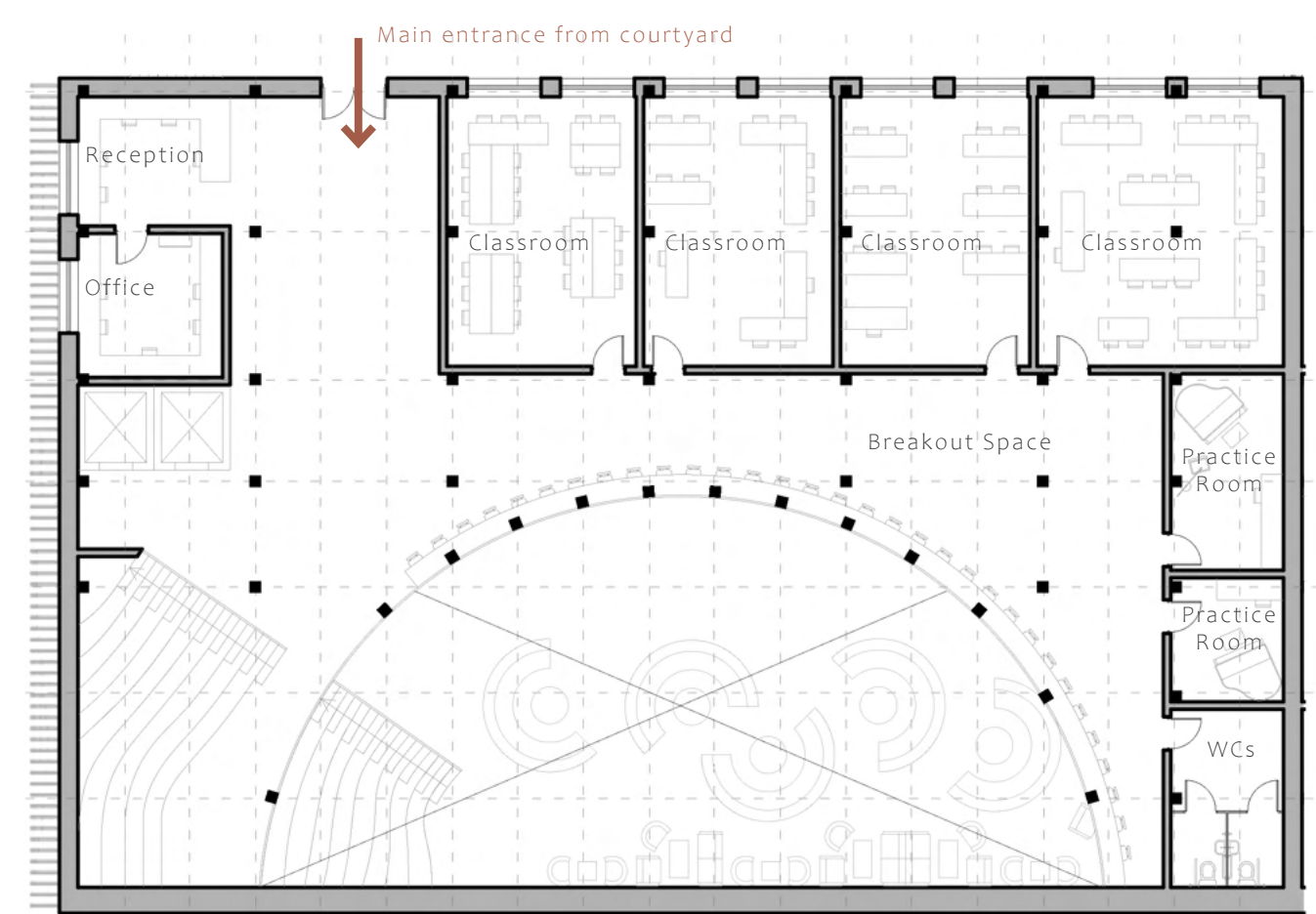
Protruding roof



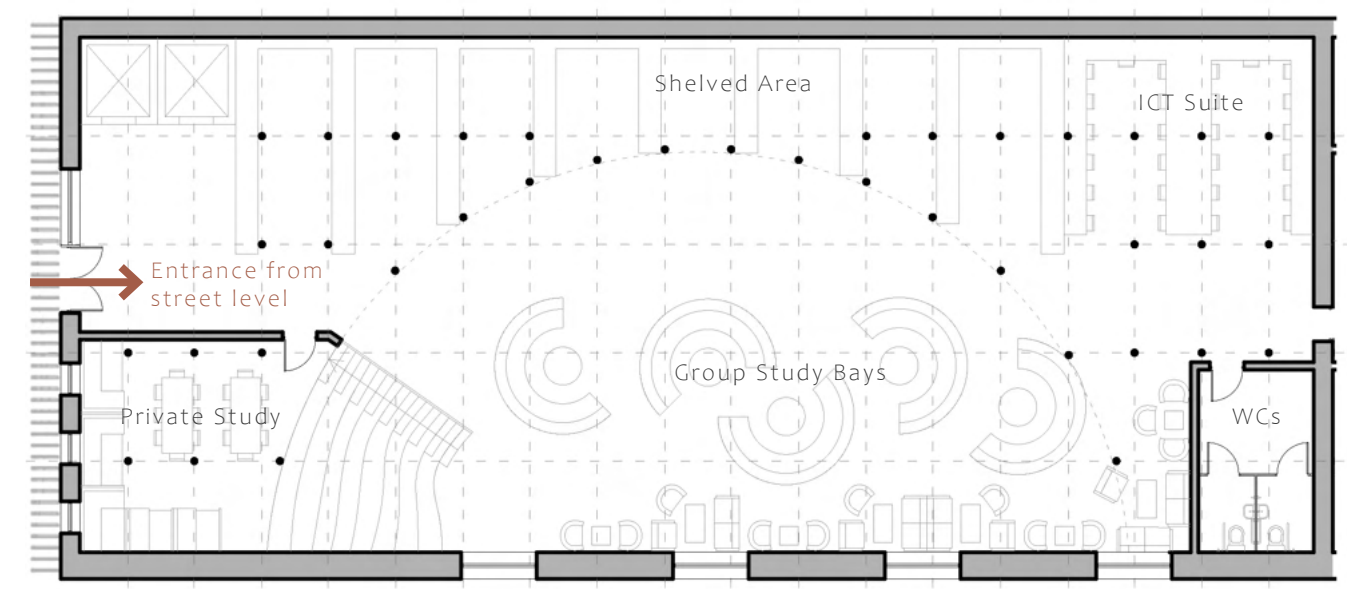
Community



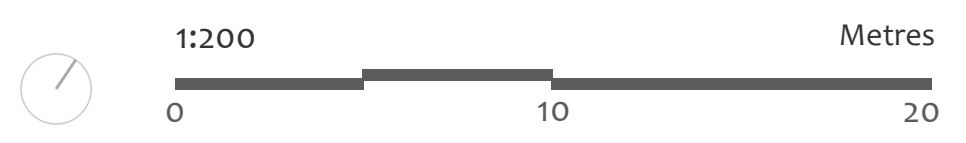
First Floor Plan



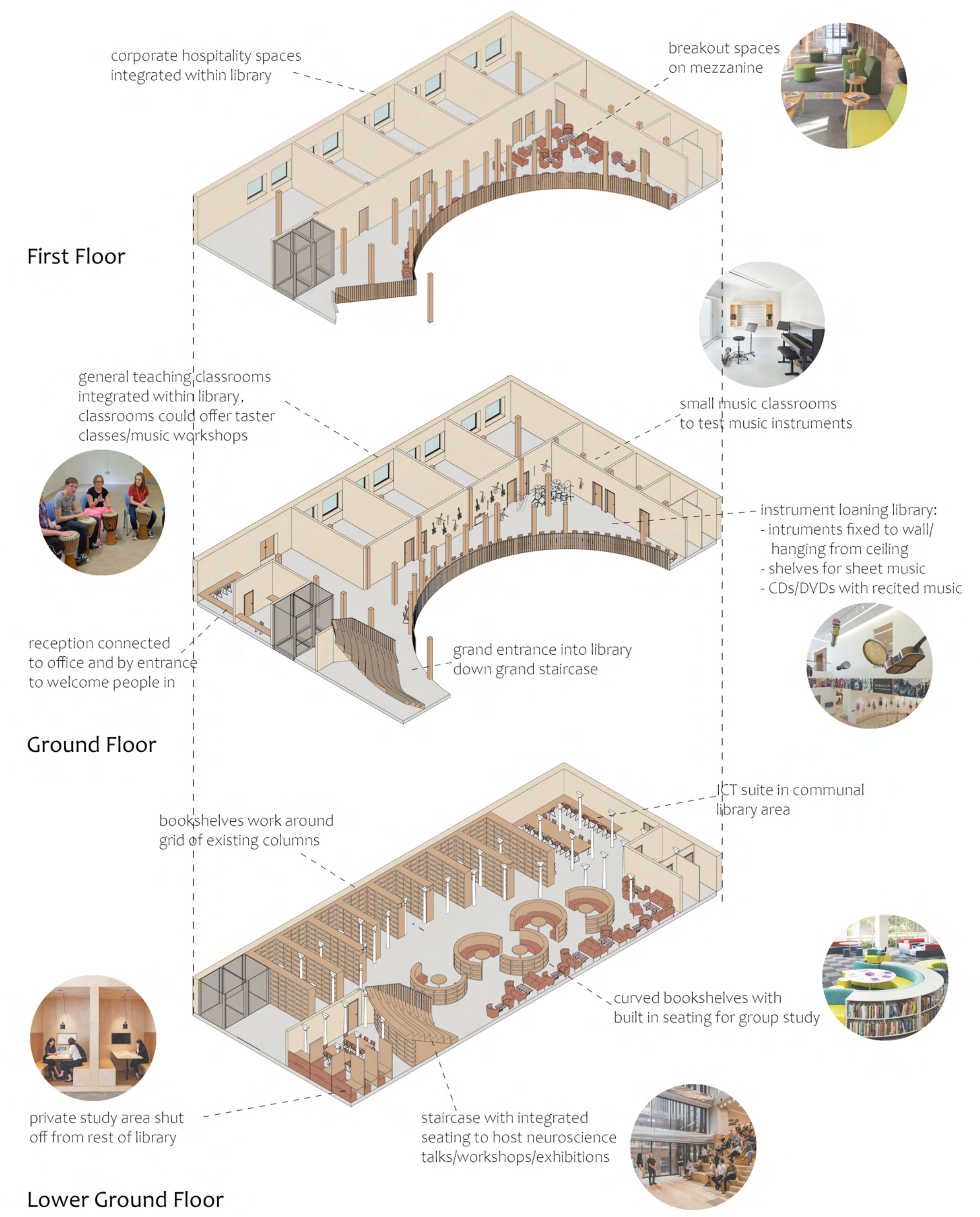
Ground Floor Plan



Lower Ground Floor Plan



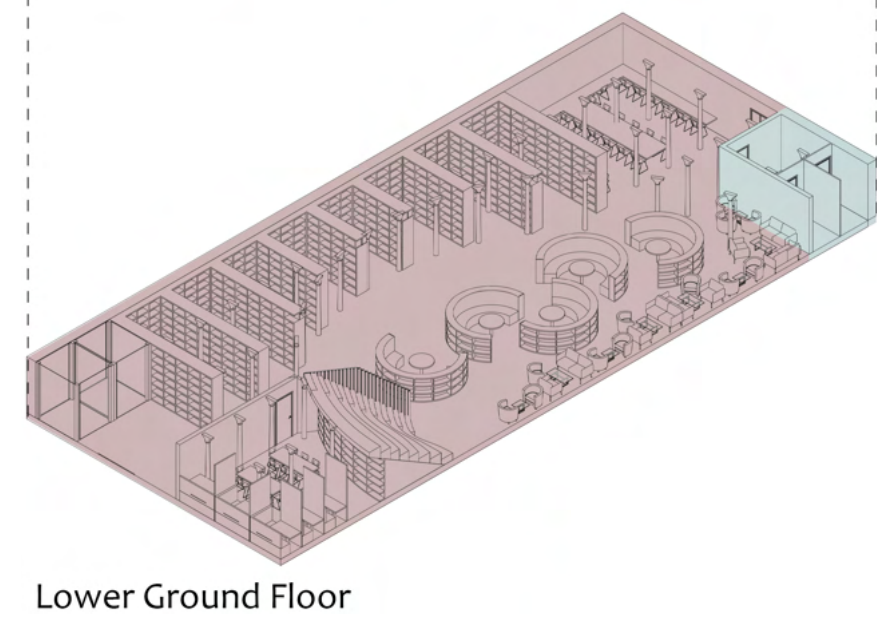
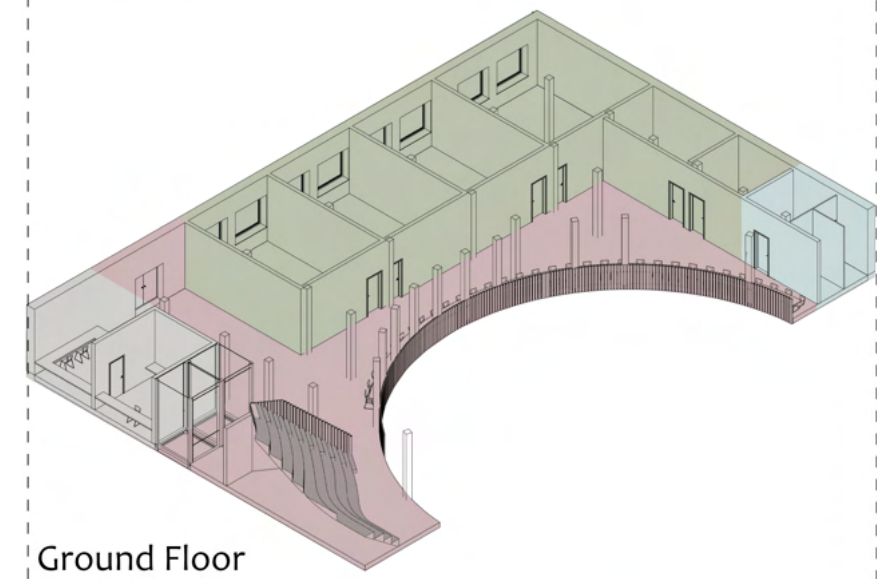
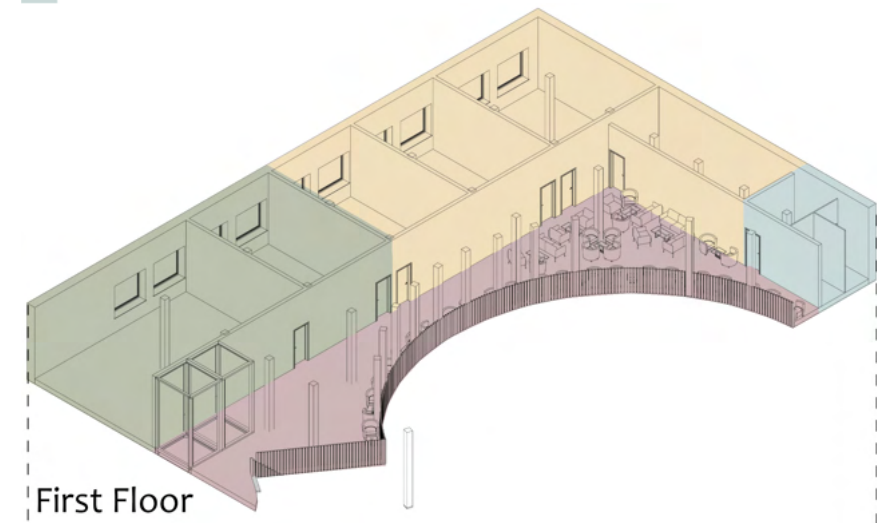
Library Function of Spaces



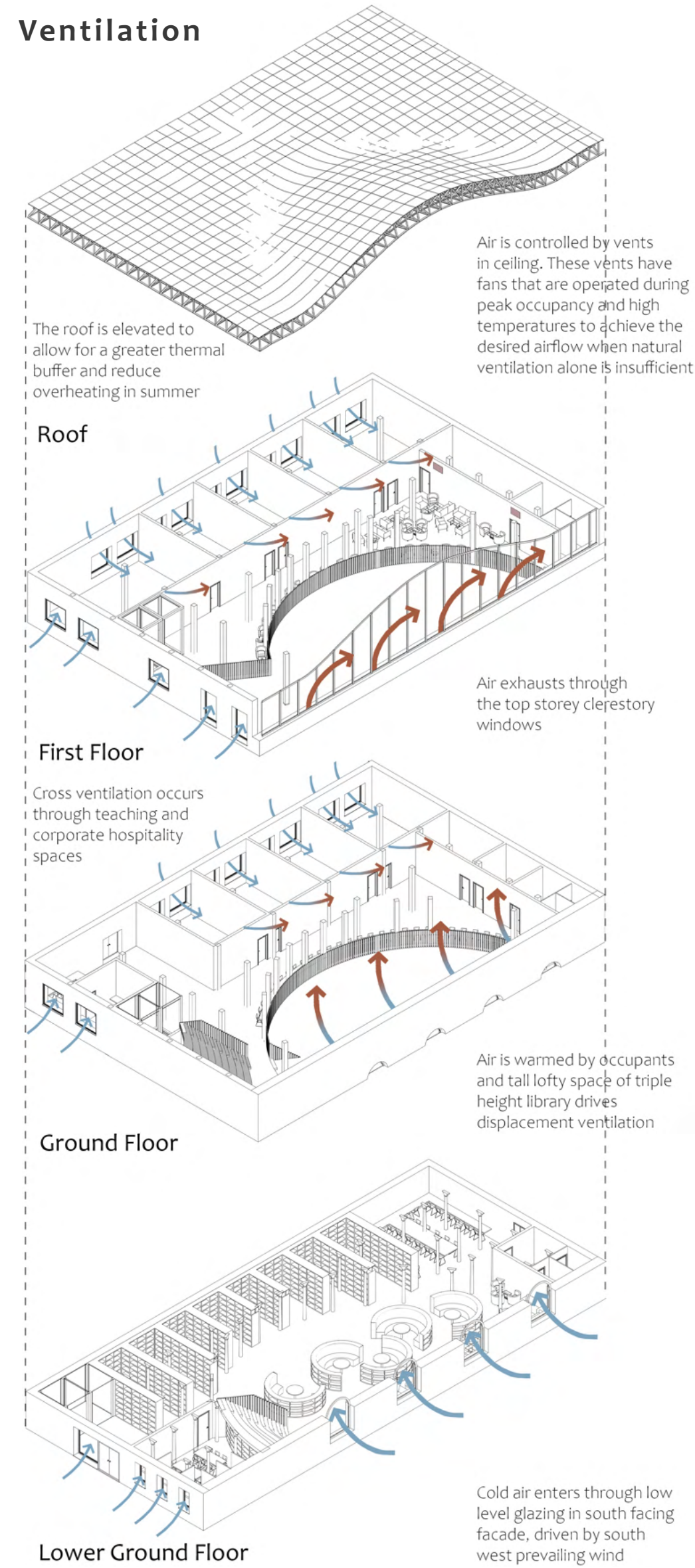
Library

Zoning Strategy

- Library
- Teaching spaces
- Corporate Hospitality
- Office/Reception
- Toilets



Ventilation



The library is adjacent to the public realm and street, inviting the public in. On the lower ground floor, we have structurally restored the cast iron columns with the book shelves in between, and some have been shifted to support our mezzanine. The library is a triple height space with two mezzanines dramatically curving through, creating a communal atmosphere. A grand staircase with integrated seating provides space to host guest speakers and neuroscience talks, whilst the ground floor features a music library area, where instruments and sheet music can be loaned, with surrounding teaching rooms where music taster sessions may be held.

Innovation Centre



Public invited in



Curve cutting through



Protruding roof



Music + Neuroscience
coalesce



Skill sharing



Innovation Centre Purpose



Our Innovation Centre aims to coalesce our two disciplines of Music and Neuroscience, and provides a space for our partners, Ipsum and the MRC, as well as students, to occupy.



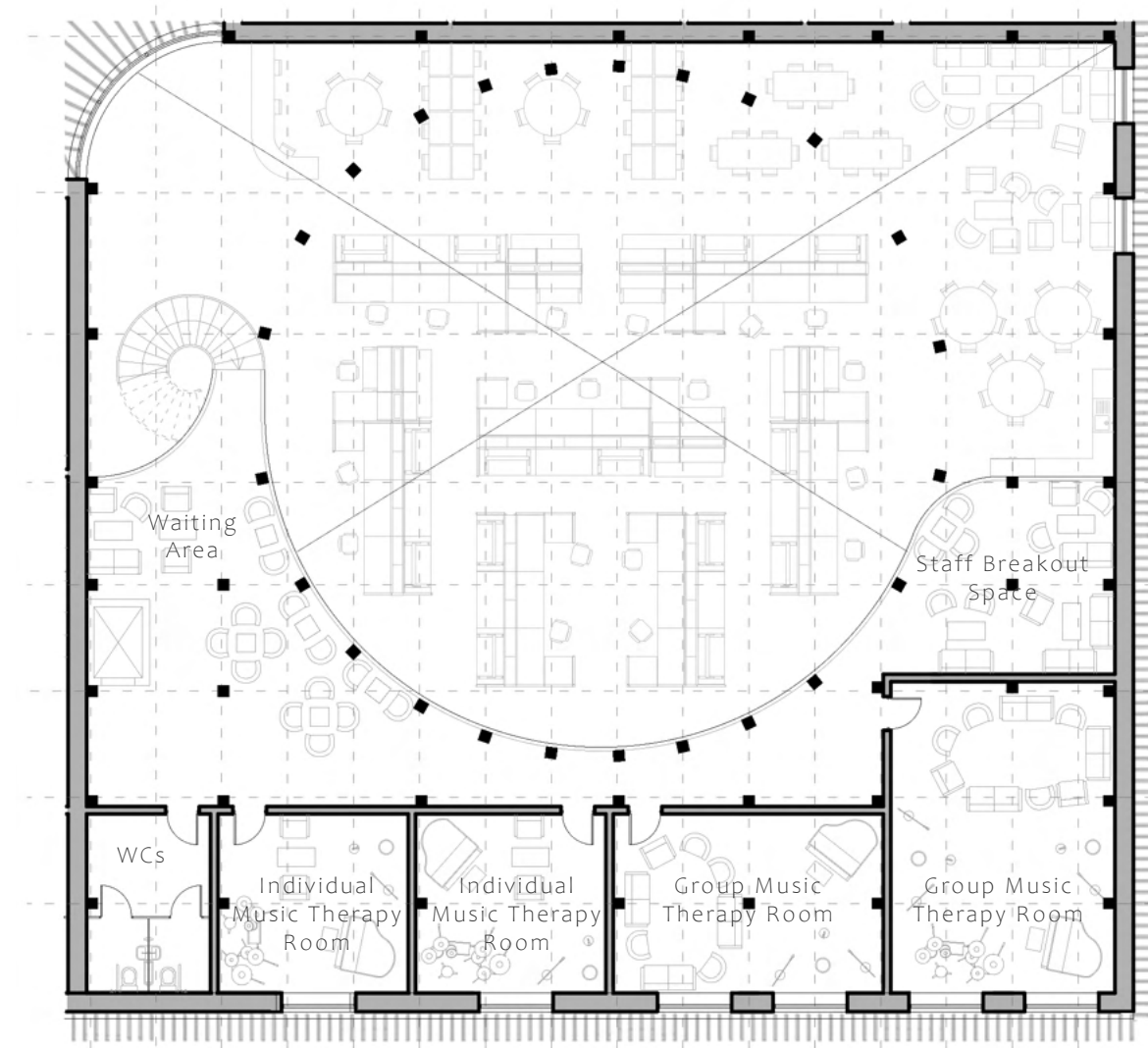
At ground floor level, there is a large, double height research laboratory for students and scientists, with research funded by the MRC. With surrounding breakout meeting spaces and open offices, this space aims to encourage collaboration and the sharing of skills, with research specialising into treatment options for neurological diseases.



Upstairs facilitates one of these treatment options - music therapy. Music therapists from Ipsum will occupy this space and provide both individual and group music therapy sessions to both students and the public.

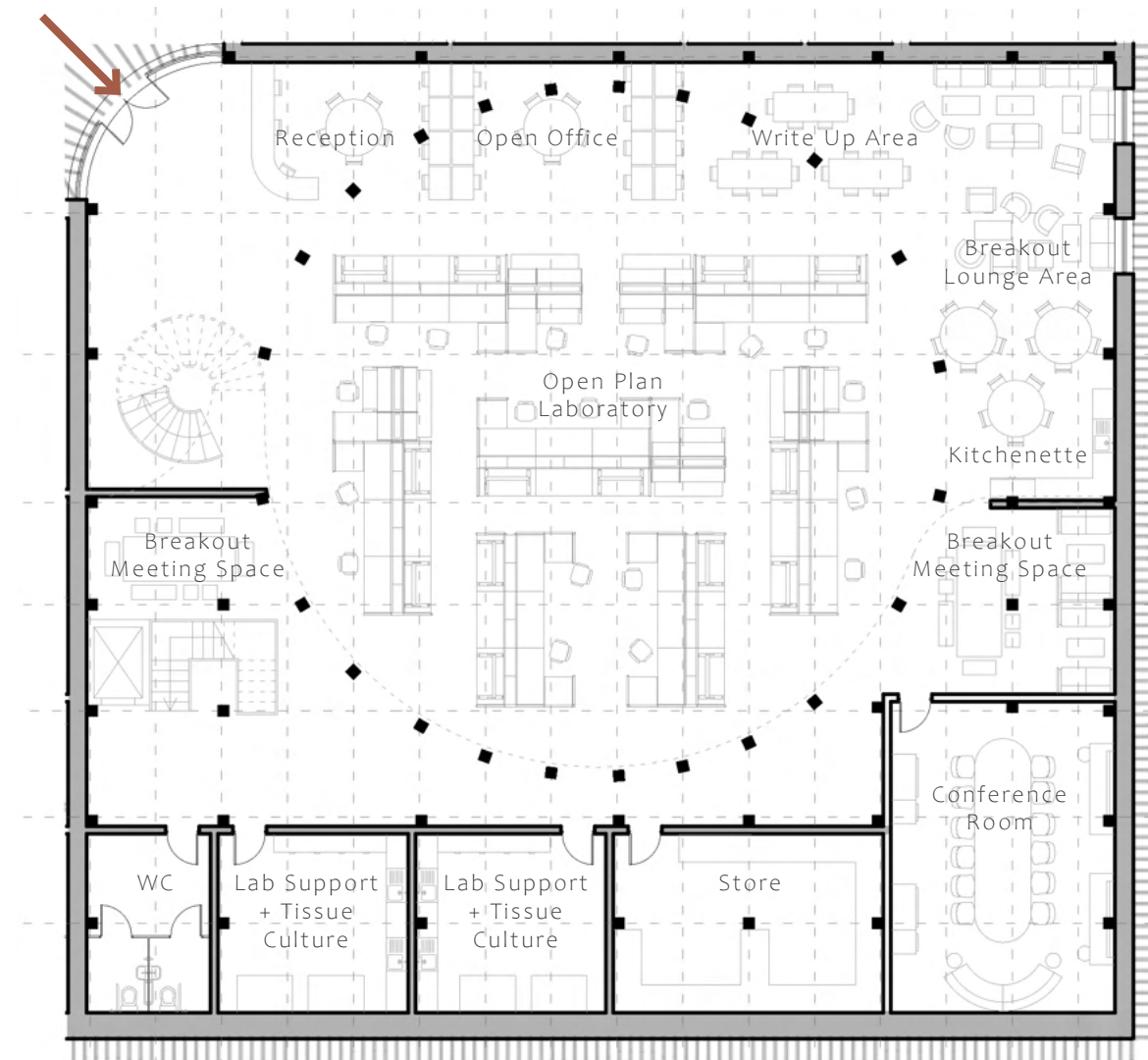


Ascending up the spiral staircase and walking along our curved mezzanine will give patients a glimpse into the innovative research happening below, and provides a connection between the treatment and research of psychological brain conditions.

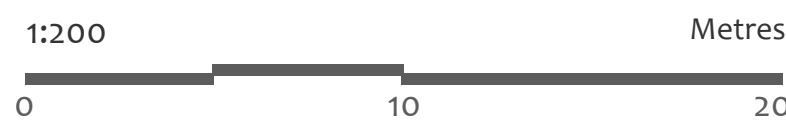


First Floor Plan

Main entrance from courtyard



Ground Floor Plan



Music Therapy Room



Patient Waiting Area



separate lounge area for staff on FF (ie therapists)

individual and group music therapy rooms

First Floor

breakout meeting spaces surrounding lab ensuring communal/collaborative areas

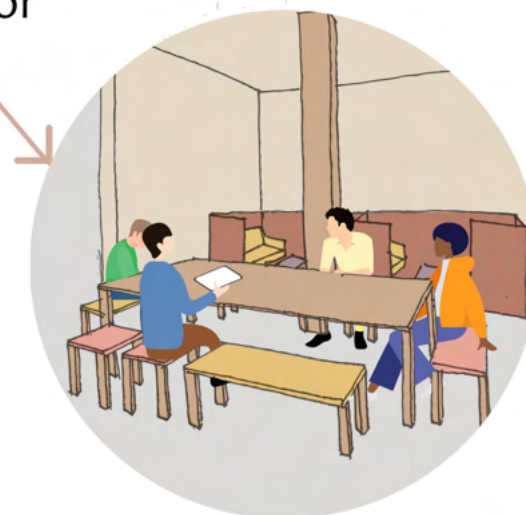
patient waiting area offering a 'glimpse' into lab

lab support rooms connected to research lab

Ground Floor

open offices and lounge areas reiterate communal atmosphere

large, open plan research lab ensures opportunity for skill sharing

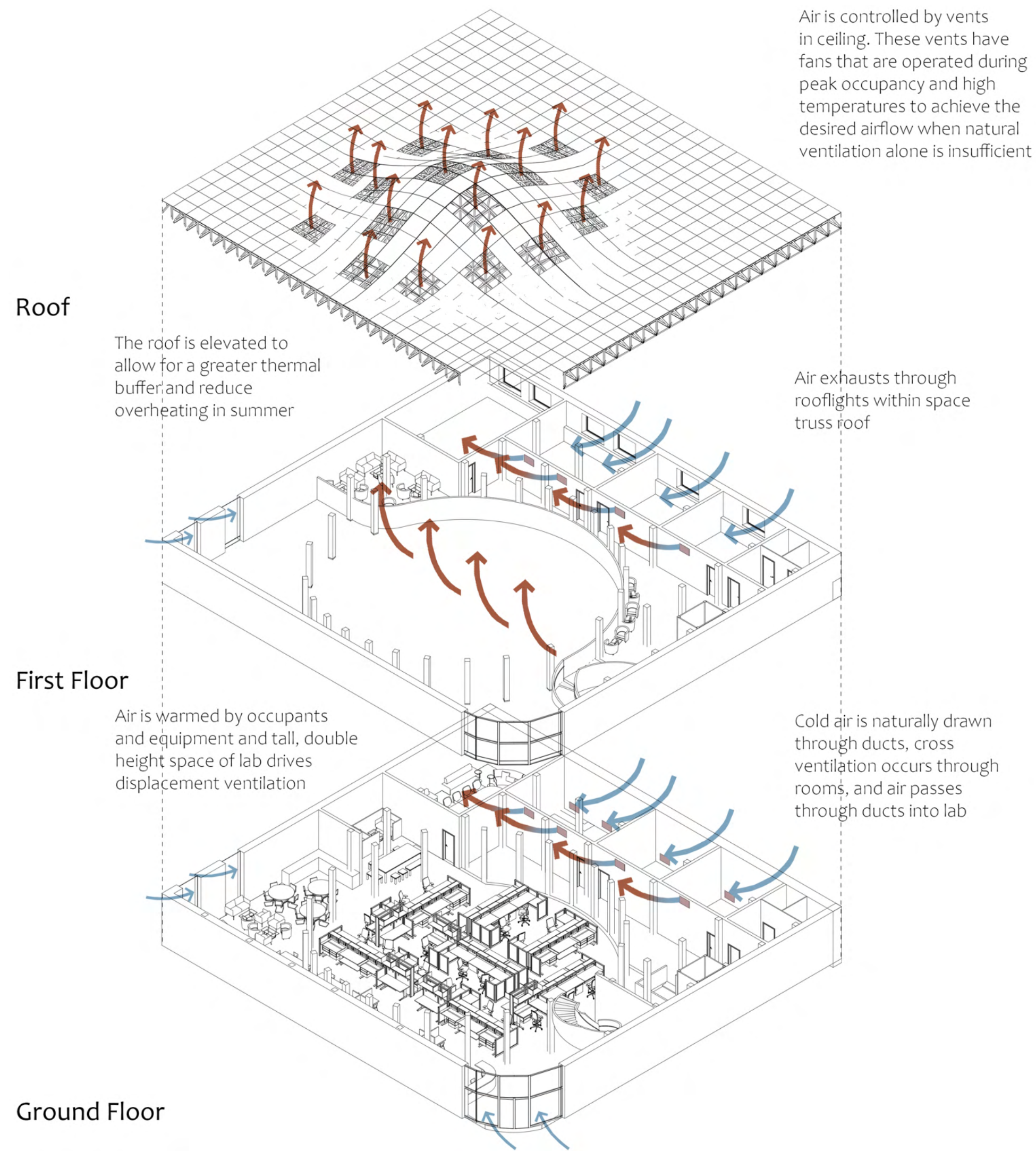


Communal Breakout Space

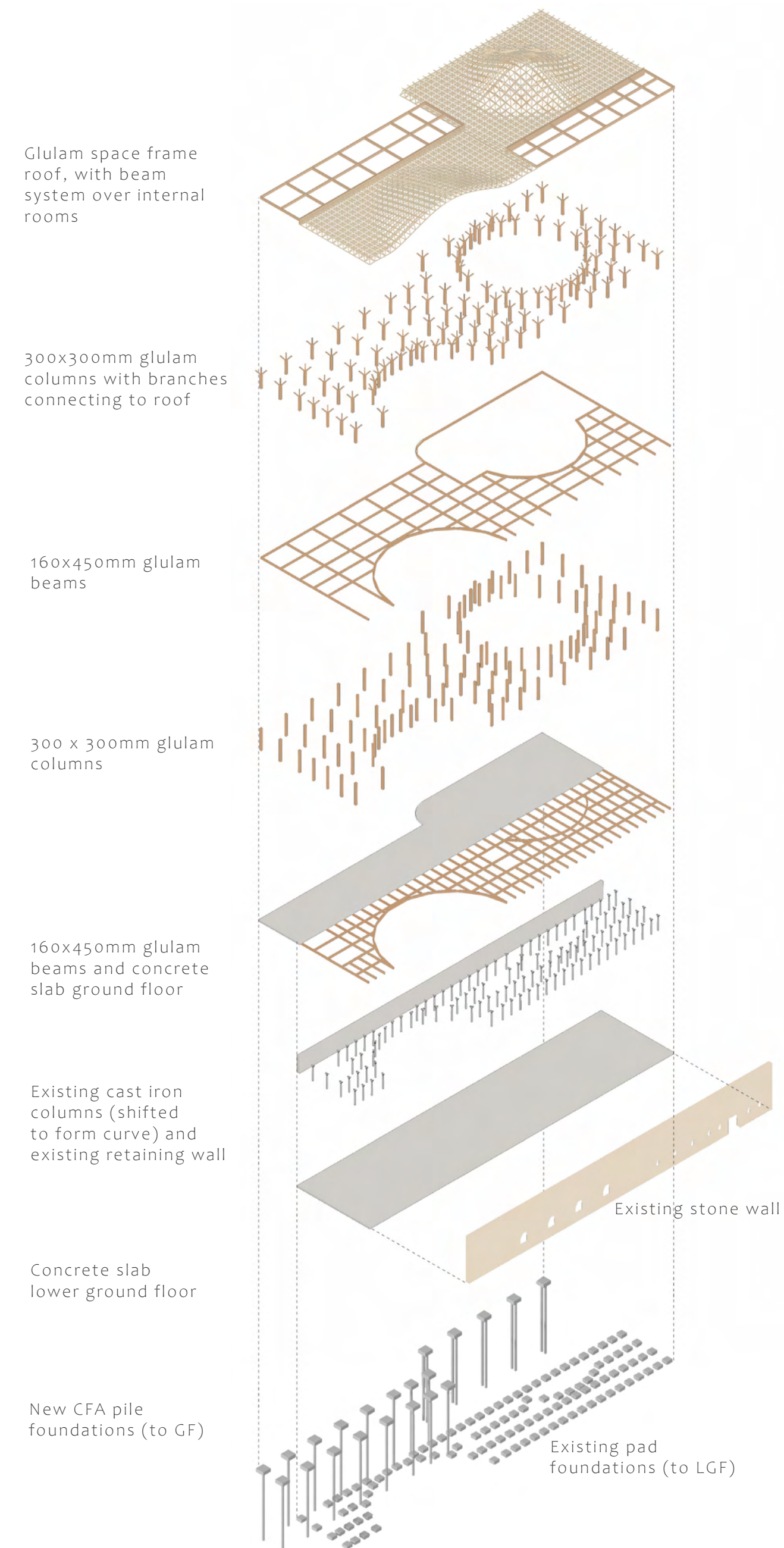


The Research Laboratory

Innovation Centre Mixed-mode Ventilation



Library and Innovation Centre Structural Strategy



Glulam Space Truss

The roof is a glulam space truss system with zinc roof panelling. This structure is lightweight in order to satisfy the 18m span in the Innovation Centre and bear onto the existing wall.

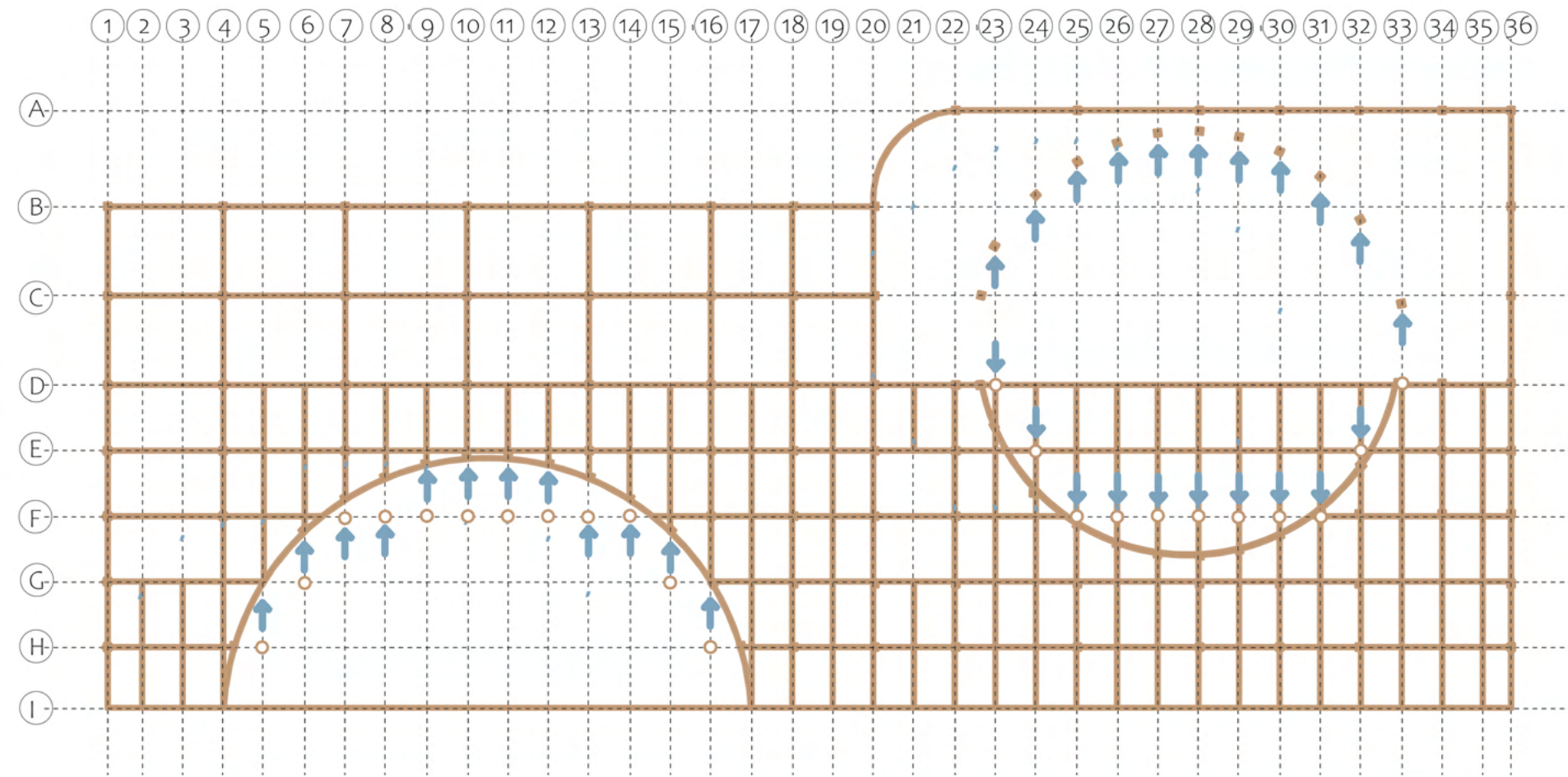
Cast Iron Columns

The existing cast iron columns have been respectfully and structurally restored, and rearranged to support new curved mezzanines. They will need to resist a greater loading than the current car park, and so they have been appraised using the Historic Structural Steel Handbook and each one found to resist a load of 272kN or 54N/m² across a 5.04m² tributary area.

Existing Wall

Prior to the site being a car park, the original industrial warehouse roof beared onto the stone wall. Our building will reuse the wall as load bearing and we have checked that there is ample capacity for the zinc clad roof and clerestory glazing to bear onto the wall by comparing the historic and proposed loadings.

Library and Innovation Centre Structural Grid



To create the structure for the curved mezzanines, columns have been shifted upwards/downwards in order to remain on the same vertical grid.

On reflection, we would have liked to have had the time to explore utilising a radial grid.

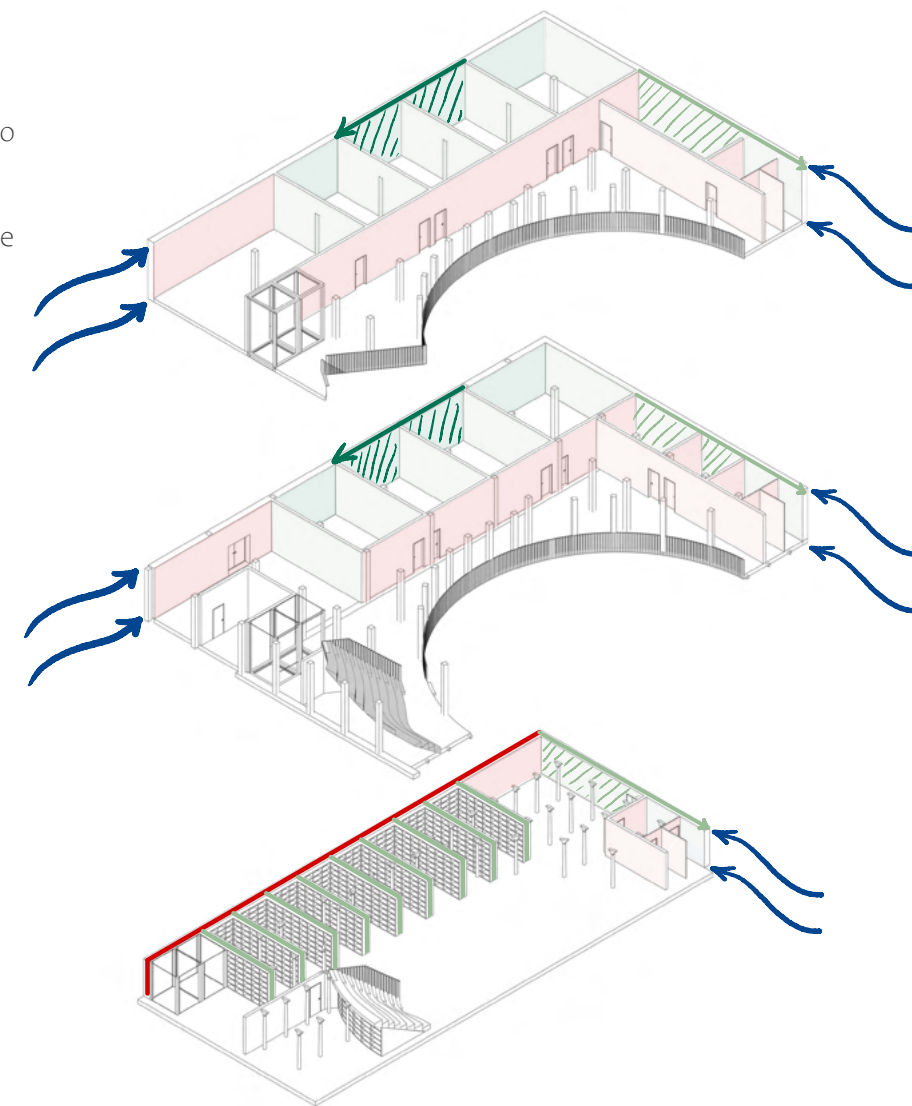
- primary columns and beams
- ↑ indicating shifting of columns
- indication of previous columns

Library Stability

This arrangement ensures that the existing wall is not required to take racking.

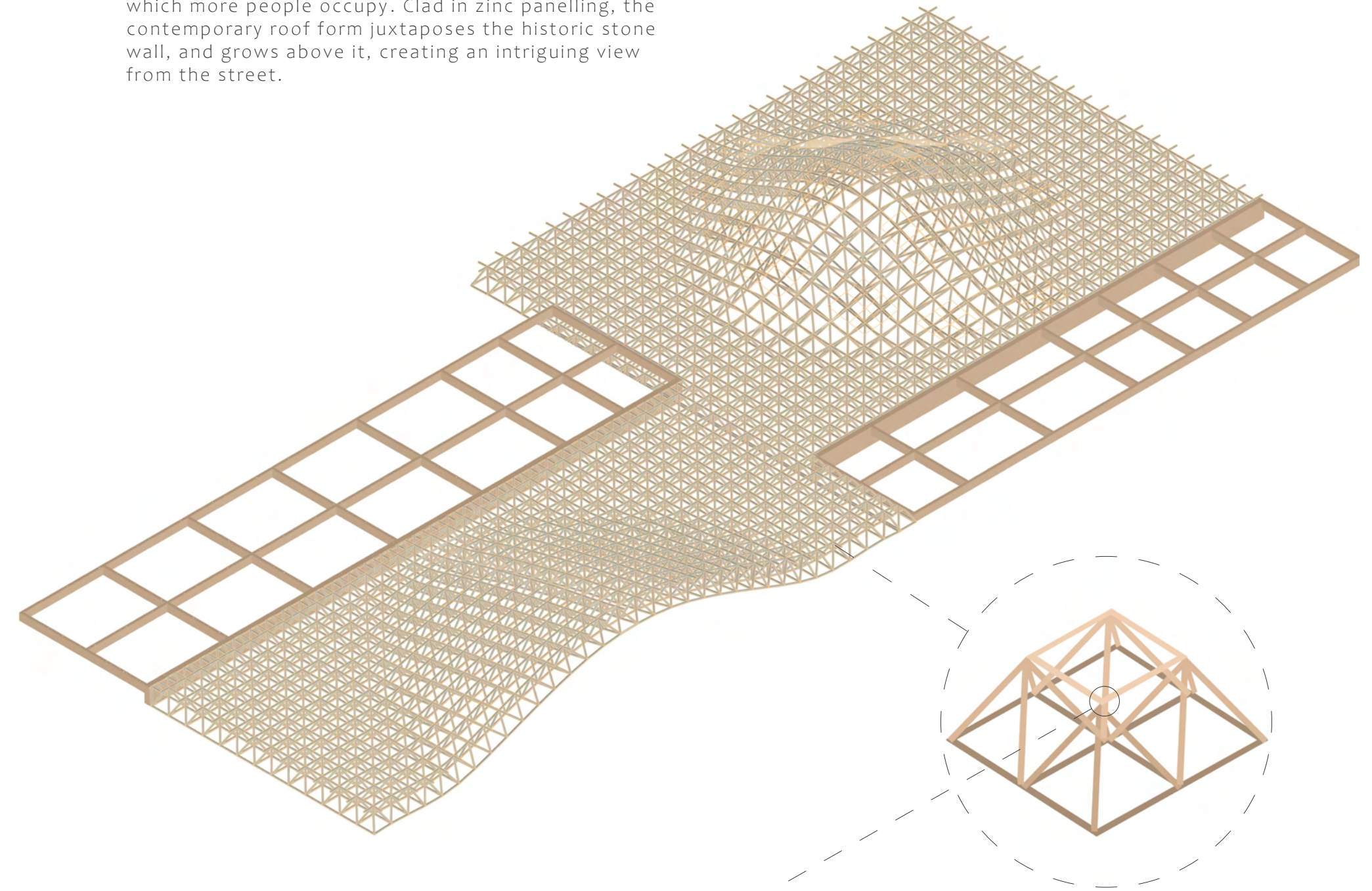
We have avoided bracing into the retaining wall, to minimise the induced load.

- Walls that act as braced bays and can take racking
- Walls that can take racking
- Walls that can't be used to resist racking (due to prominent openings, broken load paths, or lack of structure on the lower ground level).

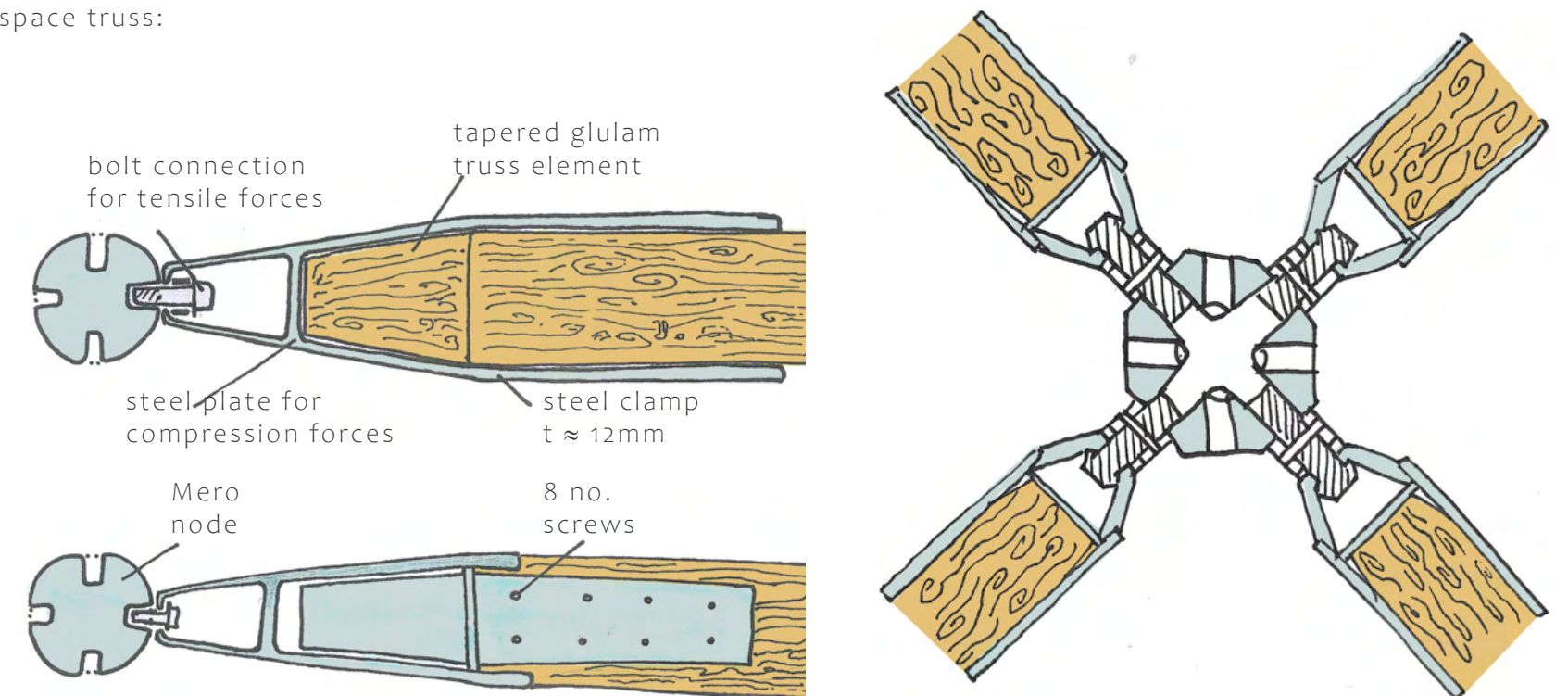


Library and Innovation Centre Glulam Space Frame Roof

The Library and Innovation Centre roof has an organic shape, expressing the musical element of our Institute. The roof topography mirrors the floor plans and is amplified around the main double/triple height areas which more people occupy. Clad in zinc panelling, the contemporary roof form juxtaposes the historic stone wall, and grows above it, creating an intriguing view from the street.

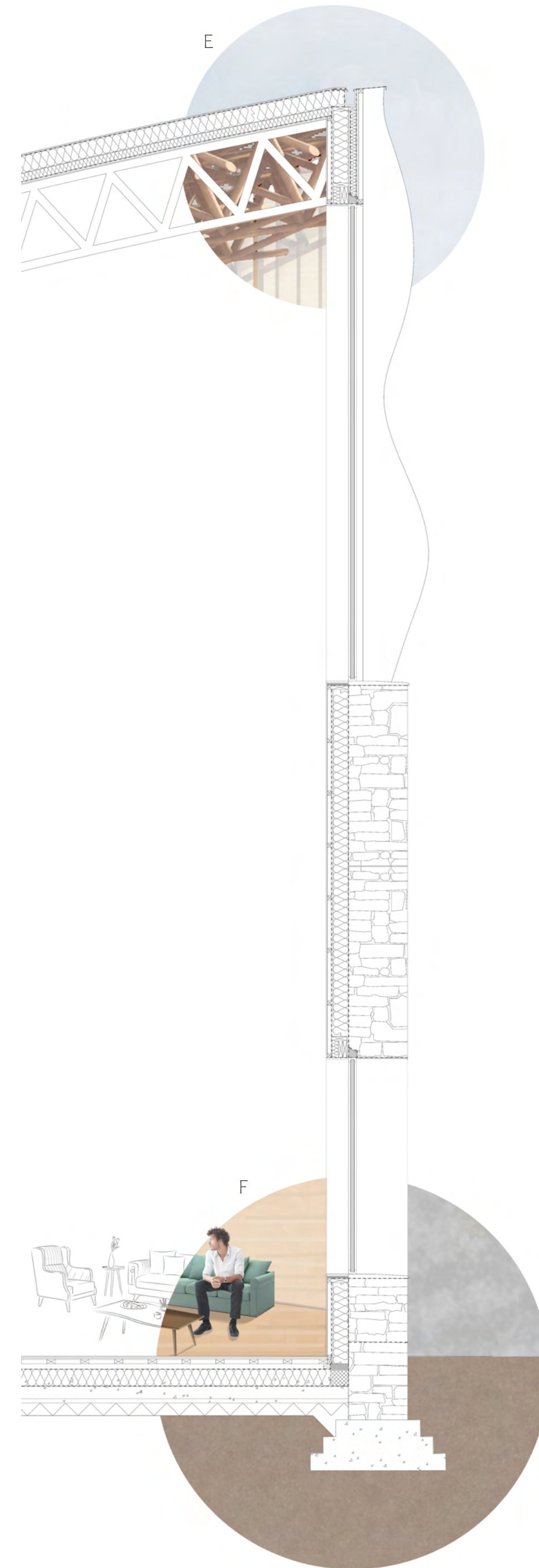
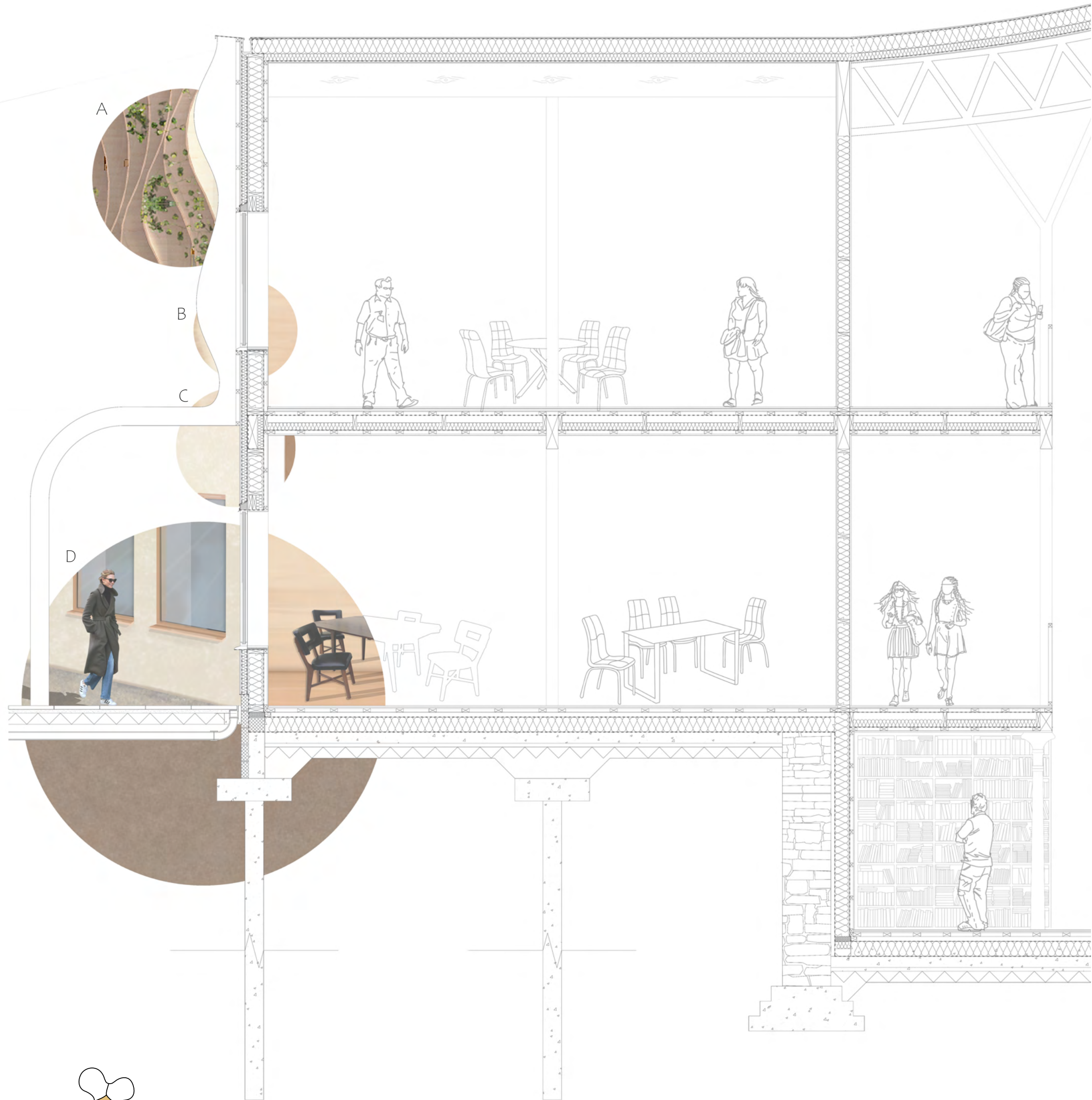
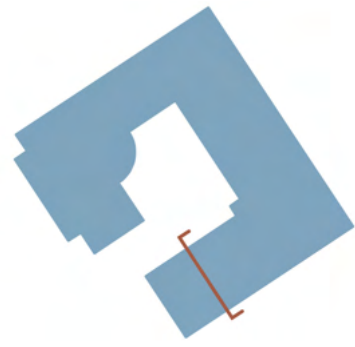


Mero node connector to connect tubular elements of space truss:

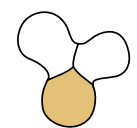
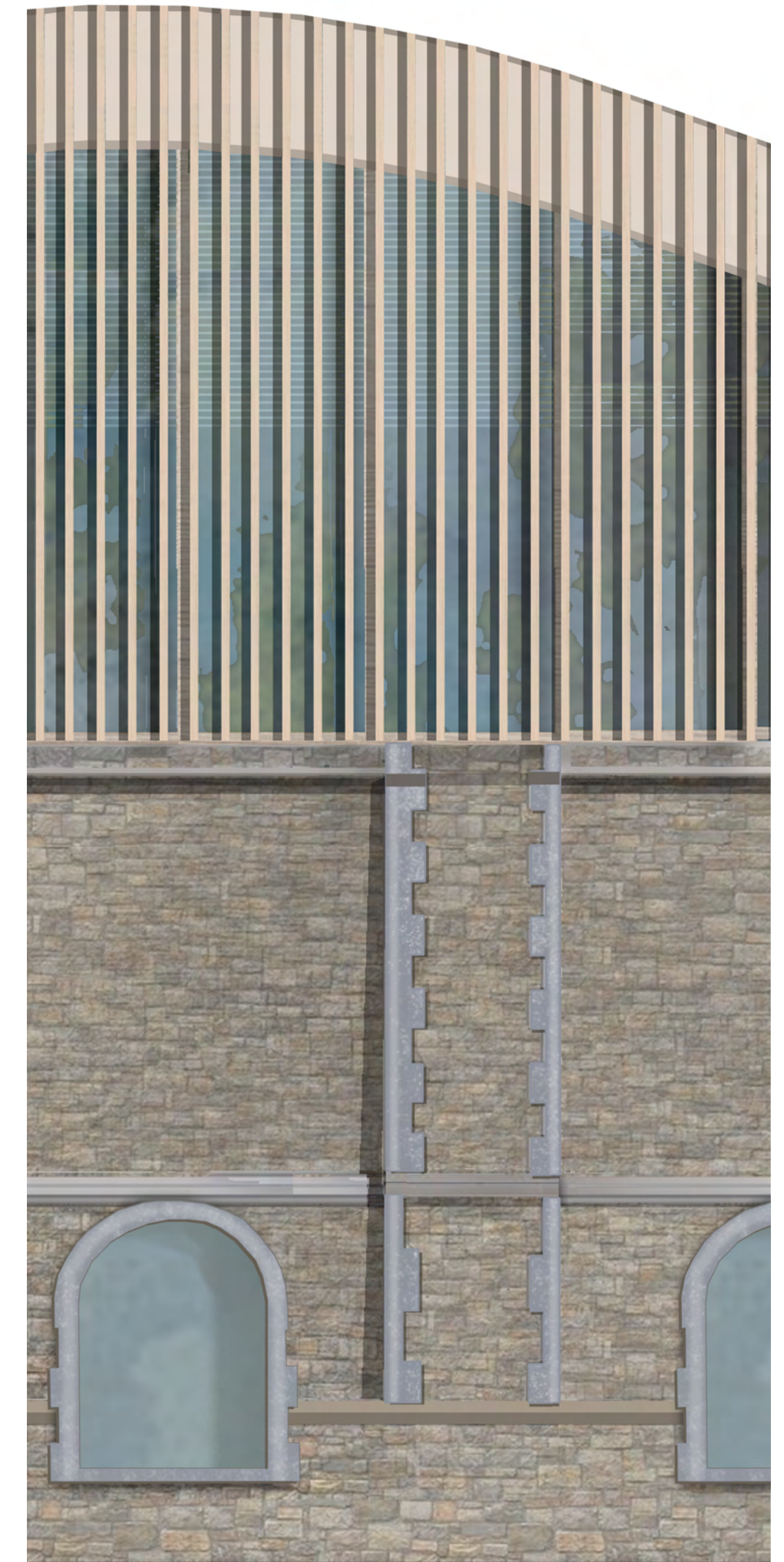


Library Detail Section

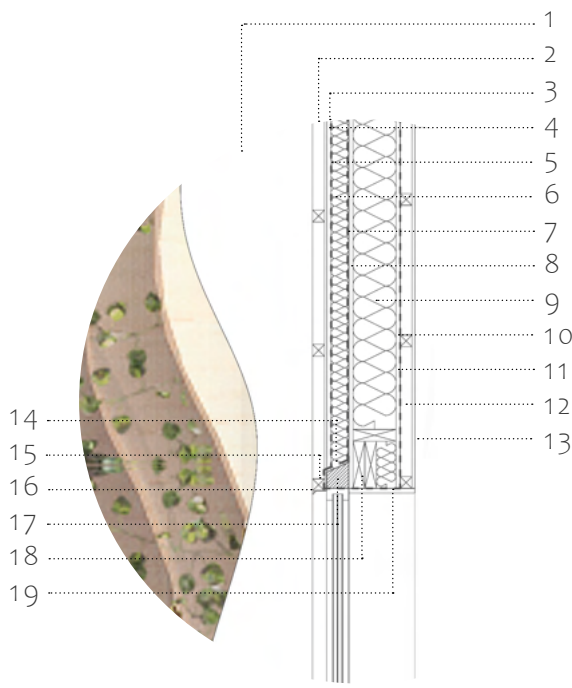
1:50
0 2.5 5 Metres



Detail Elevation 1:50

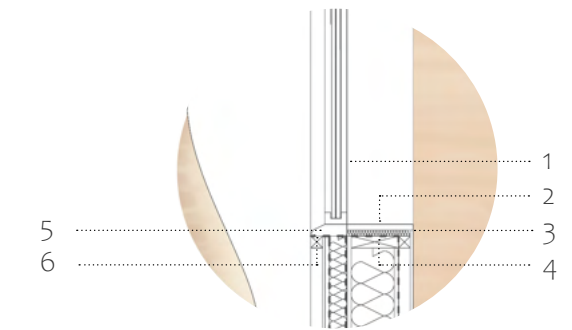


Library Detail Junctions



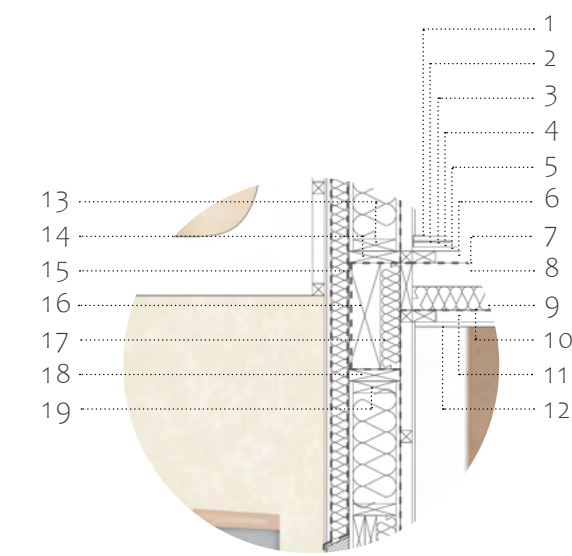
A - Window Head Junction & Wall Build Up

- | | | | |
|----|---|----|--|
| 1 | 50mm brimstone timber fins | 14 | retaining clip |
| 2 | horizontal timber fixing battens at 600mm centres | 15 | damp proof course (tucked under breather membrane) |
| 3 | 10mm lime render | 16 | steel lintel with breather membrane lapped over |
| 4 | 18mm OSB sheathing | 17 | insulated cavity barrier |
| 5 | breather membrane | 18 | edge timbers |
| 6 | 75mm overlaid insulation | 19 | 20mm oak board into reveal |
| 7 | breather membrane | | |
| 8 | 18mm OSB sheathing | | |
| 9 | 150mm hemp insulation between timber frame | | |
| 10 | 18mm OSB sheathing | | |
| 11 | vapour control layer | | |
| 12 | 50x50mm timber service battens at 600mm centres | | |
| 13 | 12mm plywood wall panels | | |



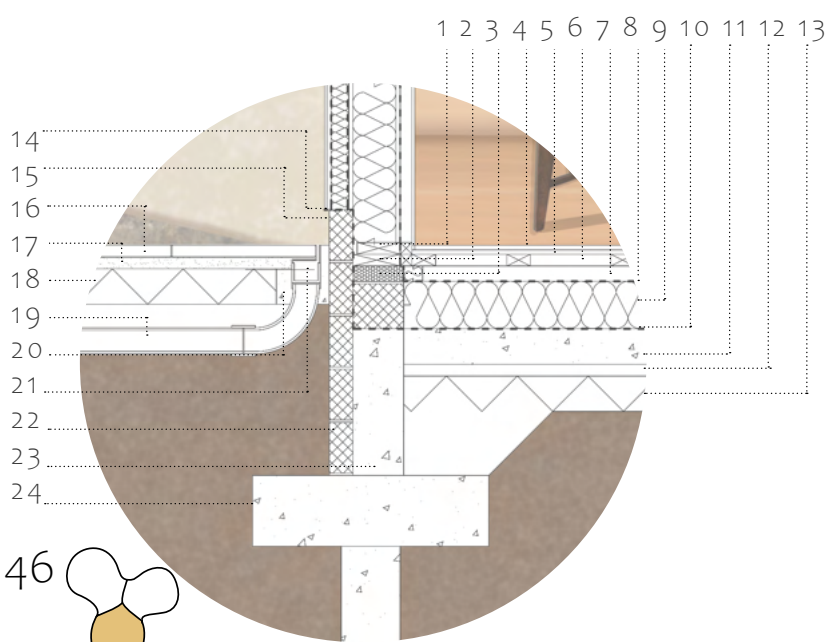
B - Window Sill Junction

- | | |
|---|--|
| 1 | argon filled triple glazed window with low e coating |
| 2 | 25mm timber sill board |
| 3 | rigid insulation under sill board |
| 4 | edge timbers |
| 5 | timber sill |
| 6 | damp proof course lapped under sill |



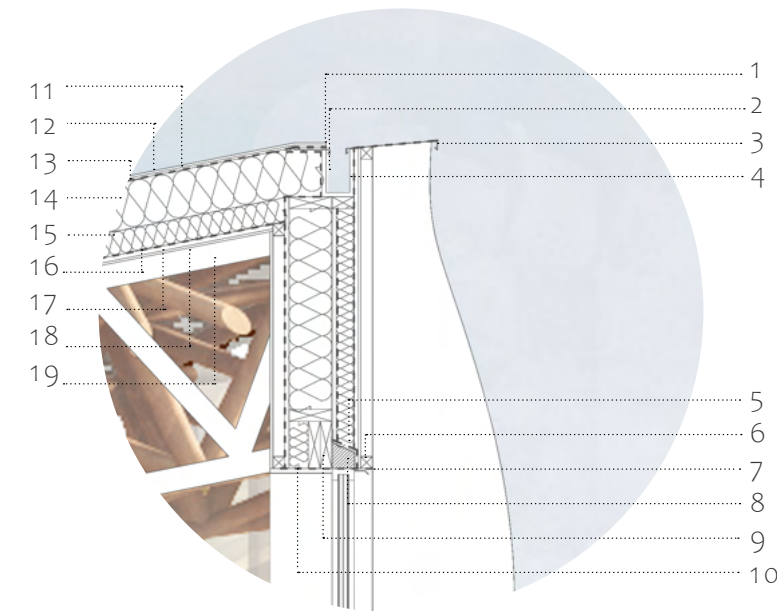
C - Intermediate Floor Junction

- | | | | |
|----|--|----|--|
| 1 | karma acoustic perimeter strip | 13 | 50mm timber bottom rail |
| 2 | 20mm oak board flooring | 14 | 50mm timber sole plate |
| 3 | 23mm karma acoustic overlay | 15 | airtight breather membrane wrapped around joists |
| 4 | 19mm gyproc plank | 16 | 450x160mm timber beam |
| 5 | 18mm t&g chipboard | 17 | 80mm insulation upstand |
| 6 | 50x100mm timber service battens at 400mm centres | 18 | 50mm timber head binder |
| 7 | vapour control layer | 19 | 50mm timber top rail |
| 8 | 200x50mm timber joists | | |
| 9 | 100mm rigid insulation | | |
| 10 | vapour control layer | | |
| 11 | 50x100mm timber service battens | | |
| 12 | 20mm oak panel ceiling | | |



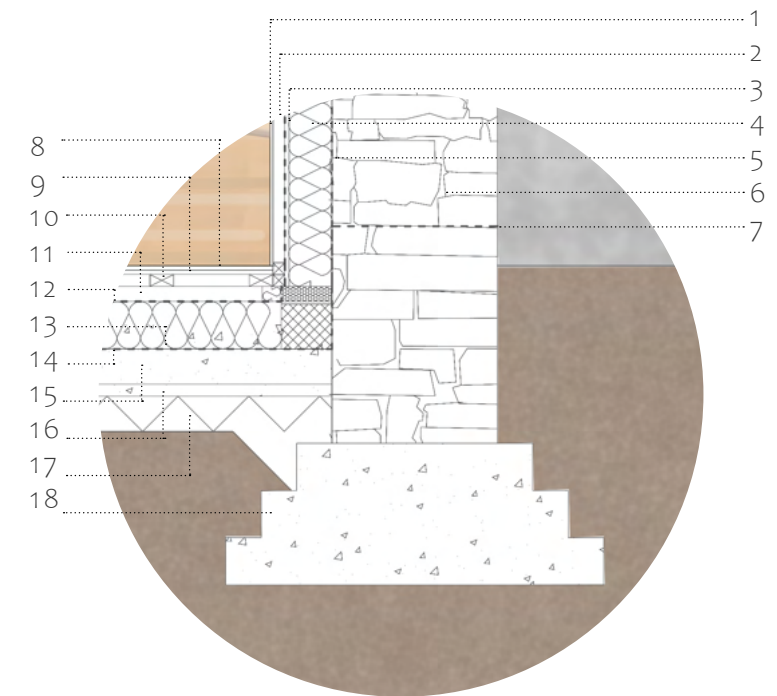
D - Ground Floor Junction

- | | | | |
|----|--|----|-------------------------------|
| 1 | 50mm timber bottom rail | 14 | damp proof course |
| 2 | 50mm timber sole plate | 15 | PPC flashing with insect mesh |
| 3 | 65x215mm marmox thermoblock | 16 | 40x600mm paving stones |
| 4 | 20mm oak board flooring | 17 | 50mm sand base |
| 5 | 18mm t&g moisture resistant chipboard | 18 | 150mm compacted hardcore |
| 6 | 50x100mm timber service battens at 400mm centres | 19 | outlet to soakaway |
| 7 | 75mm screed | 20 | lean concrete mix |
| 8 | vapour control layer | 21 | slot drain |
| 9 | 275mm rigid insulation | 22 | 102.5x215mm foundation blocks |
| 10 | damp proof membrane | 23 | concrete upstand |
| 11 | 150mm concrete slab | 24 | CFA piled foundations |
| 12 | 50mm sand binding | | |
| 13 | 150mm hardcore | | |



E - Roof Junction & Window Head Junction

- | | | | |
|----|--|----|--|
| 1 | edge flashing with waterproof membrane lapped over | 11 | 0.7mm zinc panels |
| 2 | lead guttering to tuck fold into edge of flashing | 12 | 10mm ply skin |
| 3 | aluminium flashing to top of gutter & cladding | 13 | single ply waterproof membrane |
| 4 | 18mm WBP plywood to form gutter | 14 | 200mm rigid insulation |
| | | 15 | 100mm acoustic insulation |
| | | 16 | vapour control layer, lapped under single ply membrane |
| | | 17 | 20mm acoustic panels |
| | | 18 | 10mm plywood finish |
| | | 19 | glulam space truss |
| 5 | retaining clip | | |
| 6 | damp proof course (tucked under breather membrane) | | |
| 7 | steel lintel with breather membrane lapped over | | |
| 8 | insulated cavity barrier | | |
| 9 | edge timbers | | |
| 10 | 20mm oak board into reveal | | |



F - Lower Ground Floor Junction & Wall Build Up

- | | | | |
|---|---|----|---|
| 1 | 12mm plywood wall panels | 8 | 20mm oak board flooring |
| 2 | 50x50mm timber service battens at 600mm centres | 9 | 18mm t&g moisture resistant chipboard |
| 3 | vapour control layer | 10 | 50x100mm timber service battens at 400mm centres |
| 4 | 250mm hemp insulation | 11 | 75mm screed |
| 5 | breather membrane | 12 | vapour control layer |
| 6 | 700mm existing stone wall | 13 | 275mm rigid insulation |
| 7 | damp proof course | 14 | damp proof membrane |
| | | 15 | 150mm concrete slab |
| | | 16 | 50mm sand binding |
| | | 17 | 1500 hardcore |
| | | 18 | 1mx1mx0.3m pad foundations with corbeled footings |

Materials:

Brimstone timber fins

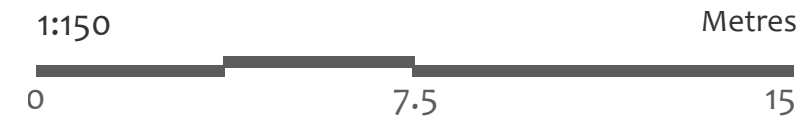
The thermal modification of the timber produces a much more durable material. The timber used for the brimstone is grown and manufactured in Britain, in sustainable managed forests. Brimstone Sycamore provides a textured and silky finish adding to the organic feel of our courtyard. It also contributes to carbon sequestration.

Lime render

Lime regulates the breath-ability of the building and is also very durable, aiding the design life of the building. Once applied, it continues to absorb carbon throughout its lifespan. It is a simple material and allows our brimstone fins to 'pop'.



Sectional Perspective



Common Room
Kitchen
Teaching
Student Foyer

Core

Dining
Break Out
Foyer

Colonnade

Performance Courtyard

Colonnade

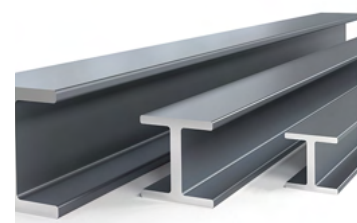
Teaching

Library

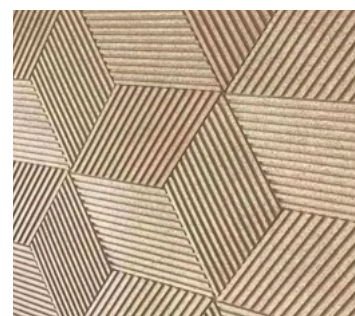
Materiality



1
1 mile
Concrete
CEMEX Swindon
Concrete Plant



2
3 miles
Steel frame
prefabricated by
Swindon Engineering
Metalworkers



3
3.3 miles
Hemp insulation &
Cork panelling
Supplied by
ecomerchant



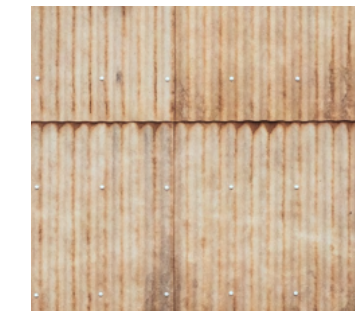
4
7.2 miles
Brimstone timber
Vastern Timber
produces external
cladding



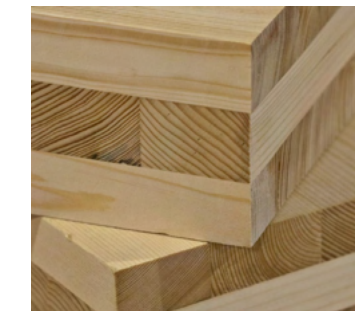
5
55 miles
Zinc Cladding
Produced by Rheinzink



6
76.5 miles
Glulam timber frame
Prefabricated by
Glulam LTD based in
Southampton



7
106 miles
Corrugated hemp
cladding
Manufactured in
Cambridgeshire by a
company called
Margent Farm.



8
965 miles
CLT Floors
This
timber complies with
emissions class 1 and
comes from Austria
and
Germany

Auditorium



Public frontage



Small and large



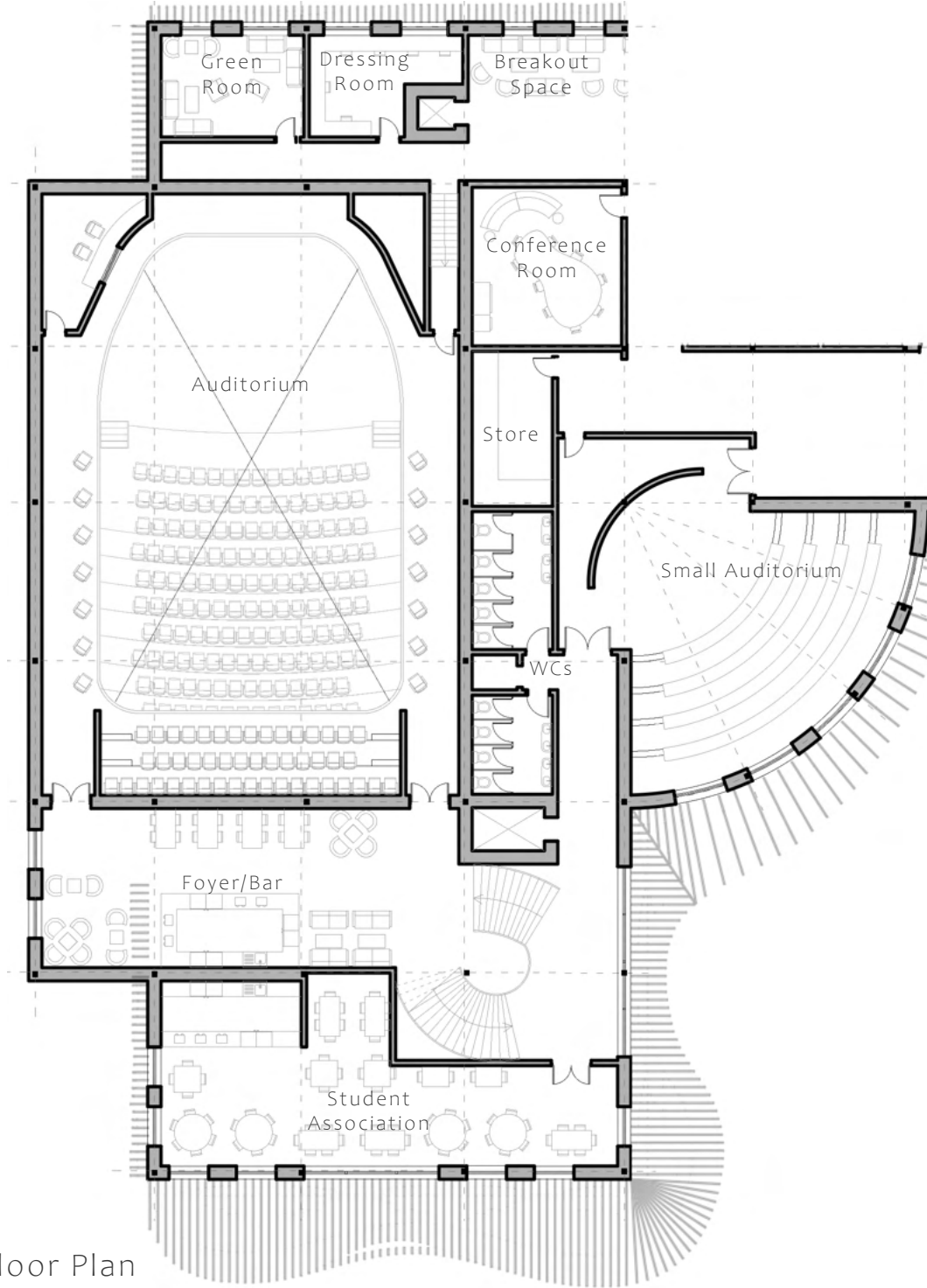
Public vs. private



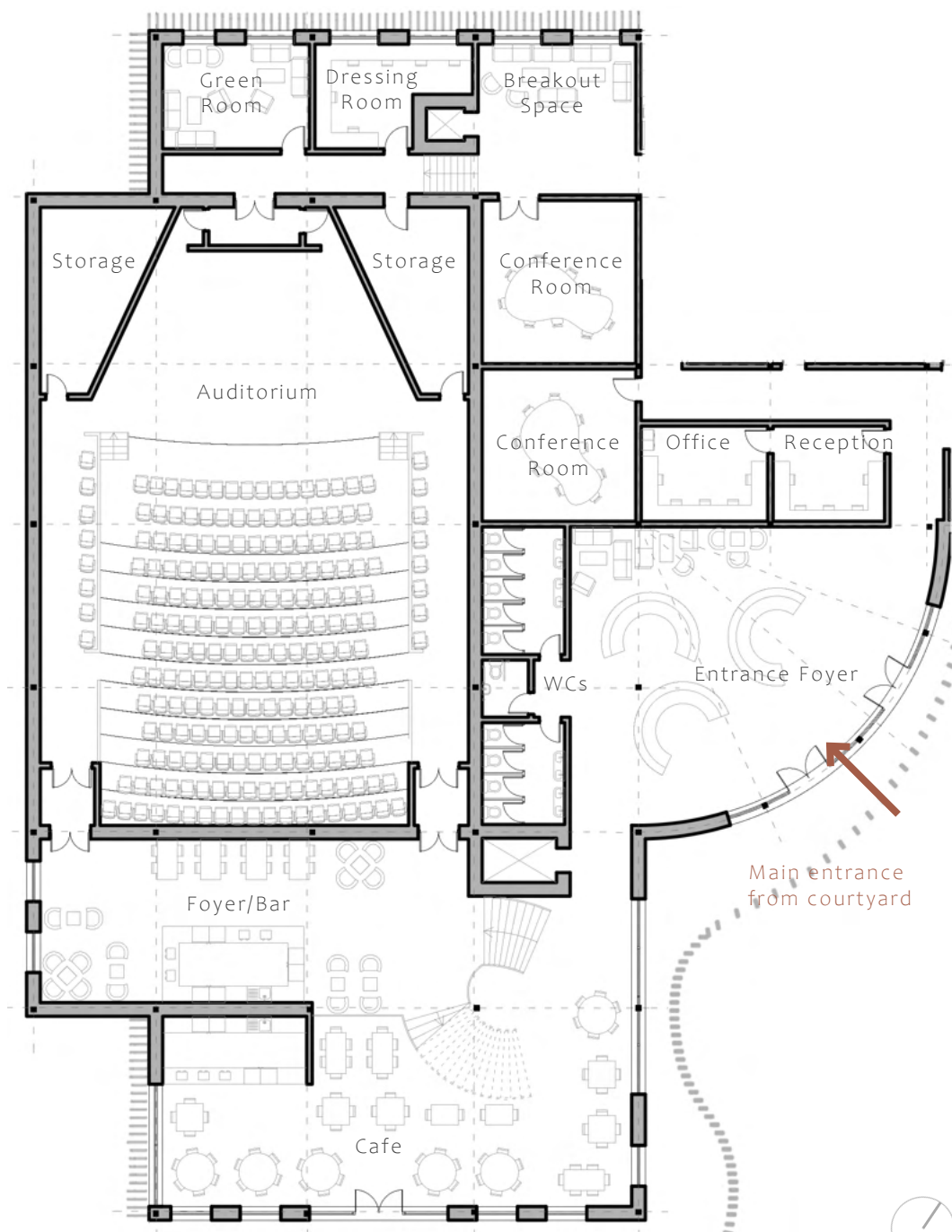
Tall & narrow



Short balcony, tiered seating



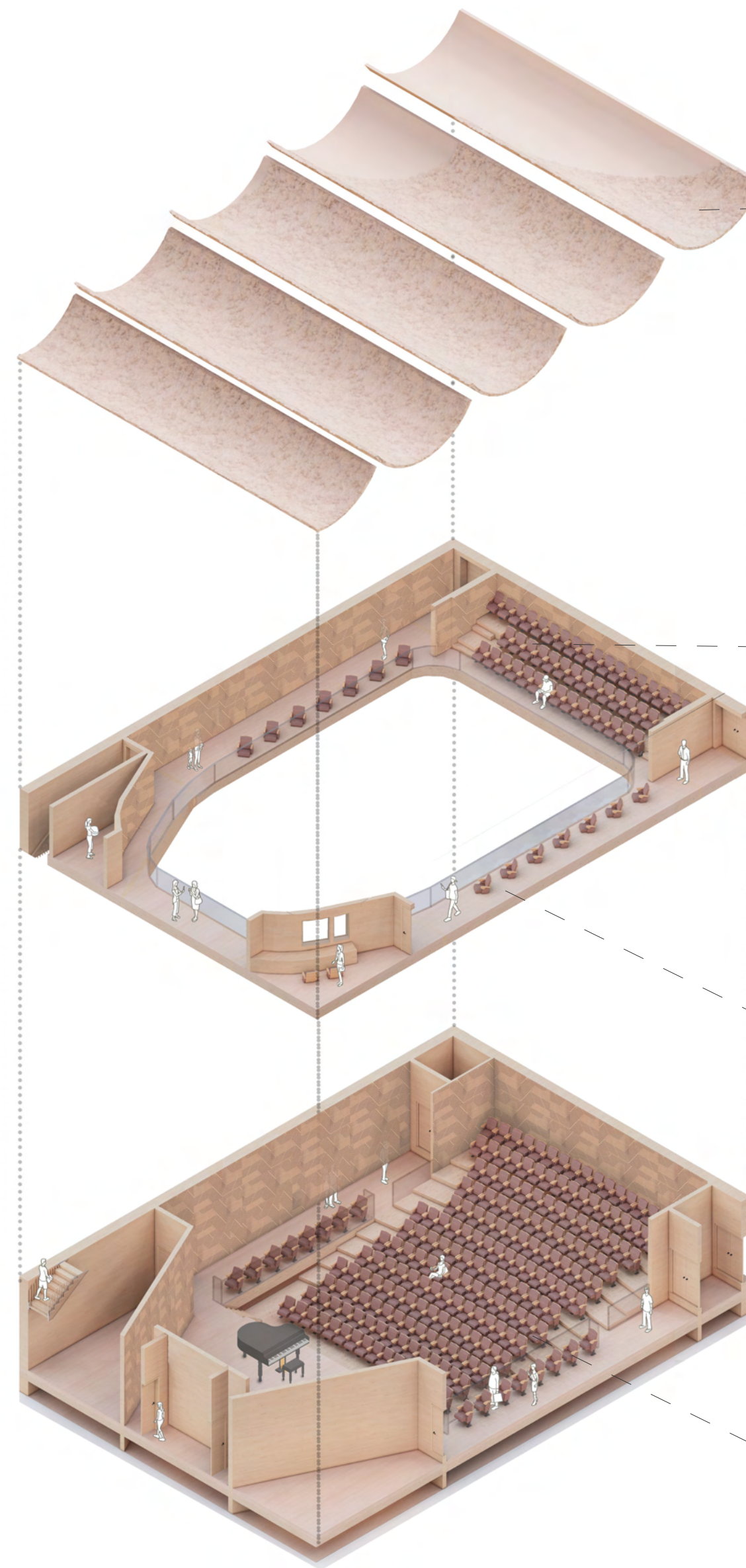
First Floor Plan



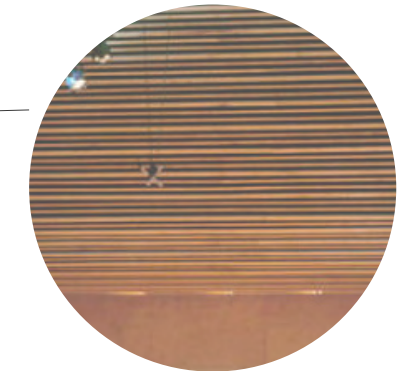
Ground Floor Plan

1:250
0 8 16
Metres

Auditorium Exploded Isometric & Materiality



Perforated wooden acoustic curved ceiling panel
- Reflective scatter grooved panel model, providing satisfying resonance and clarity



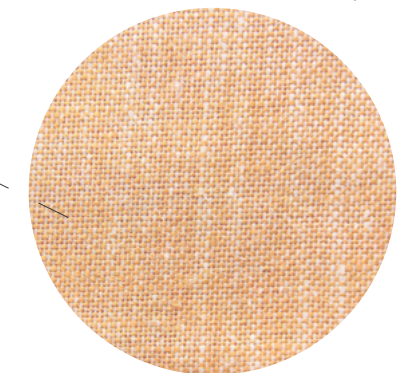
Cork acoustic panelling
- Highly sound absorbent and great acoustical performance
- Produced from waste products
- Biodegradable



Oak flooring with acoustic treatment
- Warmth and comfort while dampening and controlling sound



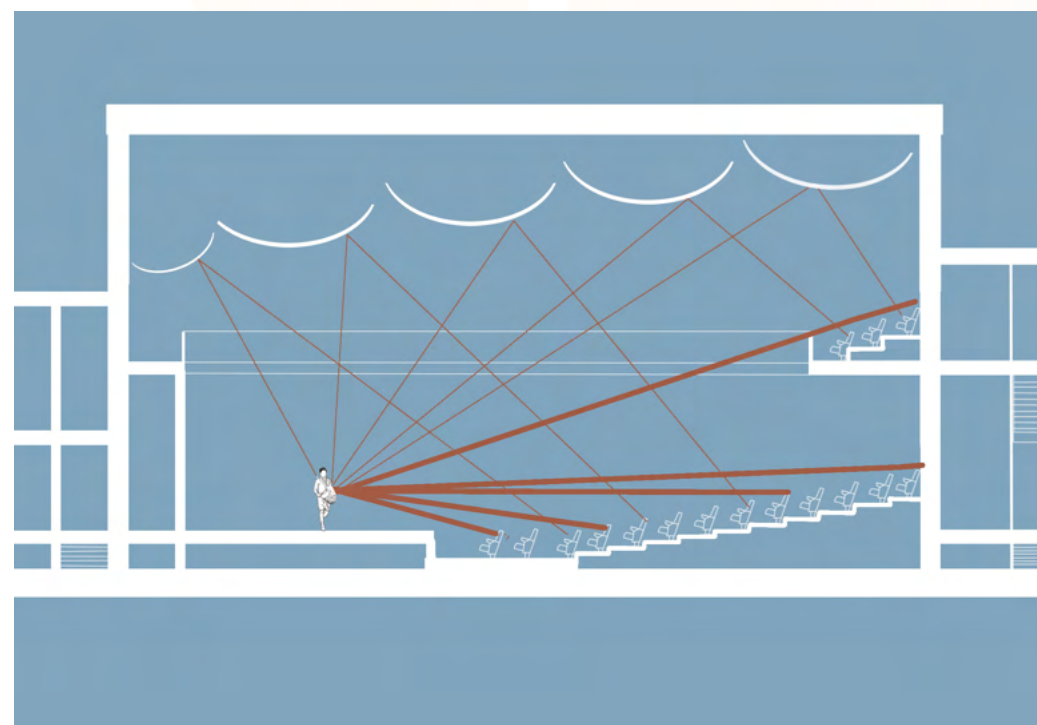
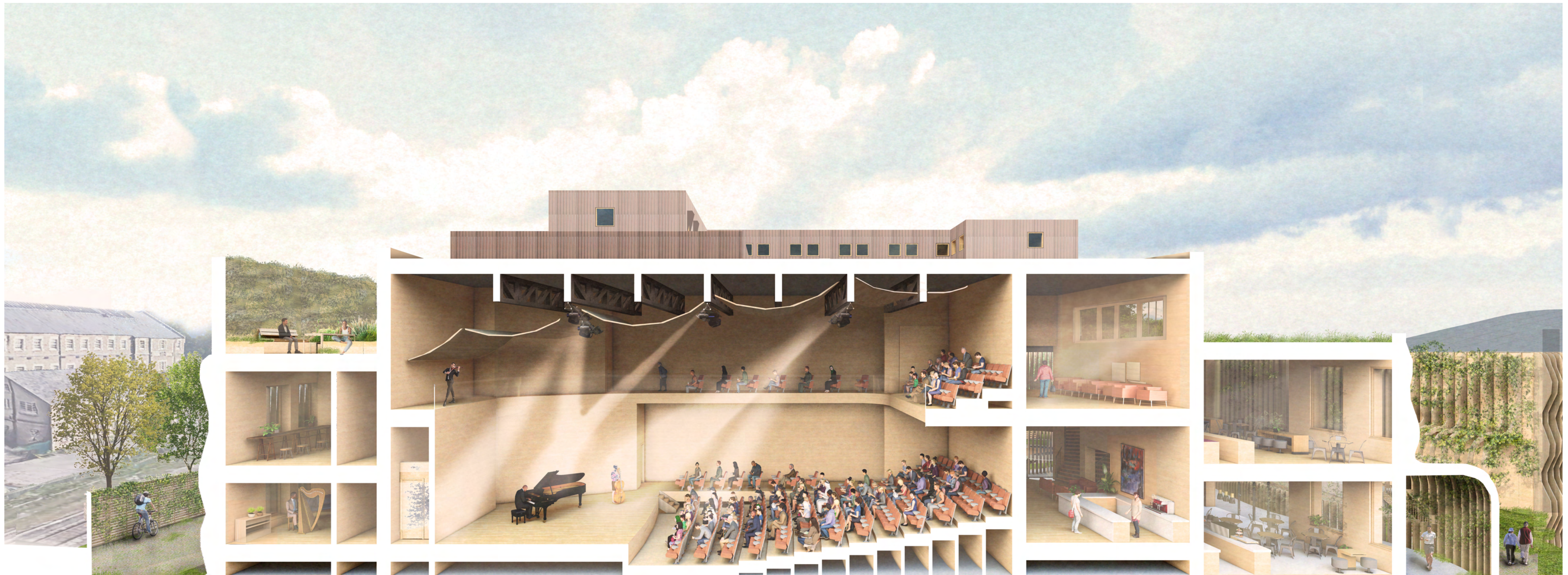
Hemp Fabric (combined with wool)
- For acoustically dampening properties
- Sustainable and locally sourced



Our auditorium sits adjacent to the public realm space, breaking into it as a way of inviting the community into the space. Introducing two auditorium spaces provides greater flexibility for performances with a clear axial separation of spaces on plan. The traditional shoebox shape is the optimal form for ensemble performances, enhanced by tiered seating and short balconies.



Sectional Perspective

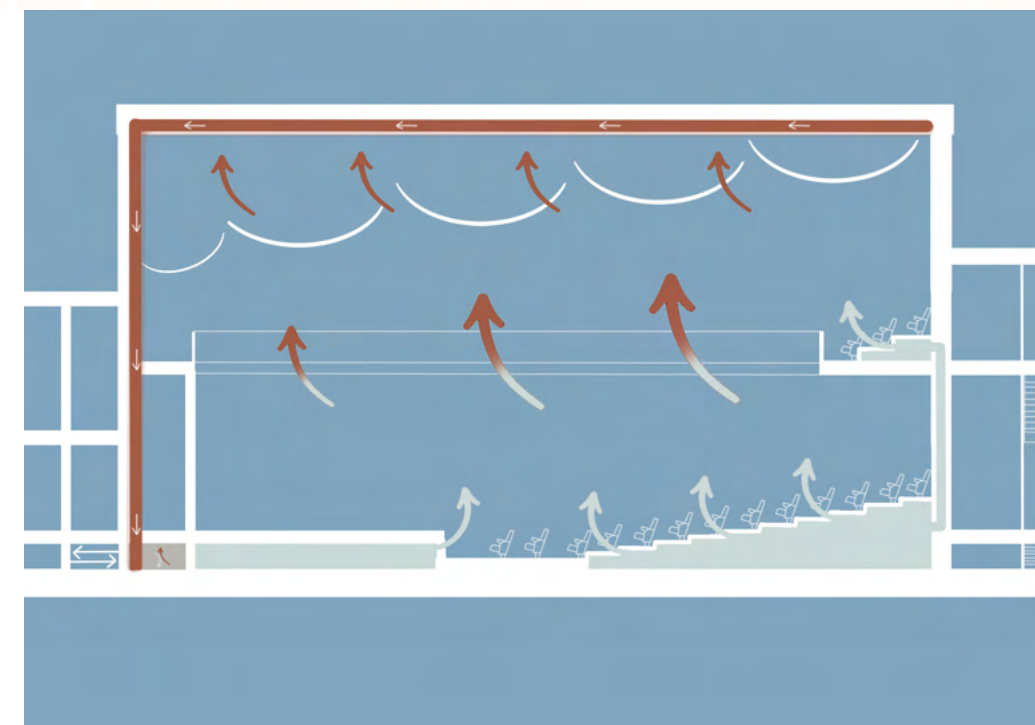


Auditorium Acoustics

The auditorium is one of the most acoustically sensitive spaces in the scheme and has a recommended reverberation time of 1.5 to 2.5 seconds.

| | Material | α | Area (m ²) |
|---|-----------------------------|----------|------------------------|
| 1 | Acoustic ceiling reflectors | 0.01 | 277.4 |
| 2 | Plywood panelling | 0.02 | 234 |
| 3 | Cork acoustic tiles | 0.5 | 304 |
| 4 | Oak flooring | 0.08 | 277.4 |

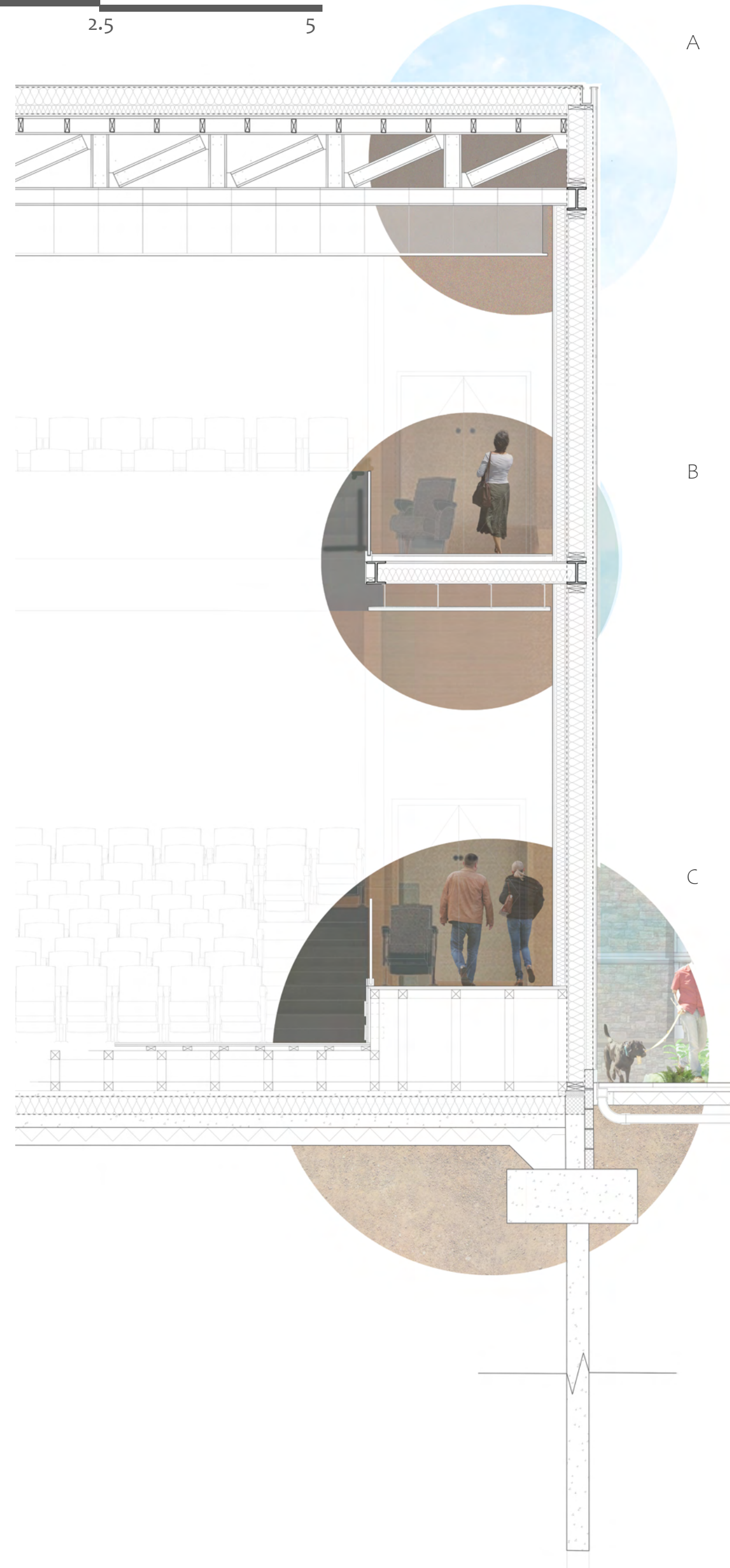
The table displays the absorption coefficients of room elements and the achieved reverberation time is 1.97s, within its ideal range for ensemble performances.



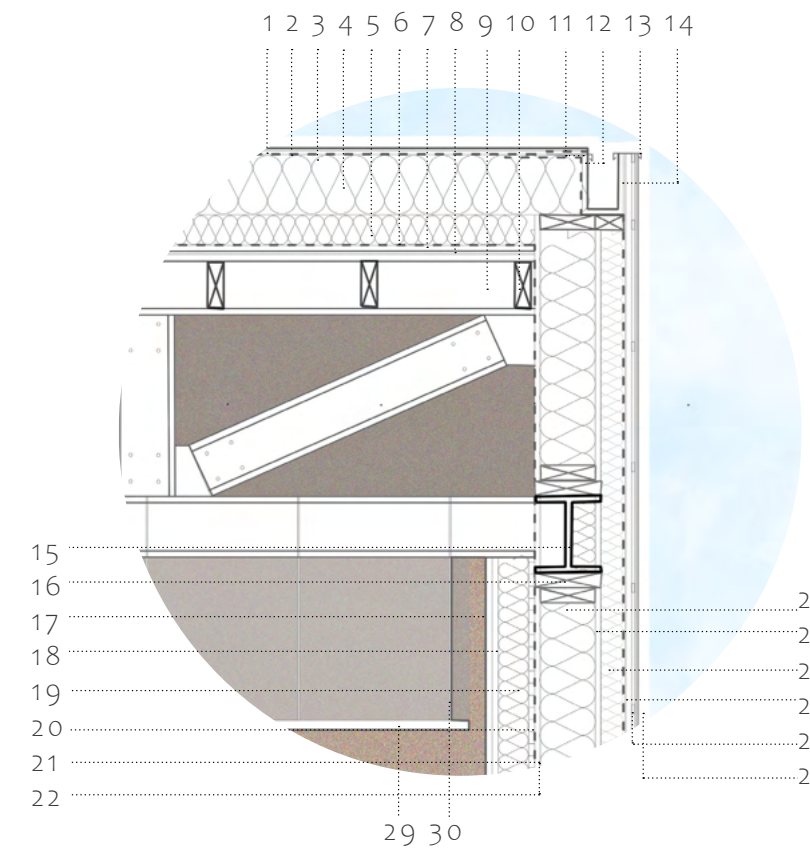
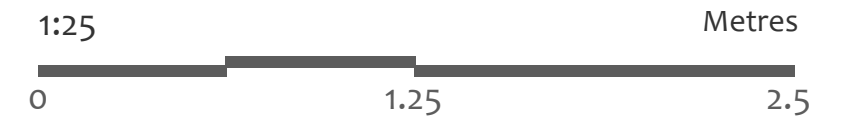
Ventilation Strategy

The auditorium has a mechanical ventilation system with heat recovery to condition the space. A ventilation intake is located on the west face of the site and is baffled to reduce external noise. The air is passed through a MVHR unit and ducted underneath the seating. The hot air rises and extracts through ceiling grilles hidden by the hung acoustic panels. The air travels through the roof void and is passed through a heat exchanger before being exhausted. Intakes and exhausts are located sufficiently far away so that the exhausted air is not recirculated.

Auditorium Detail Section

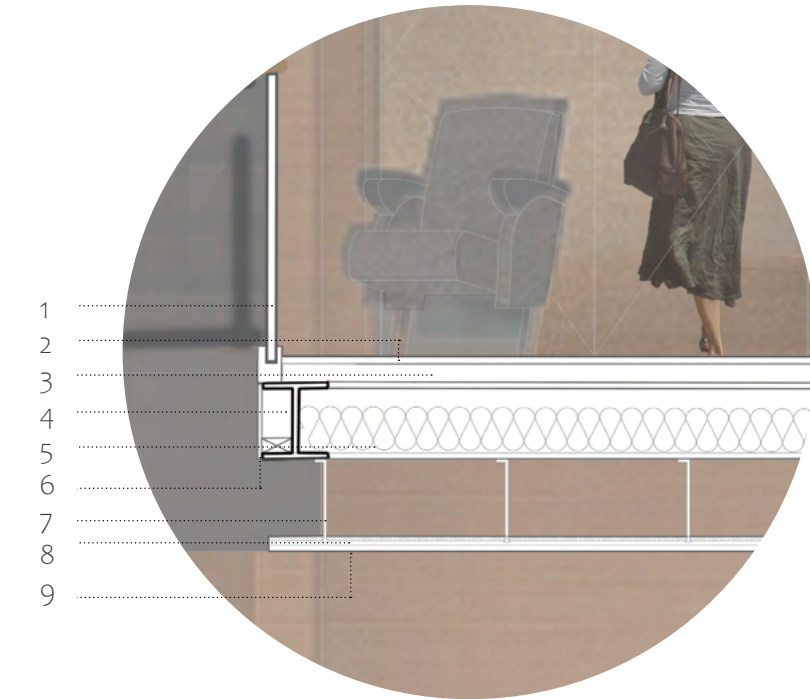


Auditorium Detail Junctions



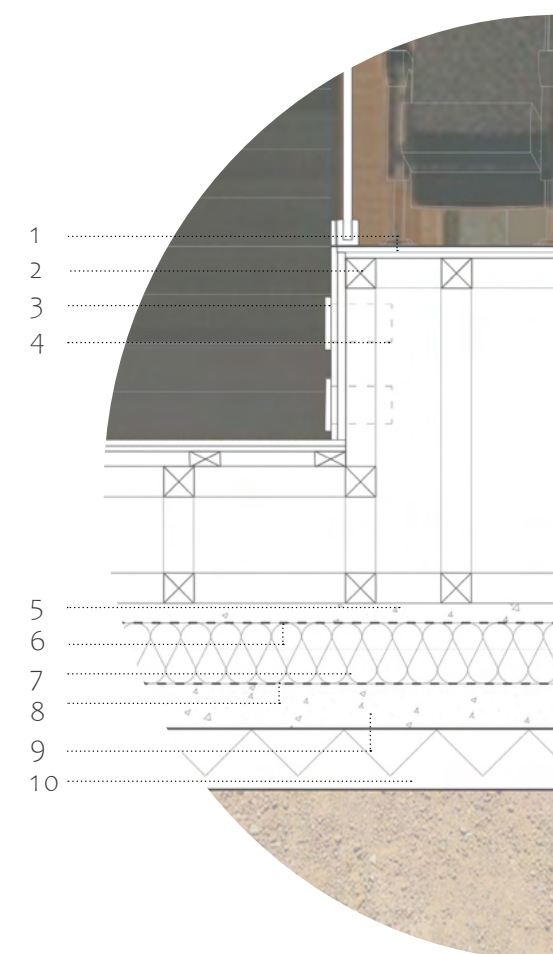
A - Roof Junction

- | | | | |
|----|--|----|---------------------------------------|
| 1 | 0.7mm zinc panels | 15 | I beam |
| 2 | 10mm ply skin | 16 | edge timber |
| 3 | single ply waterproof membrane | 17 | 10 mm reflective ply finish |
| 4 | 200mm rigid insulation | 18 | 20 mm acoustic panel |
| 5 | 100mm acoustic insulation | 19 | 100 mm sound absorbent insulation |
| 6 | vapour control layer, lapped under single ply membrane | 20 | acoustic resilient bars |
| 7 | 10mm plywood finish | 21 | vapour barrier |
| 8 | furring | 22 | 20 mm sheathing board |
| 9 | steel truss | 23 | 200 mm hemp insulation between frame |
| 10 | timber joist at 400 mm centers | 24 | 20 mm sheathing board |
| 11 | edge flashing with waterproof membrane lapped over | 25 | 75 mm overlaid insulation |
| 12 | lead guttering to tuck gold into edge of flashing | 26 | breather membrane |
| 13 | aluminium flashing to top of gutter & cladding | 27 | vertical timber battens |
| 14 | 18mm WBP plywood to form gutter | 28 | standing seam zinc cladding with clip |
| | | 29 | acoustic panel |
| | | 30 | resilient clip |



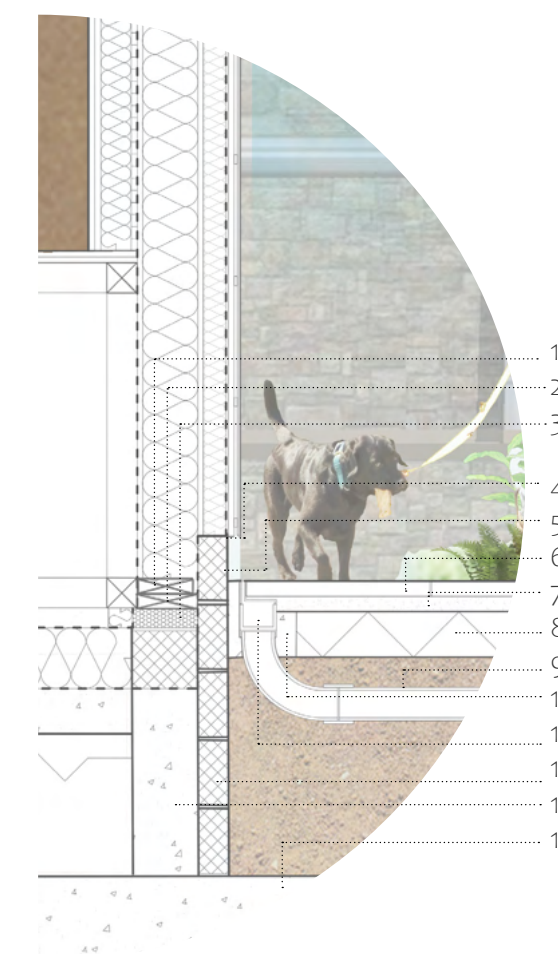
B - Balcony Build Up

- | | |
|---|--------------------------------------|
| 1 | glass balustrade fixed to I beam |
| 2 | timber oak flooring |
| 3 | 180 mm CLT |
| 4 | cantilevered steel I beam |
| 5 | 150 mm hemp insulation between beams |
| 6 | timber flashing |
| 7 | resilient clip with servicing space |
| 8 | 20 mm acoustic insulation |
| 9 | 20 mm oak panel ceiling |



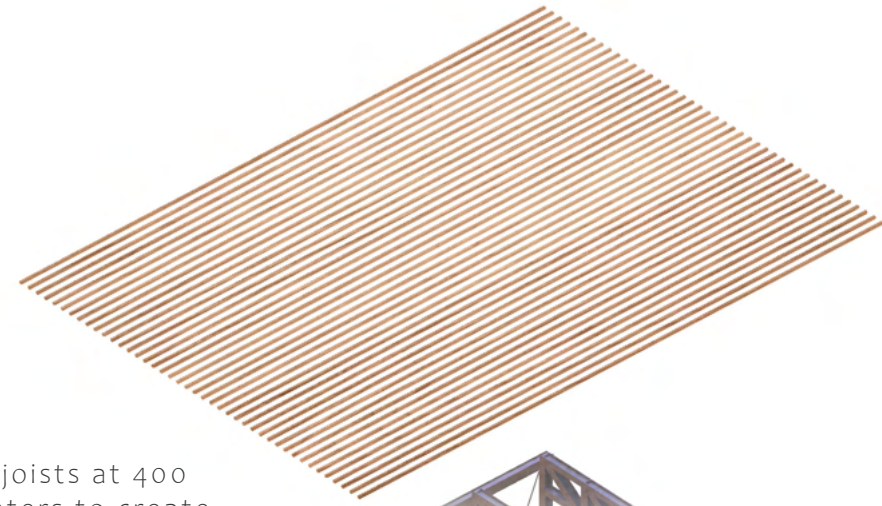
C - Floor Junction

- | | |
|----|-------------------------------------|
| 1 | double layer 18mm plywood panels |
| 2 | 100 x 100mm timber frame |
| 3 | structure to support tiered seating |
| 4 | ventilation diffusers |
| | ventilation ducts |
| 5 | 75mm screed |
| 6 | vapour control layer |
| 7 | 275mm rigid insulation |
| 8 | damp proof membrane |
| 9 | 150mm concrete slab |
| 10 | 150mm hardcore |

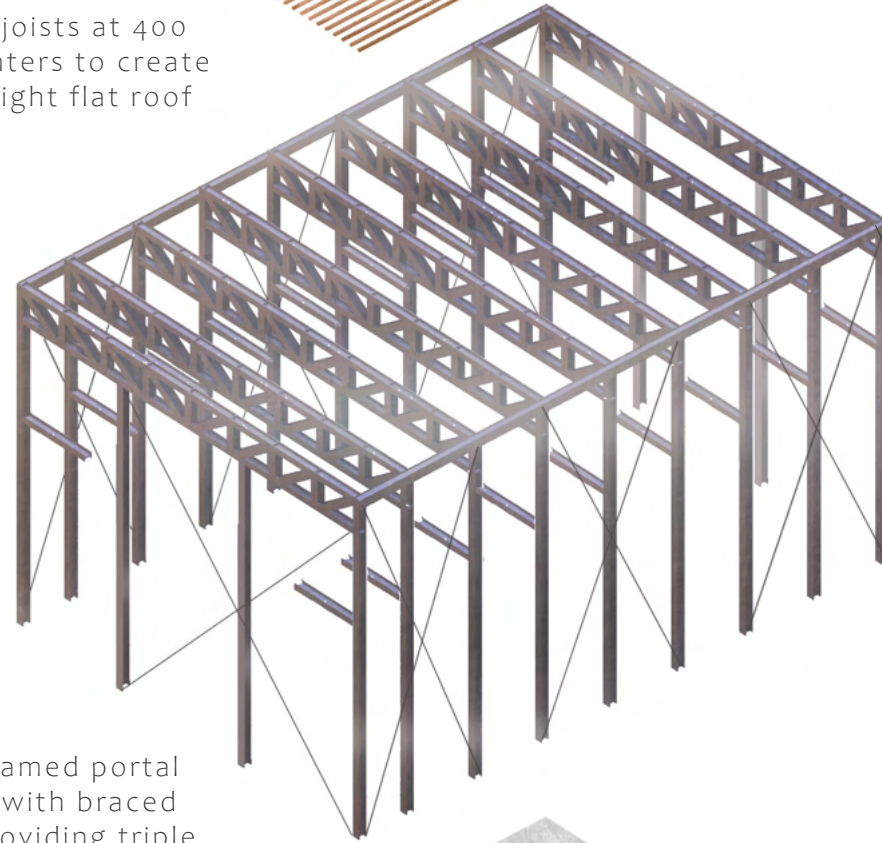


- | | |
|----|-------------------------------|
| 1 | 50mm timber bottom rail |
| 2 | 50mm timber sole plate |
| 3 | 65x215mm marmox thermoblock |
| 4 | damp proof course |
| 5 | PPC flashing |
| 6 | 40x600mm paving stones |
| 7 | 50mm sand base |
| 8 | 150mm compacted hardcore |
| 9 | outlet to soakaway |
| 10 | lean concrete mix |
| 11 | slot drain |
| 12 | 102.5x215mm foundation blocks |
| 13 | concrete upstand |
| 14 | CFA piled foundations |

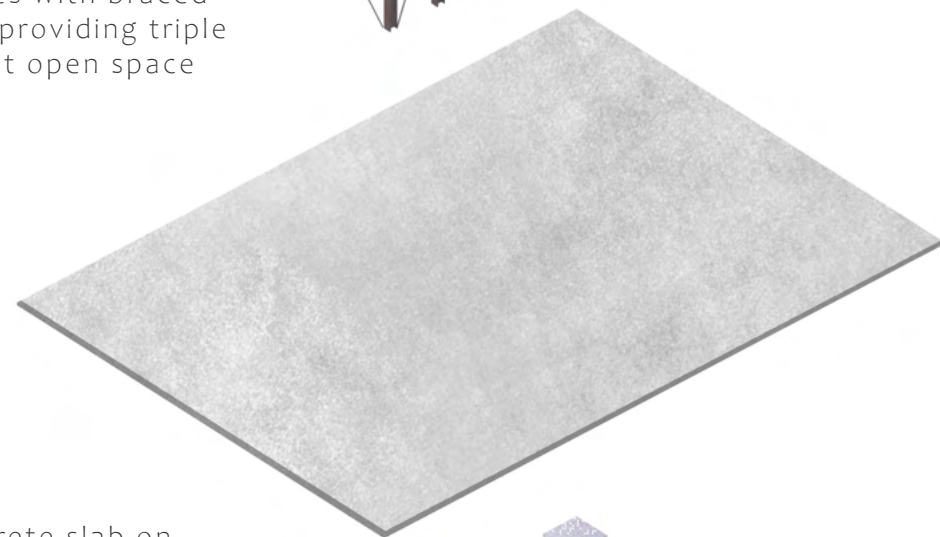
Auditorium Structure



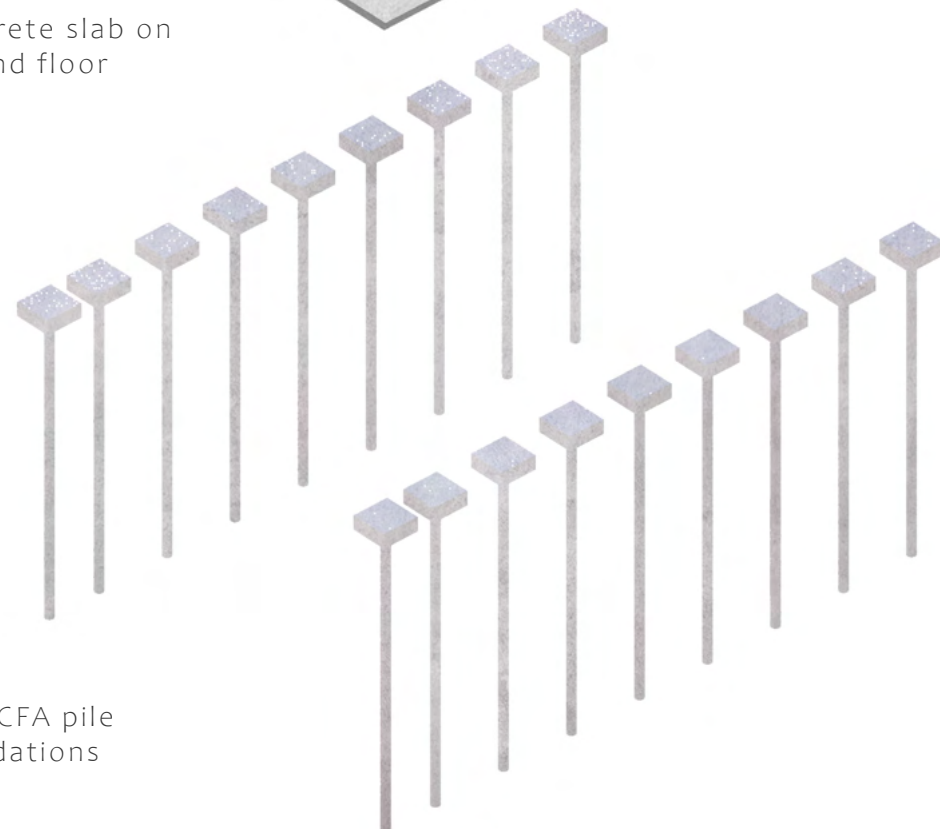
Timber joists at 400 mm centers to create lightweight flat roof



Steel framed portal frames with braced bays providing triple height open space



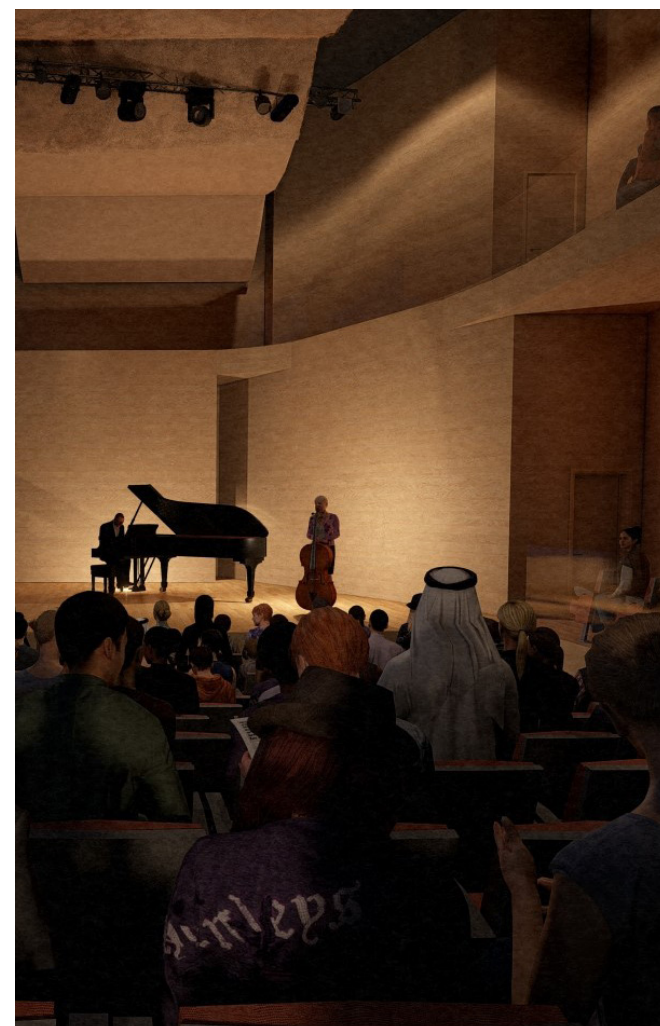
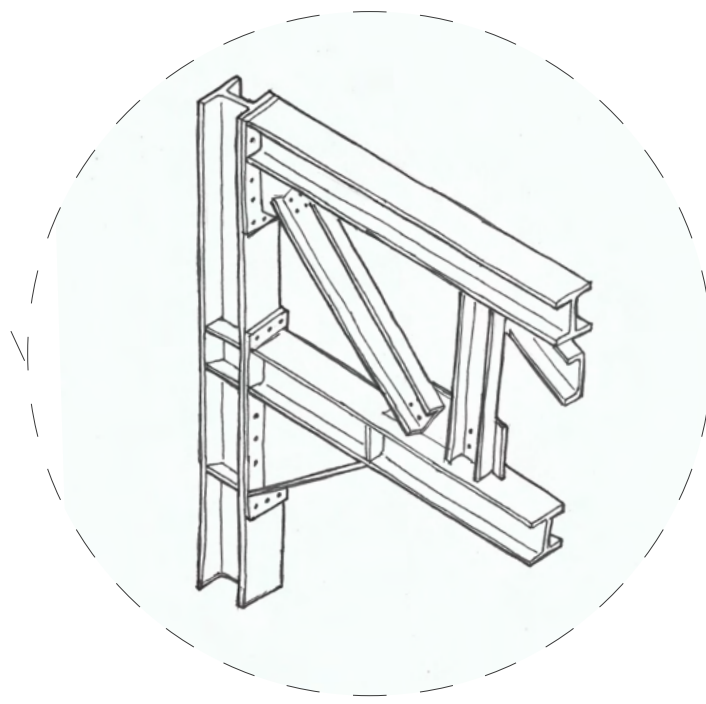
Concrete slab on ground floor



New CFA pile foundations

The steel frame grid is similar to that of the teaching block, however, here the elements are all tied into the portal frames. To ensure efficiency of the structure, no large loads were imposed onto the roof - leaving a flat roof on a portalised frame supported by the auditorium roof trusses. The flat roof option was opted for given the adaptability and capability to alter acoustic panelling from the steel trusses.

Steel truss connection



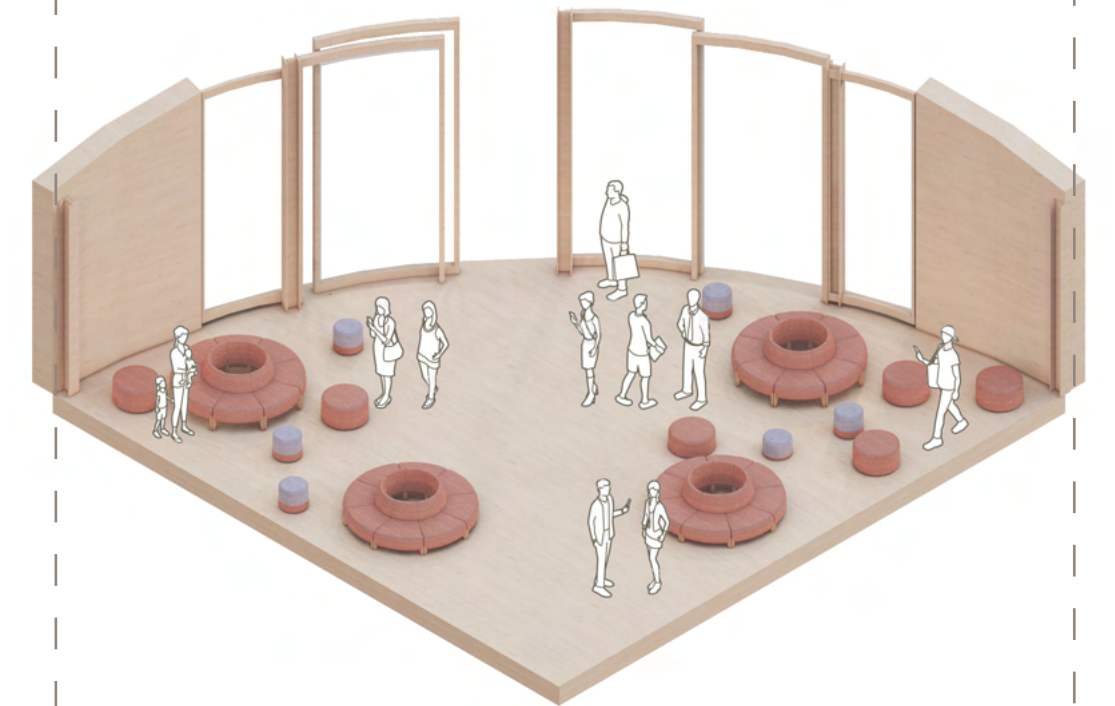
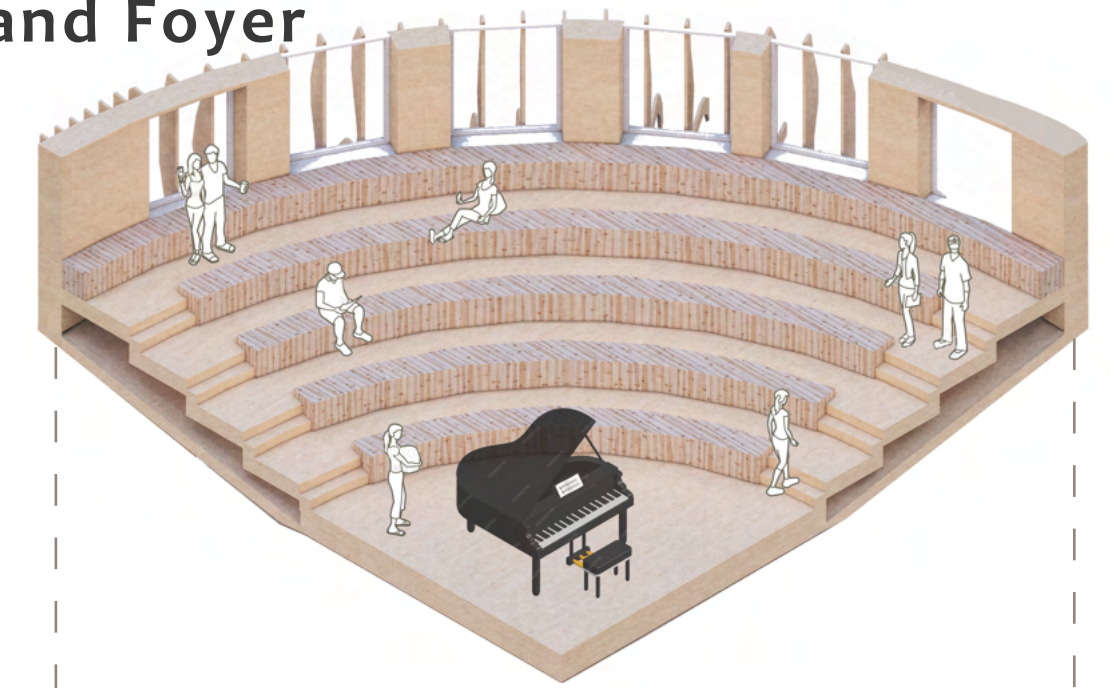
Auditorium perspective

Small Auditorium and Foyer Exploded Isometric

The small auditorium sits atop the foyer, with curved tiered seating all facing the instrument stage. Plenty of light filled windows provide a glowing, light filled atmosphere, creating an ethereal space to listen to music. It sits next to the larger auditorium and is an alternate space catered specially towards ensemble performances. This auditorium is less formal, more interactive and best for individual or smaller groups of musicians.

A radial structure is employed utilizing steel beams and columns.

The foyer provides a grand opening inwards from the courtyard, directing students and the public alike into the building. Glazed doors connect the outside and inside, whilst a casual space hosts a place to mill and relax on either end of a performance. The reception and many WC facilities sit along side, catering for visitors.



Public Offer Small Auditorium

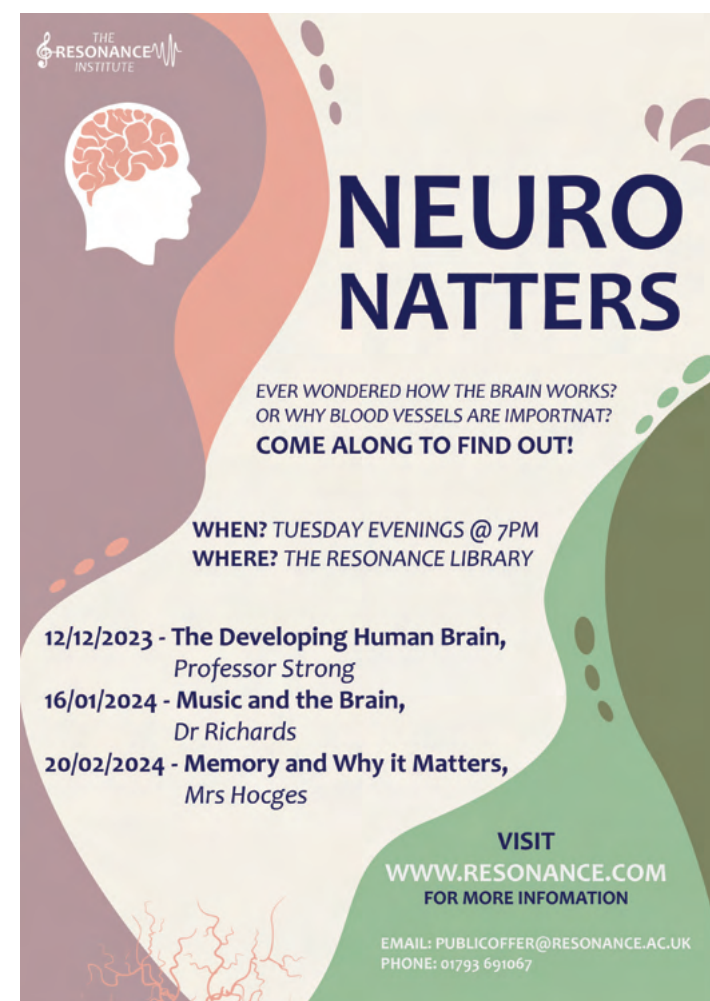


Public Offer Cafe



Events offered to the public

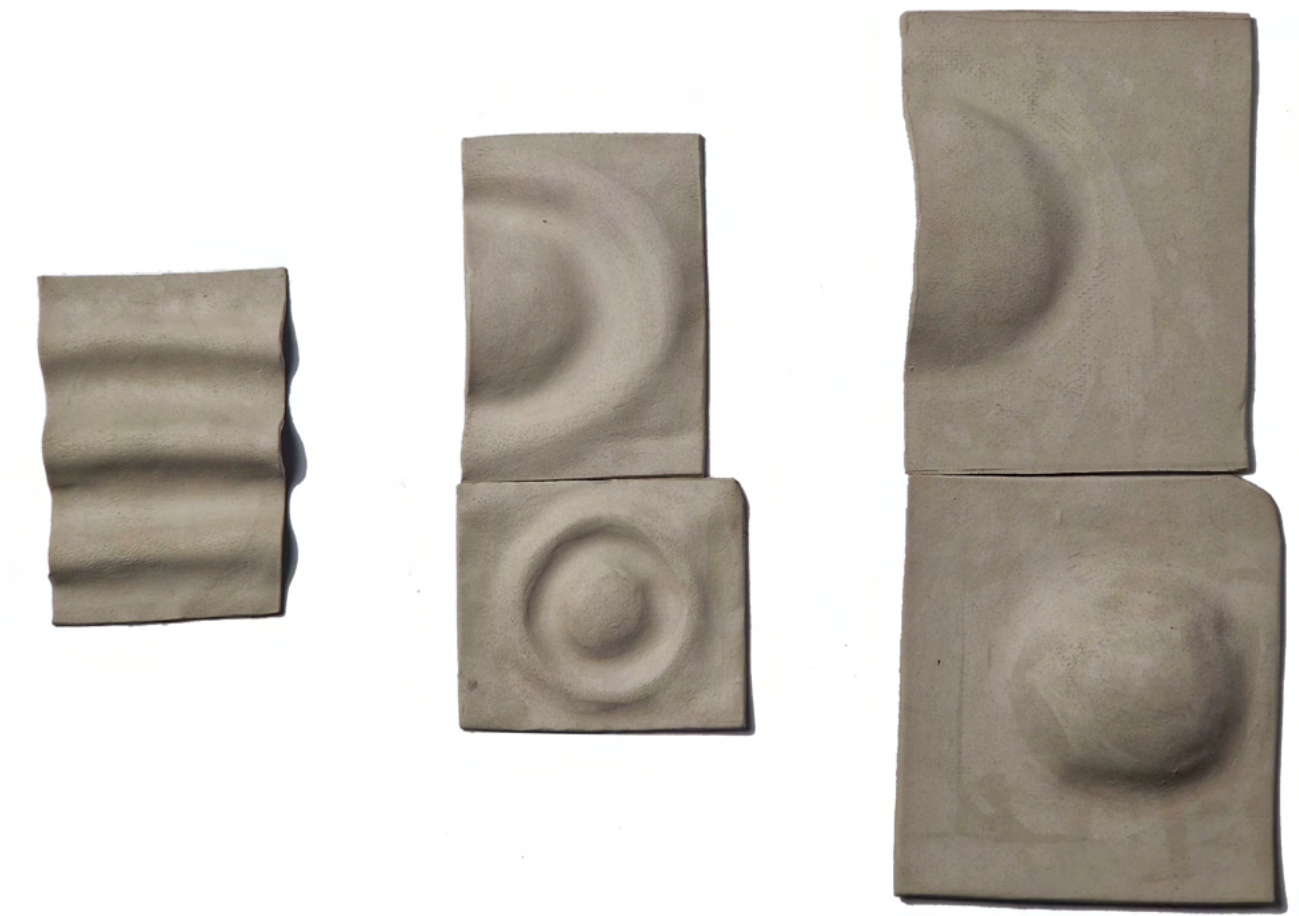
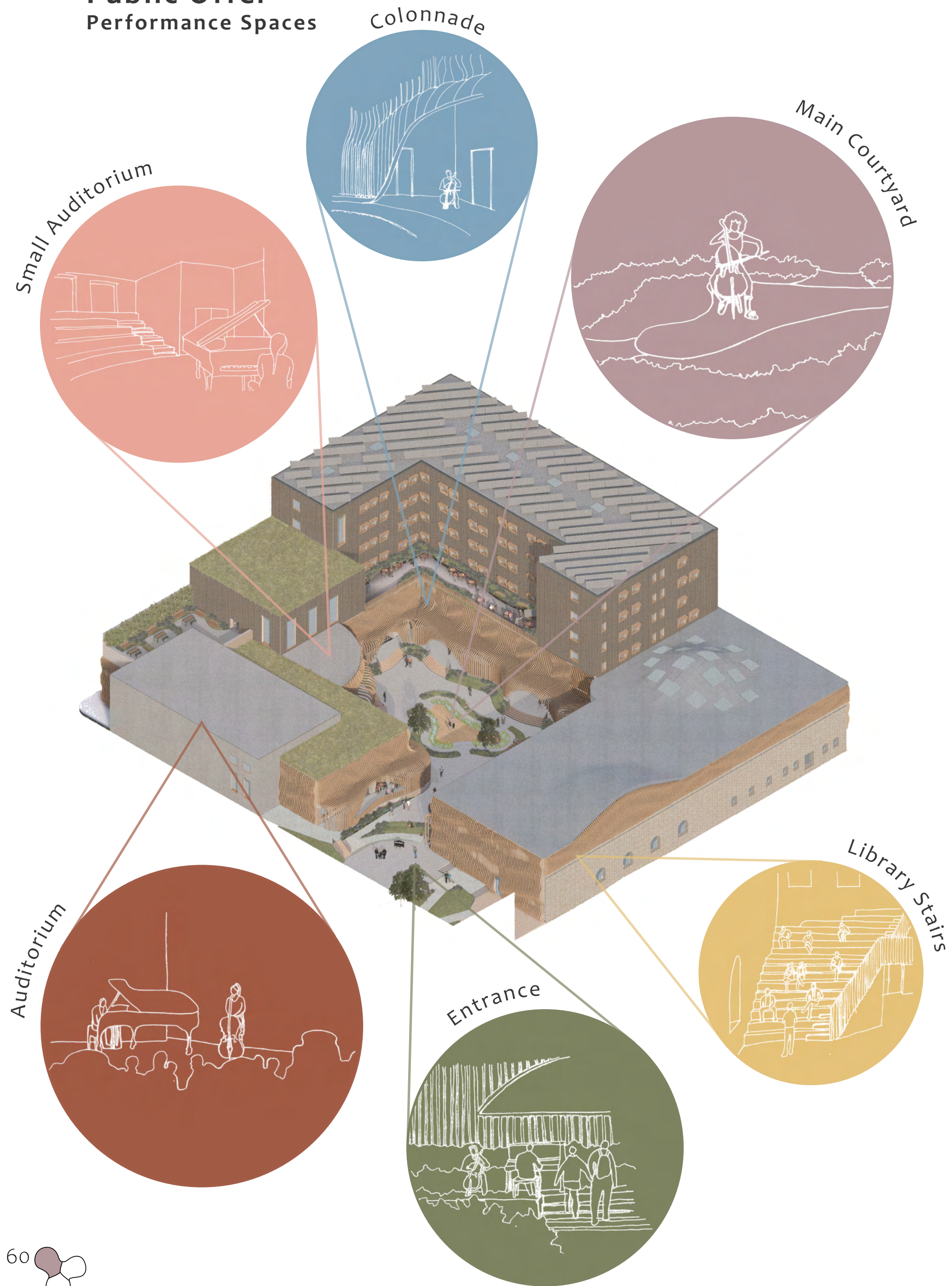
A variety of activities relating to our chosen subjects, Music and Neuroscience, are offered at the Resonance Institute for the community's benefit. The posters indicate the events that would occur. This should contribute to merging the community and our university, and creating a vibrant and lively hub.



The Cafe

The cafe is the space that faces you as you walk through the historic wall. It sits alongside the public realm and the courtyard, opening up to all faces. It links to the Auditorium and foyer, providing a space to relax and socialise before or after a performance.

Public Offer Performance Spaces



Teaching



Optimal structural grid



Vertical connection



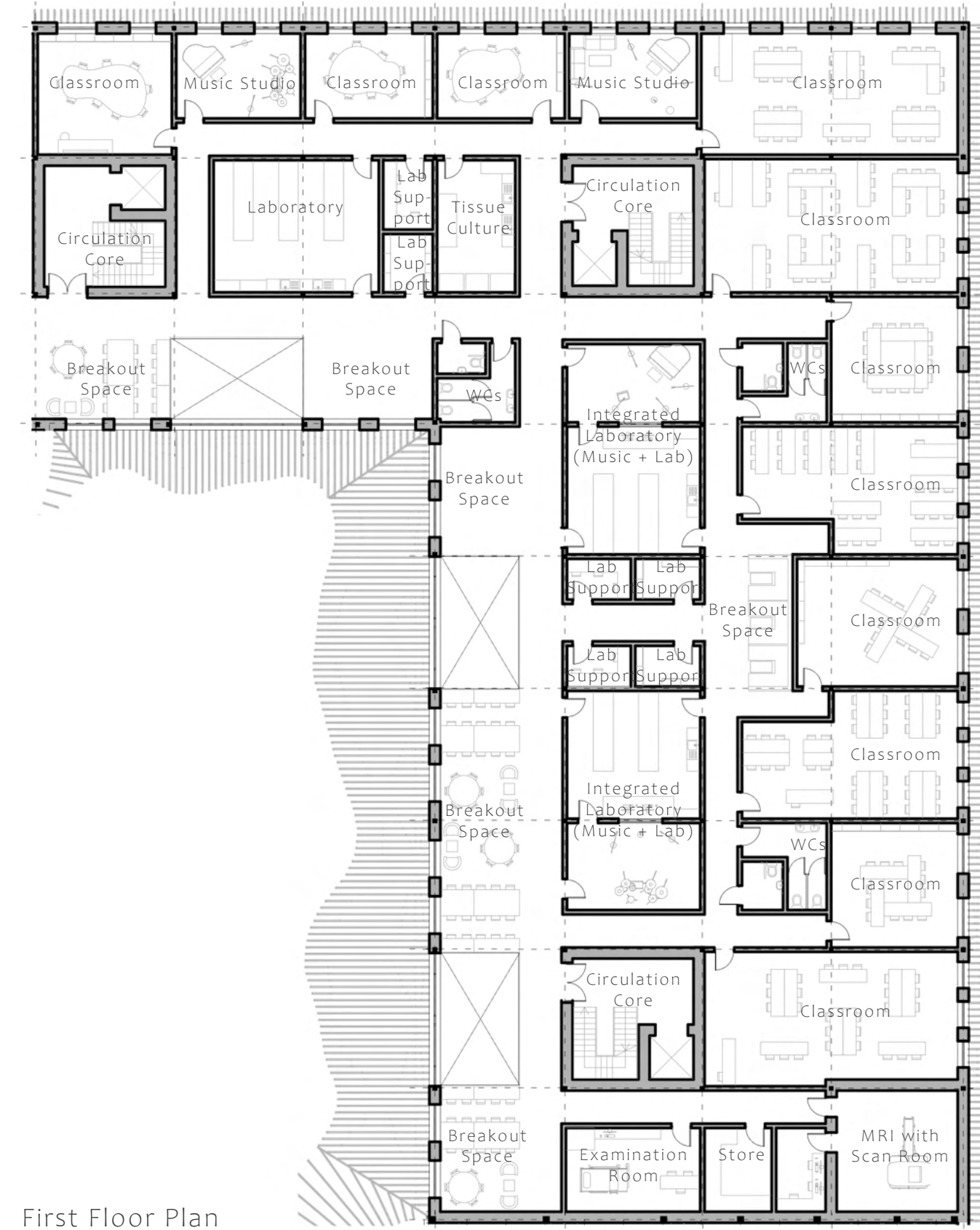
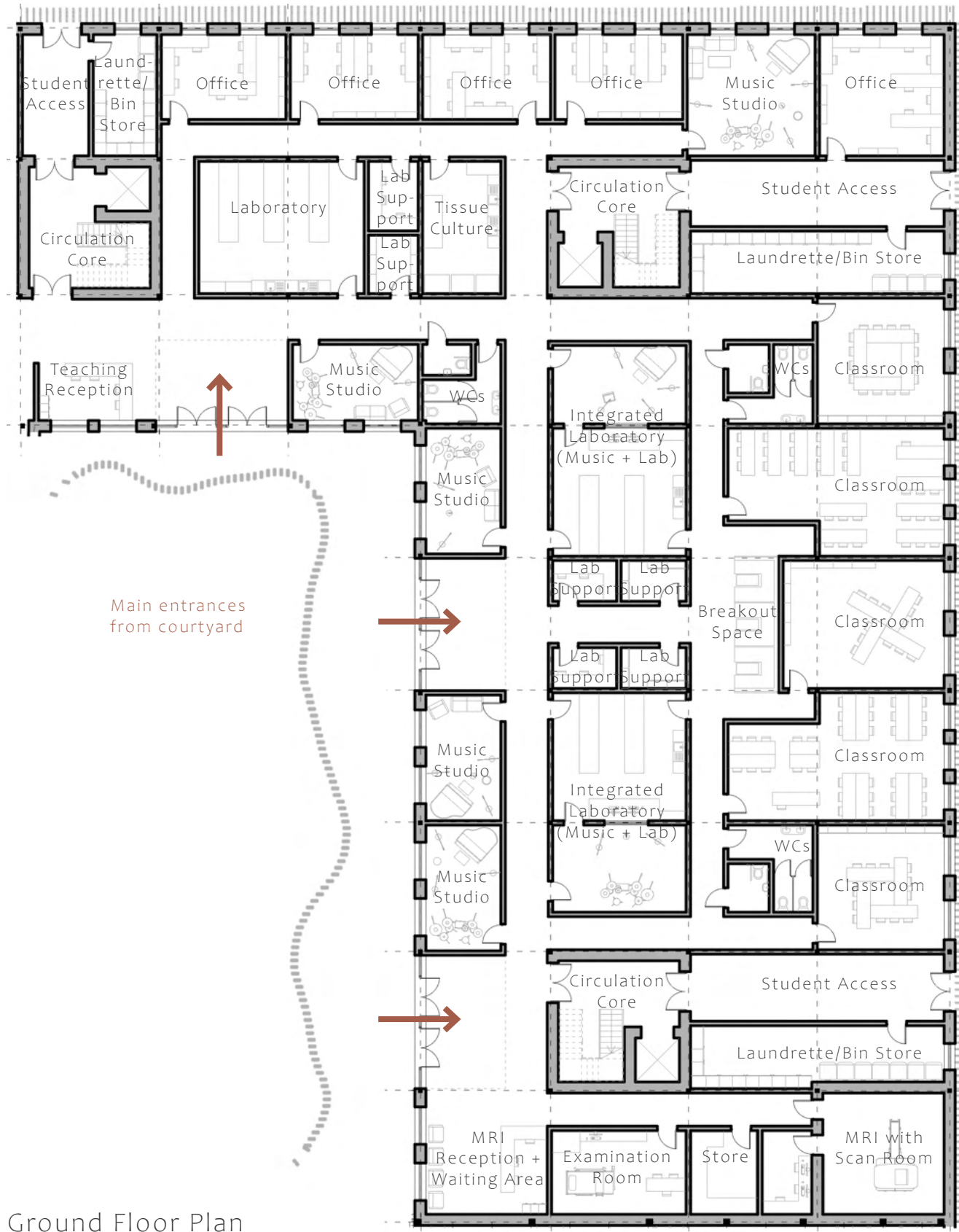
Integration of subjects



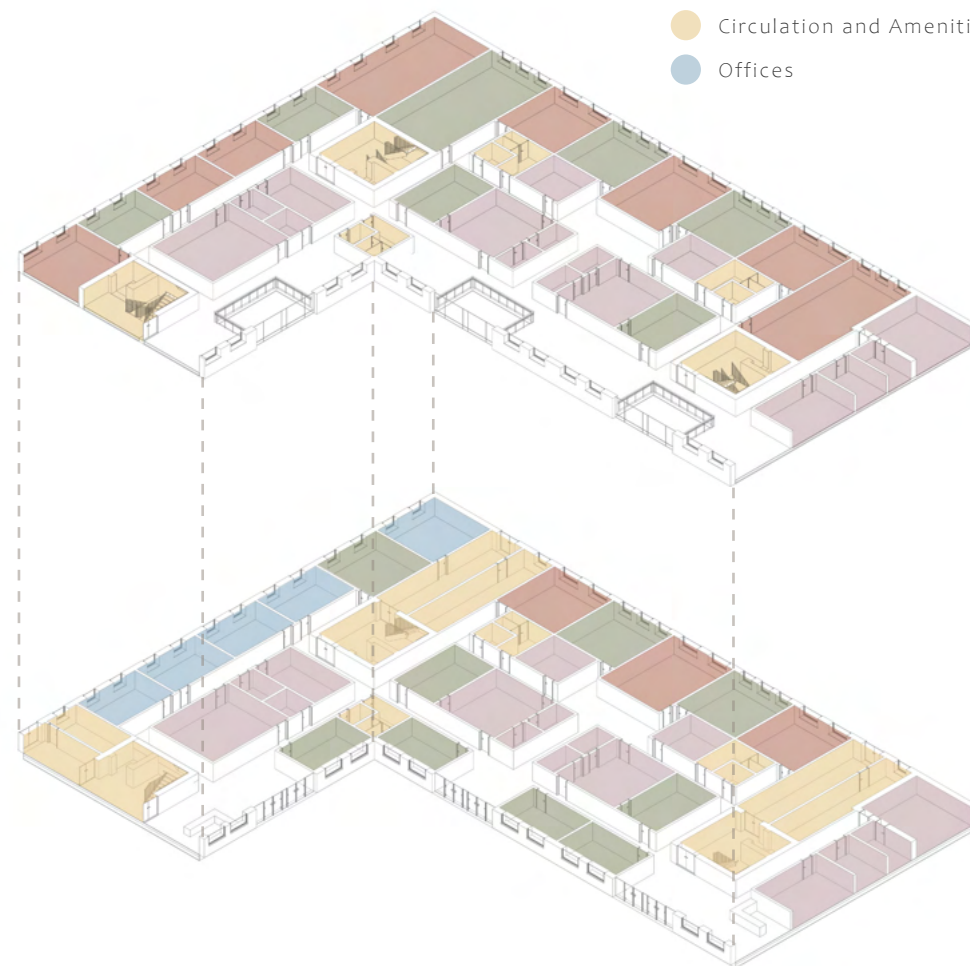
Breakout spaces



Connection to courtyard



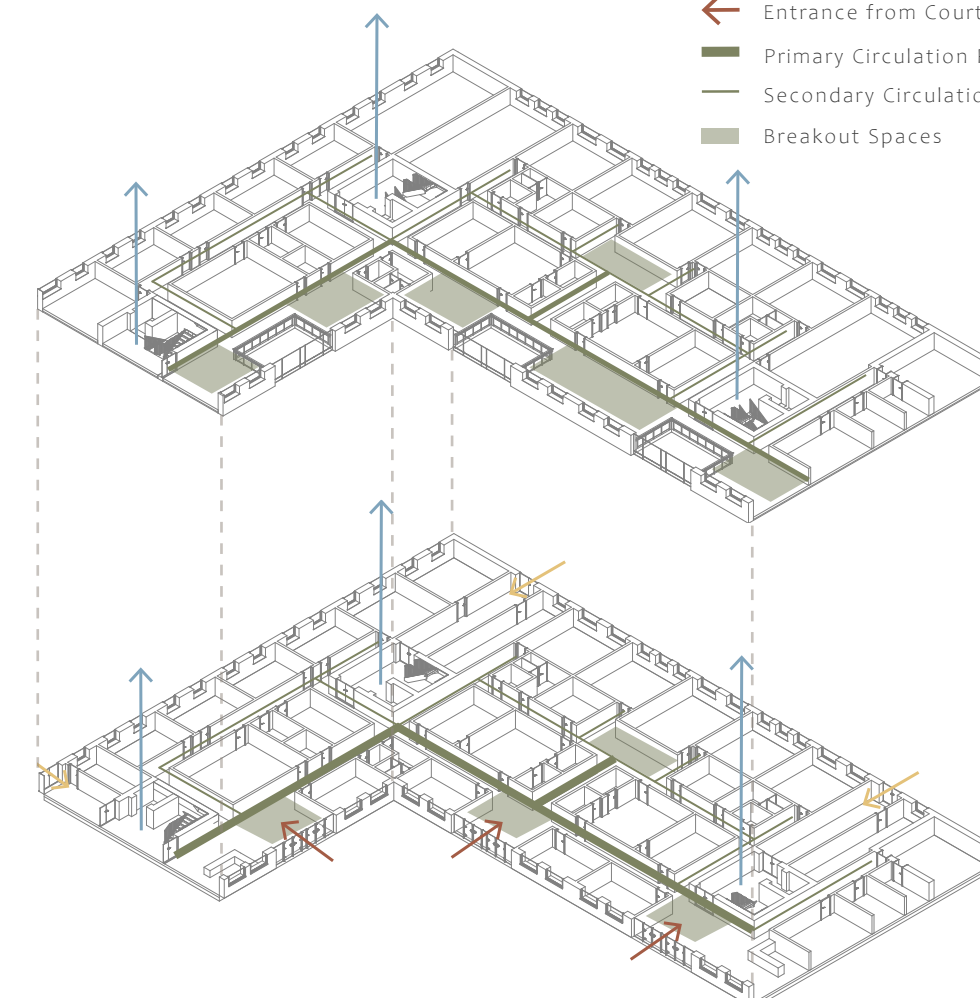
- Neuroscience Labs and Specialist Rooms
- Music Practice and Studios
- Seminar, Lecture and Classrooms
- Circulation and Amenities
- Offices



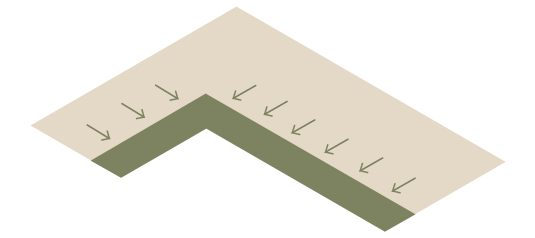
Zoning

Developing on the key intent of interdisciplinary collaboration, the teaching spaces are integrated throughout the building, prioritising connection and dynamic learning. Daylighting, ventilation and access then informed the arrangement of the teaching programme.

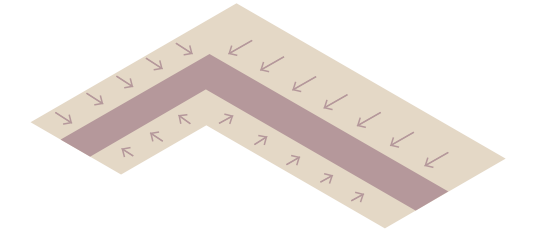
- ↔ Access to Student Accommodation
- ↕ Vertical Access
- ↔ Entrance from Courtyard
- Primary Circulation Routes
- Secondary Circulation Routes
- Breakout Spaces



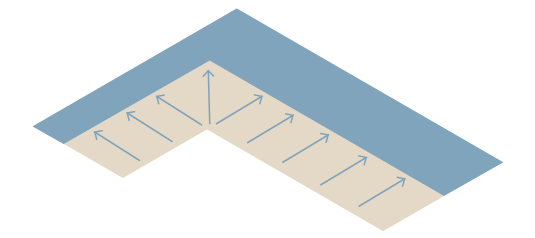
Organisation Strategy



1. Music and Breakout to the South-facing courtyard facades



2. Laboratories and Amenities to centre for controlled conditions

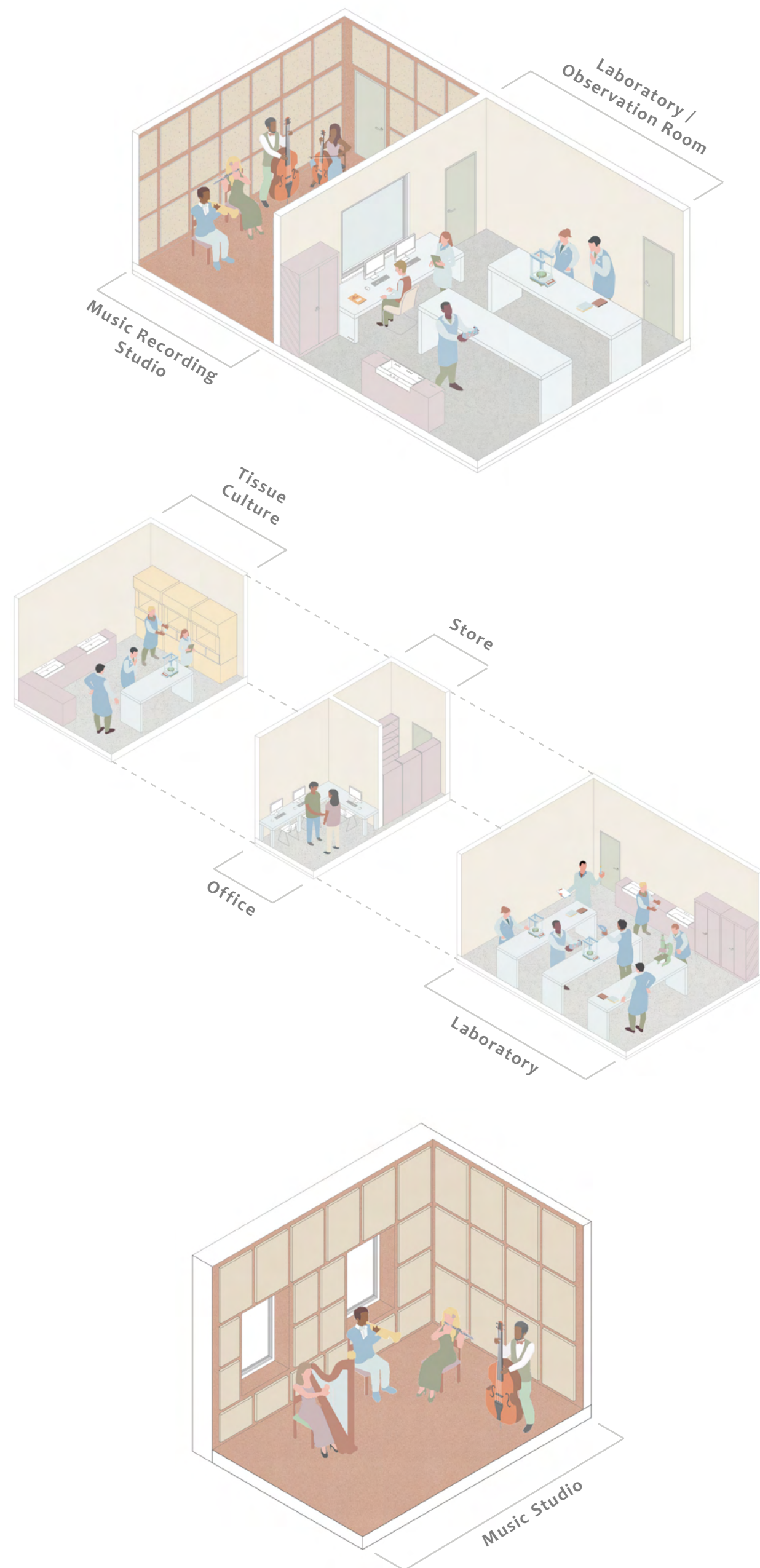


3. Music, Offices and Teaching to North for diffuse light

Movement

Arranged around a 6x6 structural grid, each space is framed by a series of corridors, following a hierarchy of use and interaction. Emphasis is given to the direct link to the courtyard, from which the cores provide vertical access to the first and student floors. Breakout spaces throughout provide opportunity for informal interaction.

Teaching Room Typologies



Integrated Laboratory

In response to our holistic approach to the brief, this space manifests the fundamental principle of combining Neuroscience and Music. The intent is to create an environment in which both disciplines can actively contribute to the research and practice of the other. The music space can act as both recording studio and treatment space, while the lab can record and interpret data directly drawn from the adjacent room.

Laboratory and Lab Support

In addition to the above integrated labs, the design includes two large lab spaces dedicated to neuroscience. This is driven by a collaborative lab approach, in which students can work together and alongside one another to maximise innovation. Lab support spaces have been provided adjacent to the labs, including offices, stores and tissue culture rooms.

Music Studio

Amongst the general teaching spaces, music studios of various sizes are situated throughout the plan. These rooms provide accommodation for music workshops, practice and theory-based learning, as part of the wider music provision of the scheme. Acoustic panels are incorporated into the finishes of each room, as well as necessary acoustic improvements to the building fabric.

Teaching Internal Perspective

PROGRAMME PRECEDENTS

Caltech Chen Neuroscience Centre

As a specialist neuroscience centre, this building provided insight for the required spaces in this typology, such as tissue culture rooms and large, collaborative laboratories. Additionally, the arrangement of spaces was a key factor in our own design decisions, such as moving the lab spaces to the centre of the plan and lab proximity to breakout spaces.



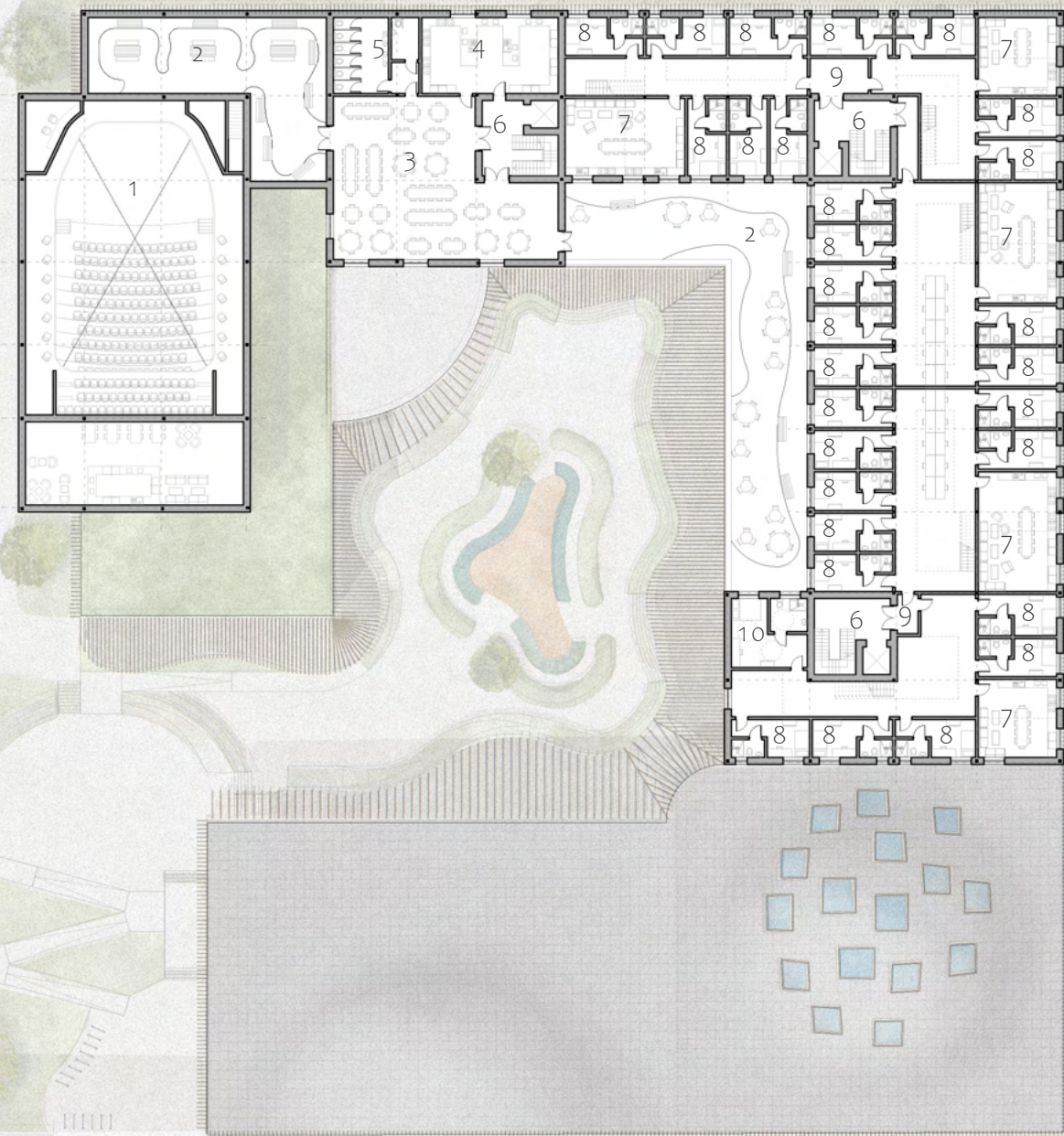
University of Warwick Faculty of Arts

Designed by Feilden Clegg Bradley as a centre for various art subjects, including music, this provided a reference for the scale, arrangement and requirements of each room, such as studios and practice spaces. The scheme also features dynamic circulation, where students have space for breakout and informal interaction. This has been carried into our design at various points.



Proposed Second Floor Plan

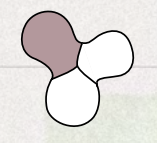
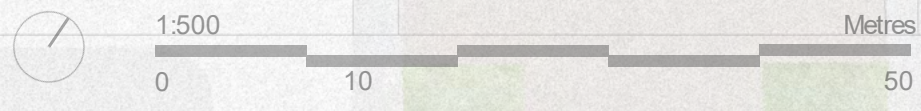
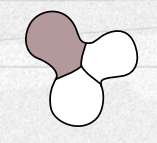
Proposed Third Floor Plan



- 1 Auditorium
- 2 Roof Terrace
- 3 Dining Hall
- 4 Kitchen
- 5 WCs
- 6 Circulation Cores
- 7 Kitchen/Lounge
- 8 Student Bedroom
- 9 Flat Lobby
- 10 Accessible Bedroom



- 1 Common Room
- 2 Circulation Cores
- 3 Practice Rooms
- 4 Student Bedroom
- 5 Flat Lobby
- 6 Accessible Bedroom



Proposed Third Floor Plan

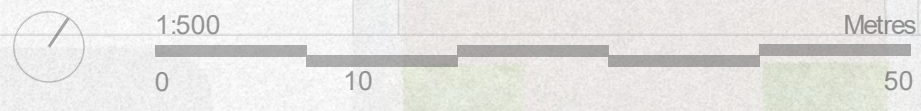
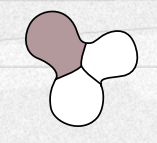
Proposed Fourth Floor Plan



- 1 Circulation Cores
- 2 Kitchen
- 3 Student Bedroom
- 4 Flat Lobby
- 5 Accessible Bedroom
- 6 Lightwell



- 1 Circulation Cores
- 2 Practice Room
- 3 Student Bedroom
- 4 Flat Lobby
- 5 Accessible Bedroom
- 6 Lightwell



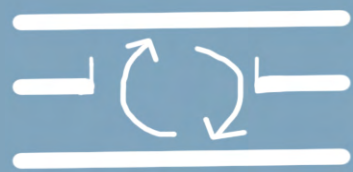
Student Living



Vertical separation



Optimising light provision



Internal vertical circulation



Integrated music

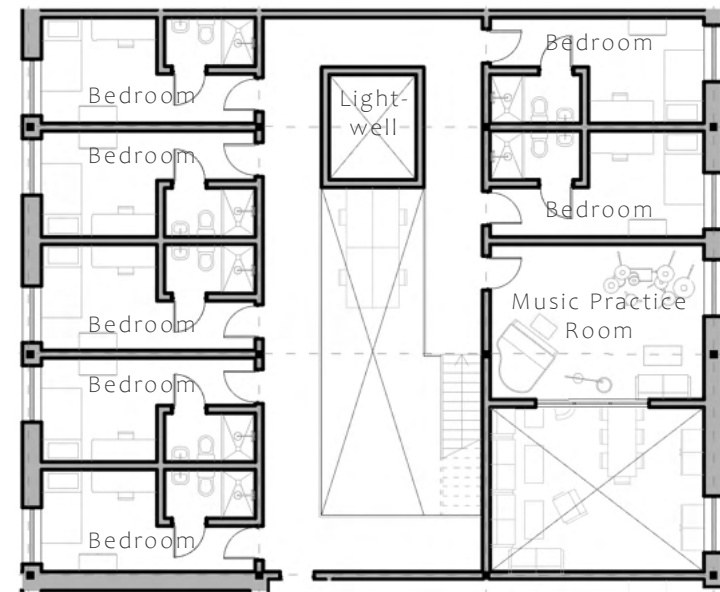


Community

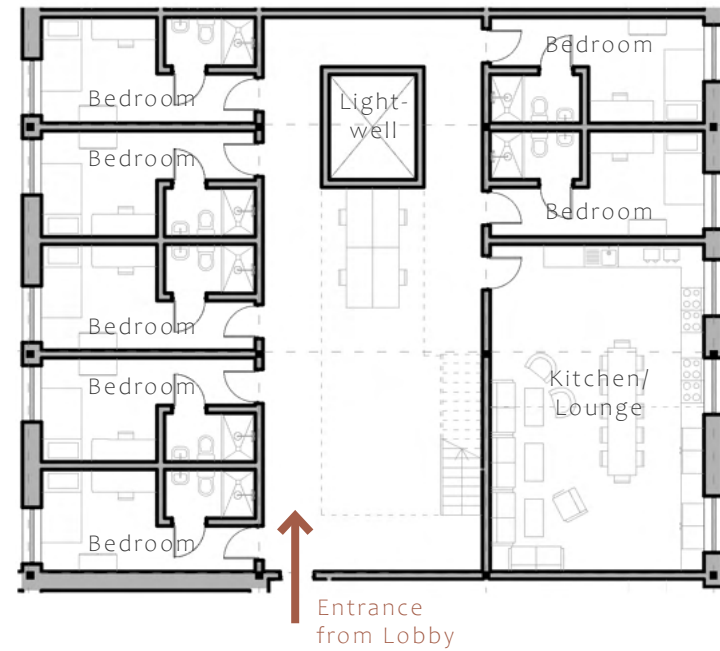


Example Two Storey Flat

FF of Flat

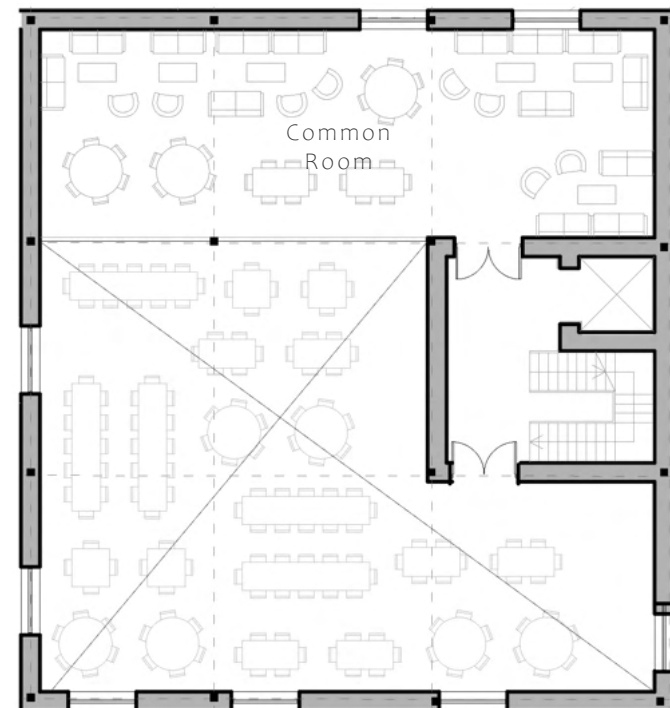


GF of Flat



Student Dining

FF of Dining



GF of Dining

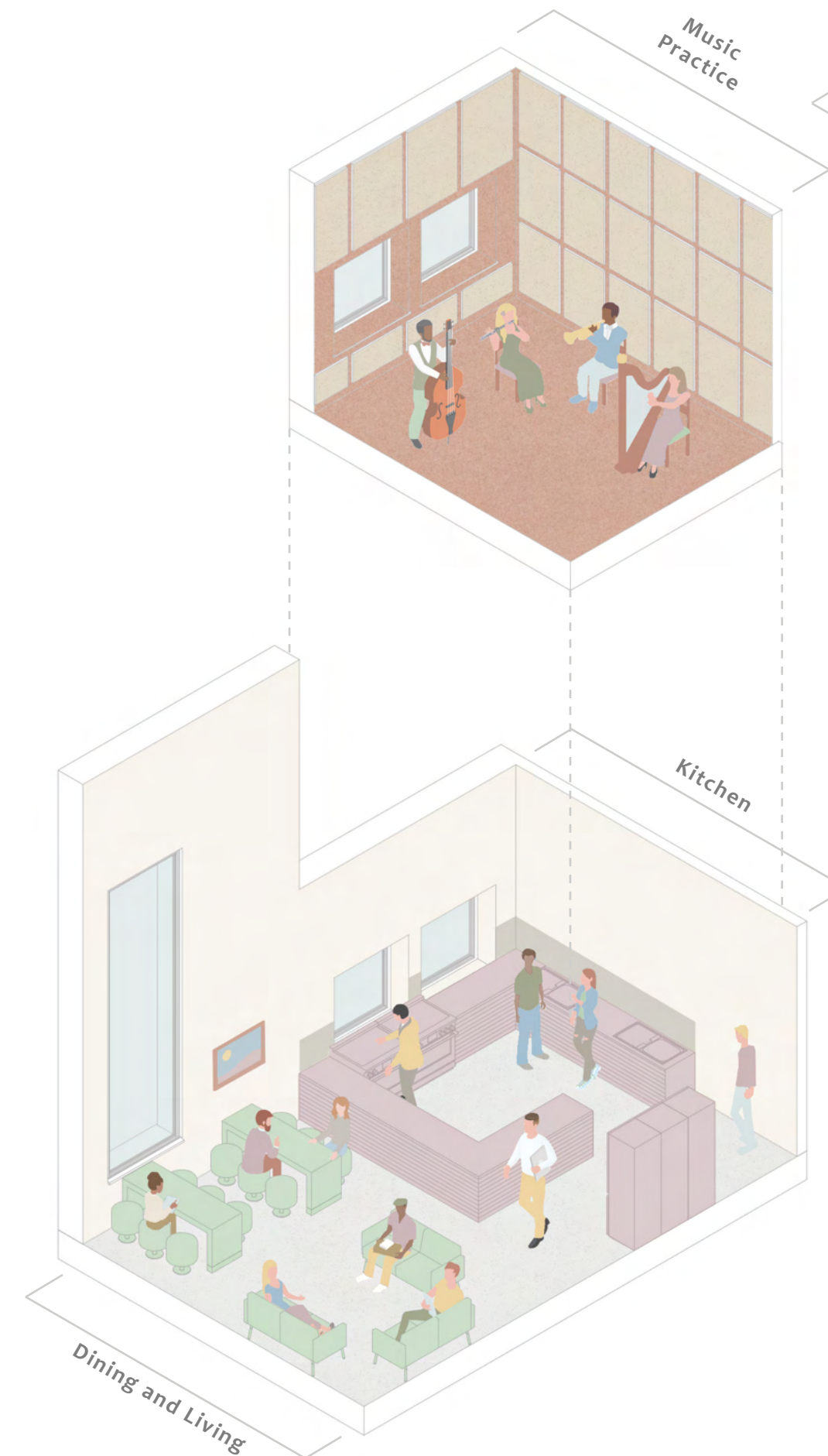
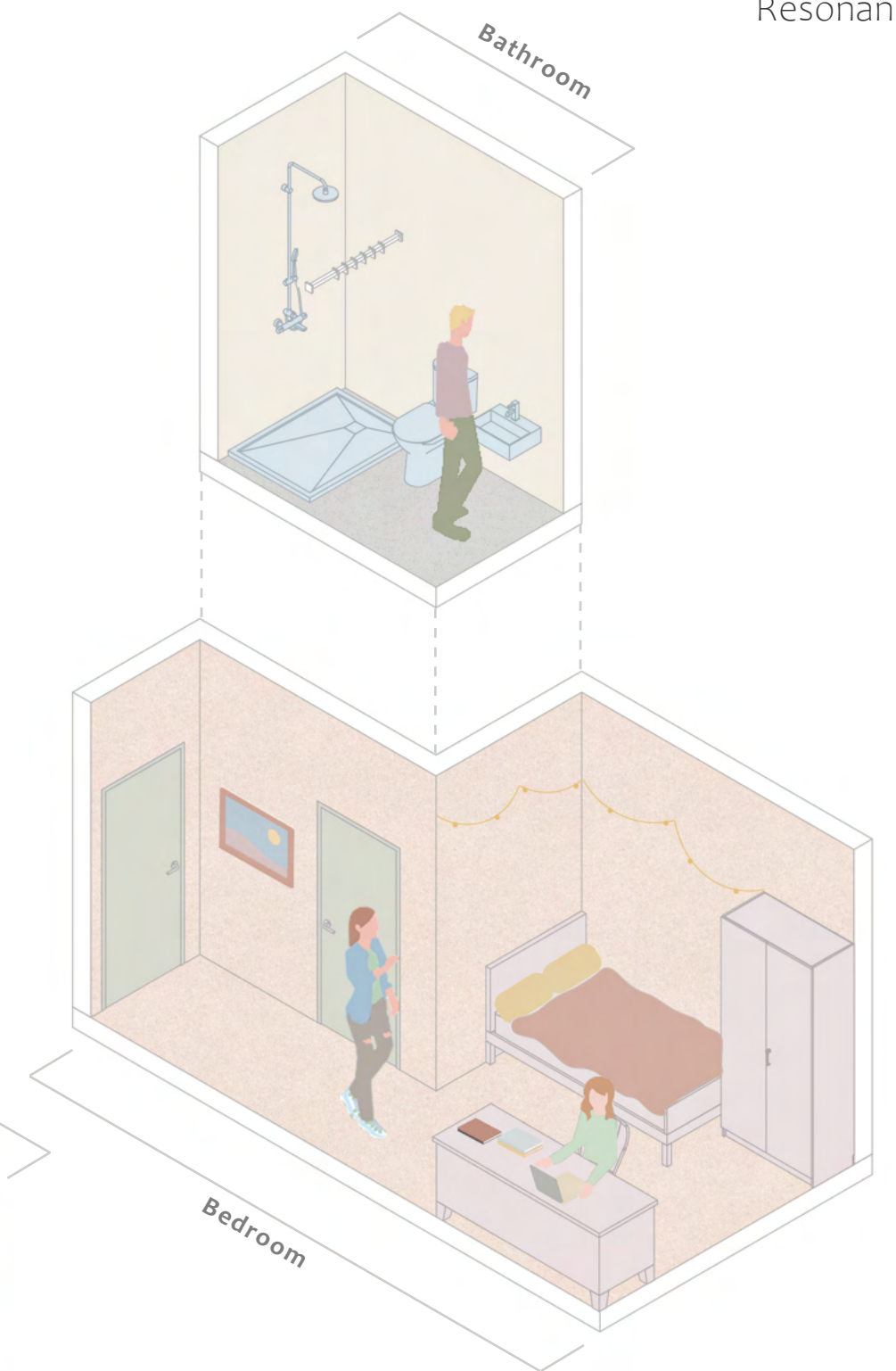


Student Living Room Typologies

Ensuite Room

The 3 x 6m rooms provide all the basic amenities a student needs, including a bed, desk and storage. The stacked ensuites allow for efficient servicing of the building. With plywood finishes and timber oak floors there is a homely feeling to the rooms, and the natural light supplied to each ensures they have pleasant living conditions.

There are 4 accessible bedrooms, following a similar layout. These are integrated into the flats, and the cores ensure that all the 2-storey flats are fully accessible.



Kitchen Diner and Music Practice

The double height space is celebrated with a large window, providing light to the dining breakout space. The layout encourages collaboration, with a music practice space overlooking the kitchen, acoustically separated through panels.

The spacious kitchens provide plenty of facilities for the large flat sizes, with two of each equipment (ovens, sinks and fridges).



Student Living Perspectives



Gazing across the communal space of the student flat

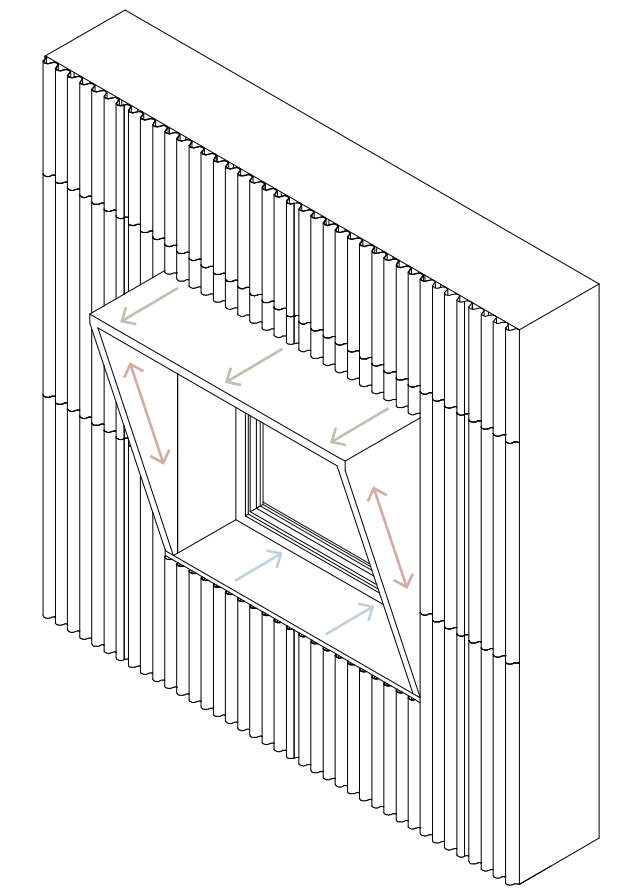


Returning into the dining hall from the external seating terrace



Student Living External Terrace

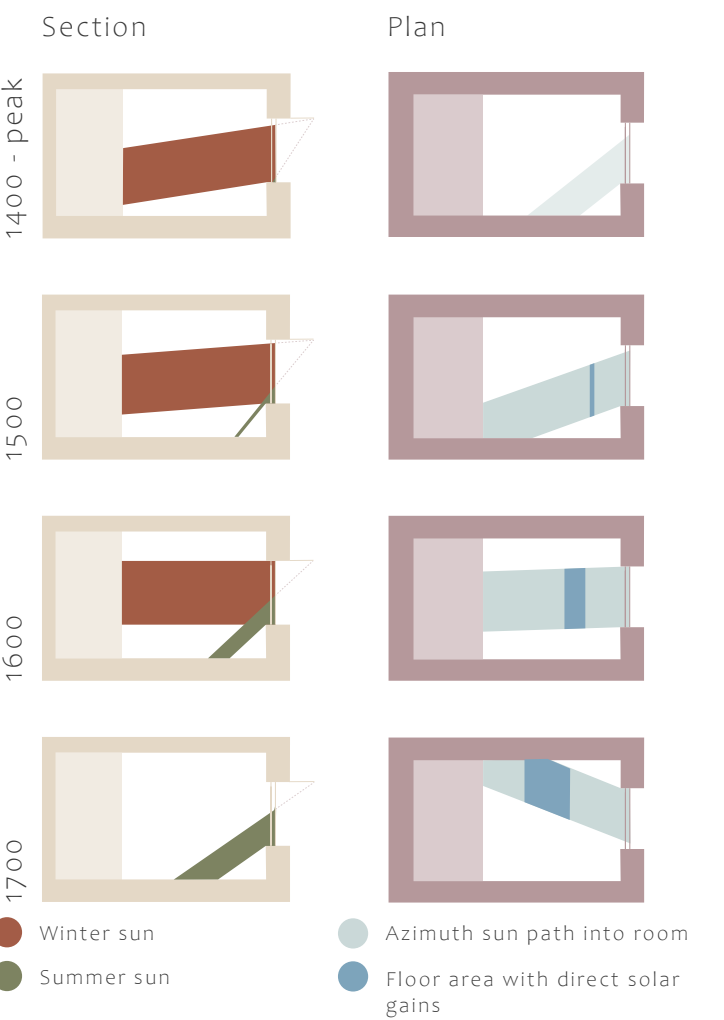
Student Living Solar Shading Strategy



Brise Soleil

For the South-East and South-West student facades, timber brise soleil will be used to minimise direct solar gains during the summer and maximise during the winter. After analysing the solar altitudes and azimuths of the site, the design was formulated to provide shading primarily from a top panel, which extends 500mm from the external face, in addition to a 300mm recessed window position. Angled fins extend either side of the top panel, providing additional solar shading to the South, privacy from other student rooms and structural stability for the brise soleil.

Solar Gains Analysis



Student Living and Teaching Structural Strategy

Vertical Separation

As a reflection of the conceptual divide between the teaching and student programme and their respective requirements, the structure is vertically separated by material - steel at Ground and First Floor, timber between Second and Fifth Floor.

Core Stability

RC Cores act as stability for the two framed structures, extending from Ground Floor to Fifth Floor. These support the lateral forces of the structure (with the CLT floor diaphragm) as an alternative to braced bays.

6 x 6 Grid

To optimise material use and capacity, a 6 x 6m grid has been implemented across both the steel and timber frames.

Load Take-down

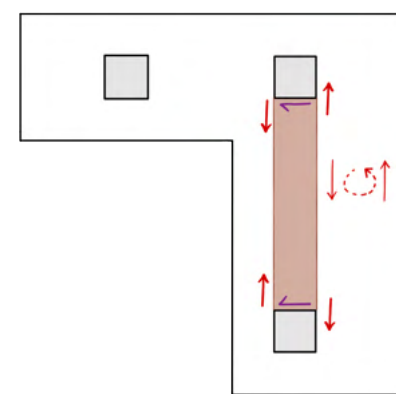
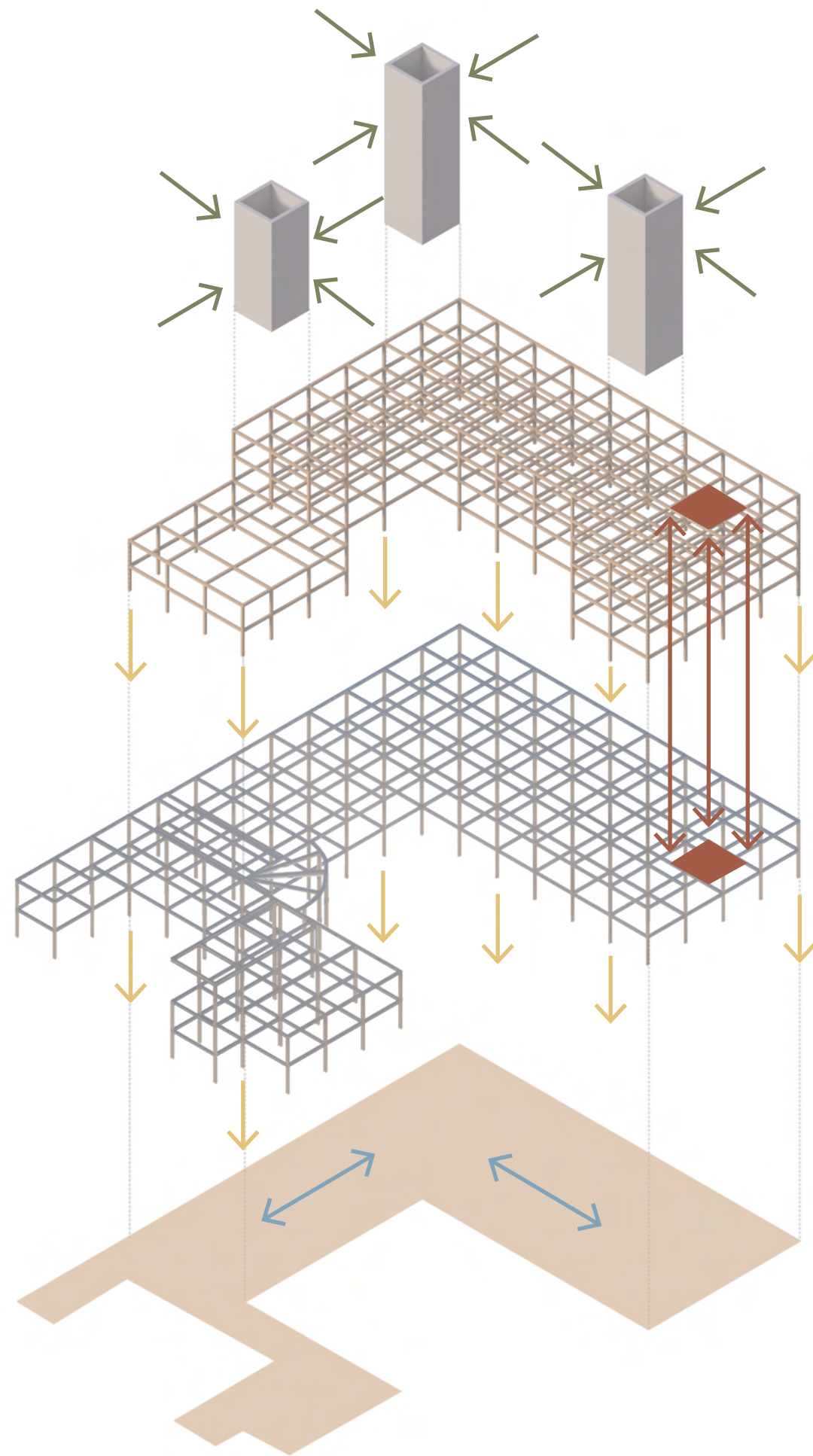
By stacking the grid layout across the structure, load paths extend directly from the Fifth to Ground Floor, where they reach pile foundations.

CLT Floors as Diaphragm

In order to transfer loads into the vertical stability system, the CLT floors have been modelled as a deep beam fixed between the RC cores. The moment induced is taken out by the push - pull force on the cores. (Fig X)

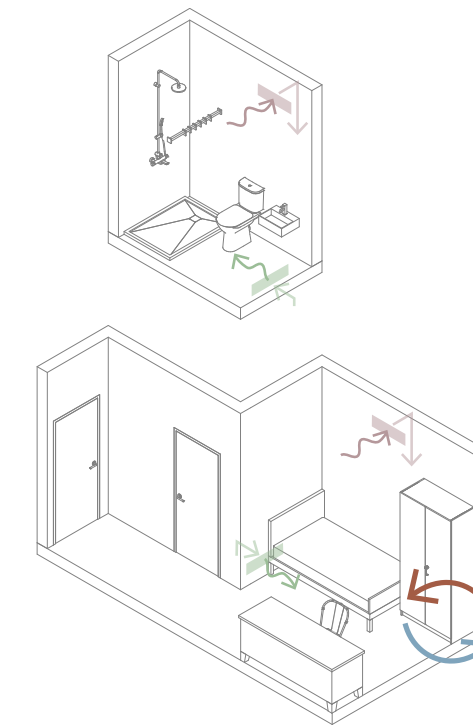
Demountable for Future Use

Looking to the future of the site, standardised element sizes and bolted junctions have been used to maximise adaptability of the structure. The timber structure, in particular, can be adapted for teaching use as the student population inevitably rises, allowing student accommodation to be expanded elsewhere.



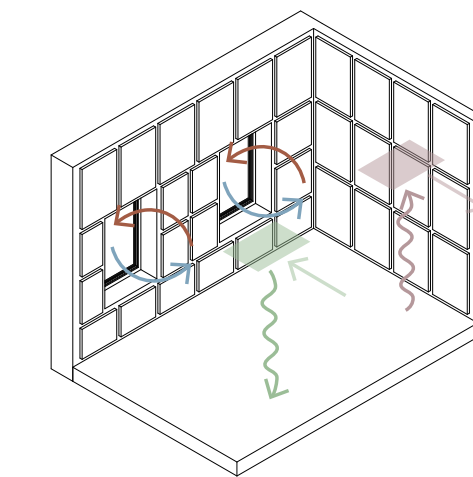
Floor diaphragm to RC core load transfer (R Shah)

Student Living and Teaching Ventilation Strategy



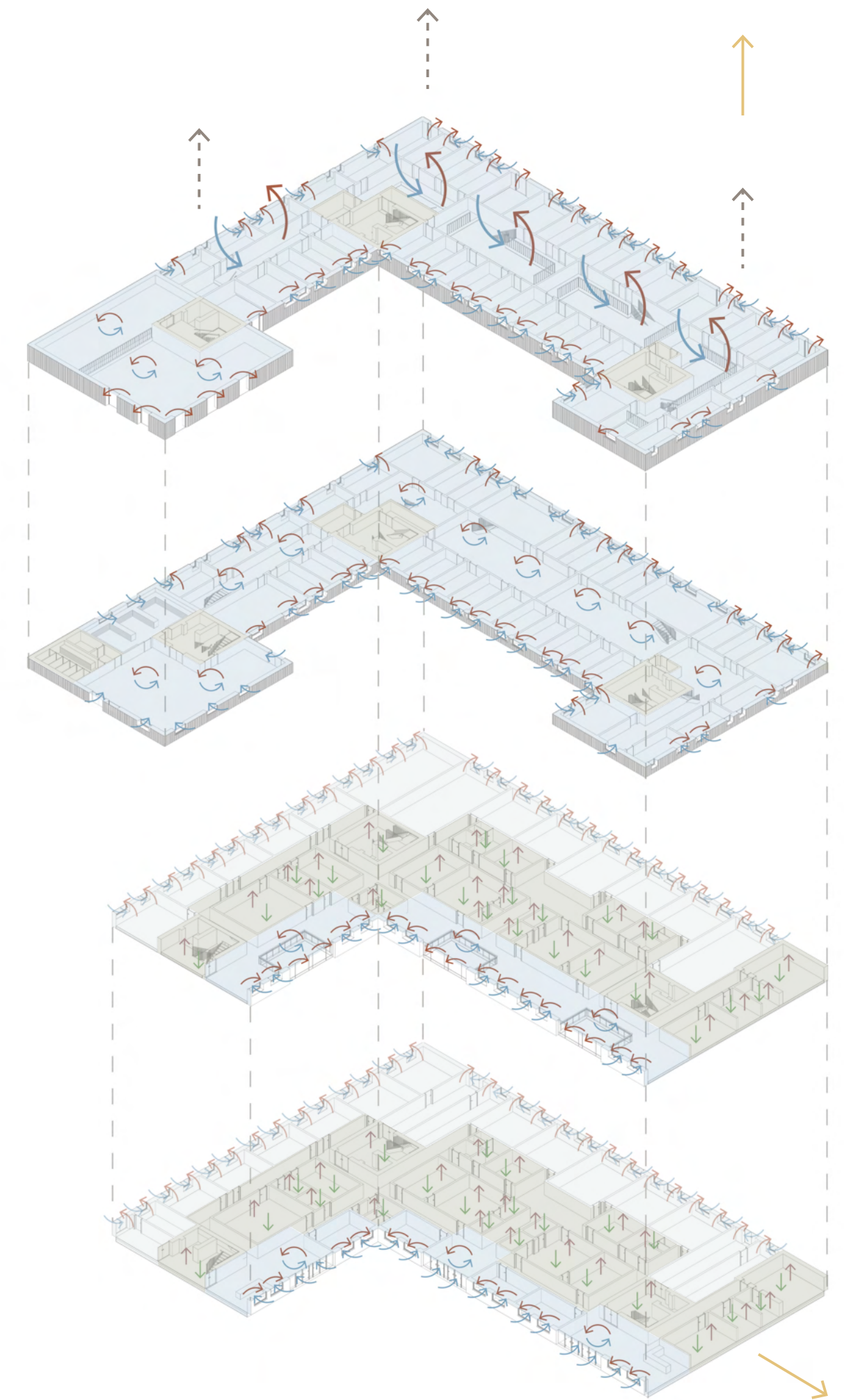
Student Bedrooms

Mixed Mode: When external conditions are suitable, natural ventilation will occur via the single-aspect windows in each room. Mechanical ventilation will occur when this is not appropriate, via supply and extract ducts extended from the suspended floor system.



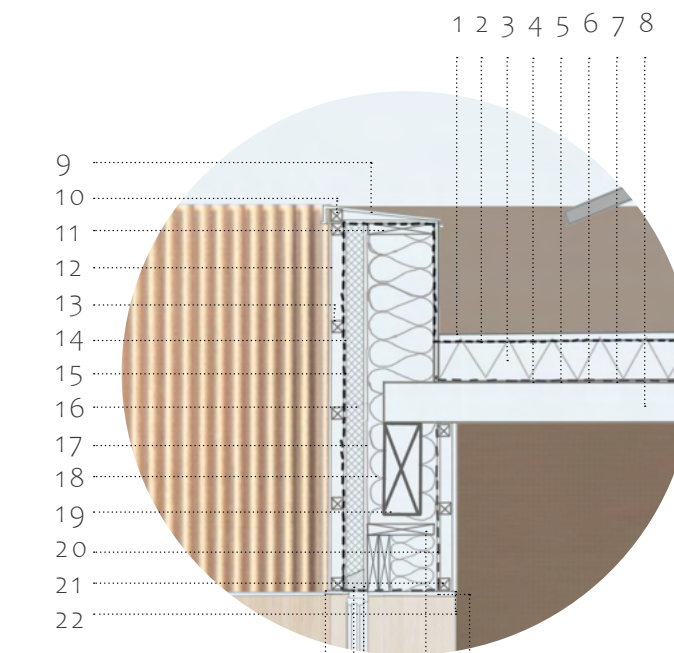
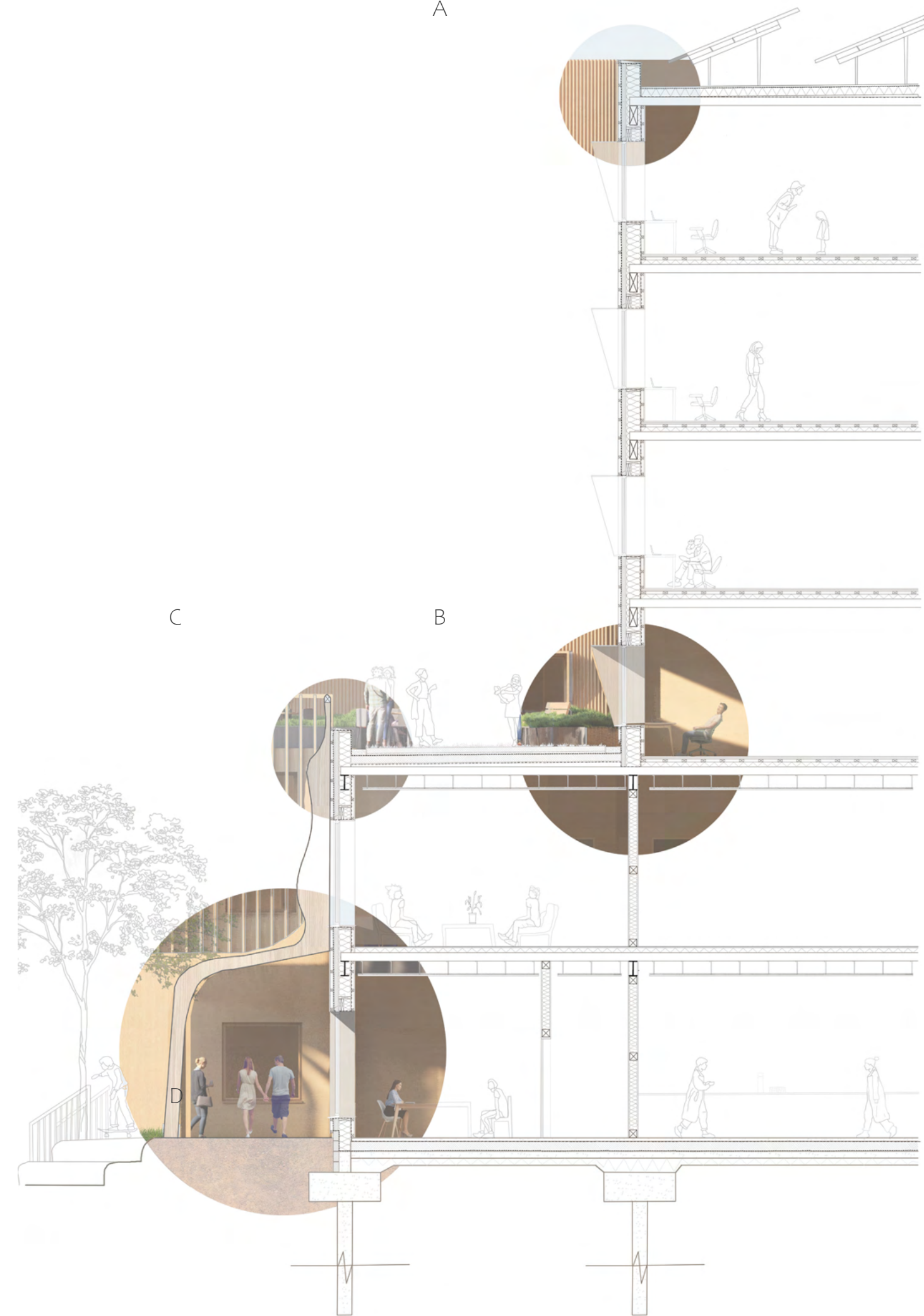
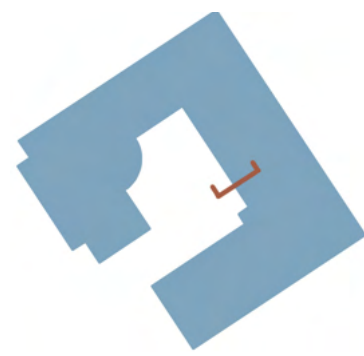
Teaching Rooms

Mixed Mode: Similarly, natural ventilation will occur when possible, although due to noise and air pollution to the North, this is likely to be limited. Mechanical ventilation will operate via supply and extract ducts in the suspended ceiling system.



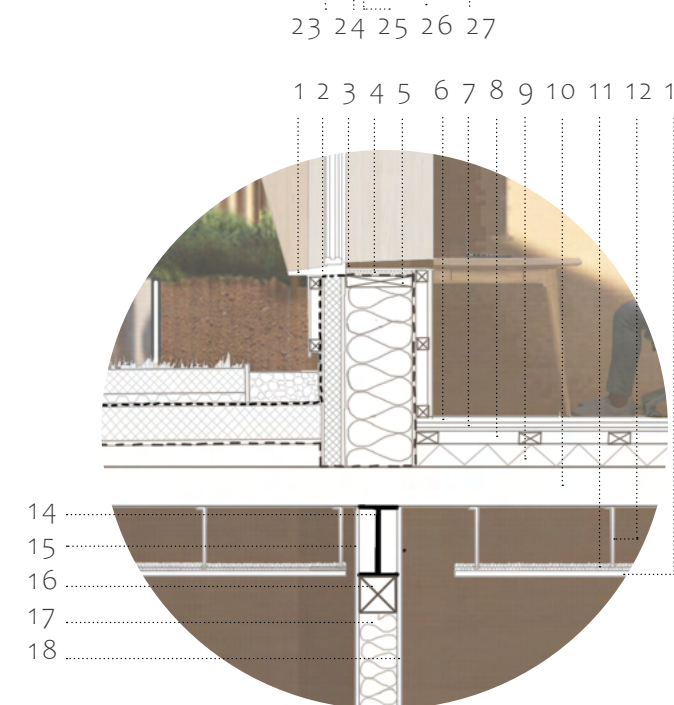
| | | |
|--|--|---|
| <ul style="list-style-type: none"> Natural Ventilation - Warm Air Out Natural Ventilation - Cold Air In Mechanical Ventilation - Warm Air Out Mechanical Ventilation - Cold Air Out Mechanical Ventilation - Extract Duct Mechanical Ventilation - Supply Duct | <ul style="list-style-type: none"> To CO2 Heat Pump and Thermal Store To Fourth and Fifth Floor Student Living Natural Ventilation Mechanical Ventilation Natural Ventilation dependent on external conditions | <ul style="list-style-type: none"> Natural Ventilation Zone Mechanical Ventilation Zone Natural Ventilation Zone dependent on external conditions |
|--|--|---|

Student Living and Teaching Detail Section



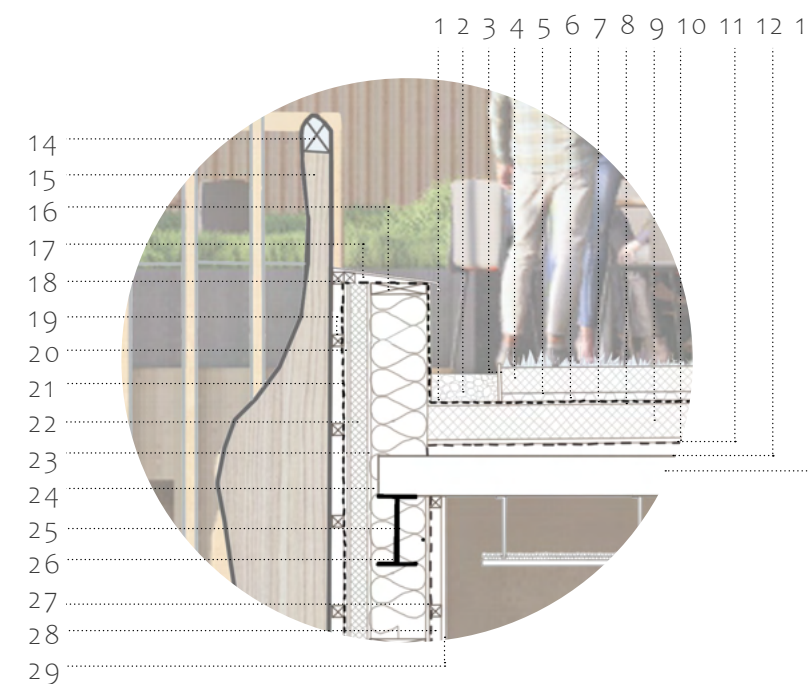
A- Roof Junction

- | | |
|---|---|
| 1 gravel | 15 vapour control layer |
| 2 water proof membrane | 16 75 mm overlaid insulation |
| 3 250mm rigid insulation | 17 18mm OSB sheathing |
| 4 vapour barrier | 18 250 mm hemp insulation between timber frame |
| 5 25mm plywood deck | 19 160x405 glulam beam |
| 6 50mm furring | 20 18mm OSB sheathing |
| 7 vapour control layer | 21 50 x 50mm timber service battens |
| 8 180 mm CLT | 22 20mm plywood wall panels |
| 9 parapet metal flashing | 23 steel lintel with breather membrane wrapped over |
| 10 tapered rigid insulation | 24 retaining clip |
| 11 timber blocking | 25 insulated cavity barrier |
| 12 hemp cladding | 26 edge timbers |
| 13 horizontal timber battens at 600mm centres | 28 20mm oak board into reveal |
| 14 vertical timber counter battens | |



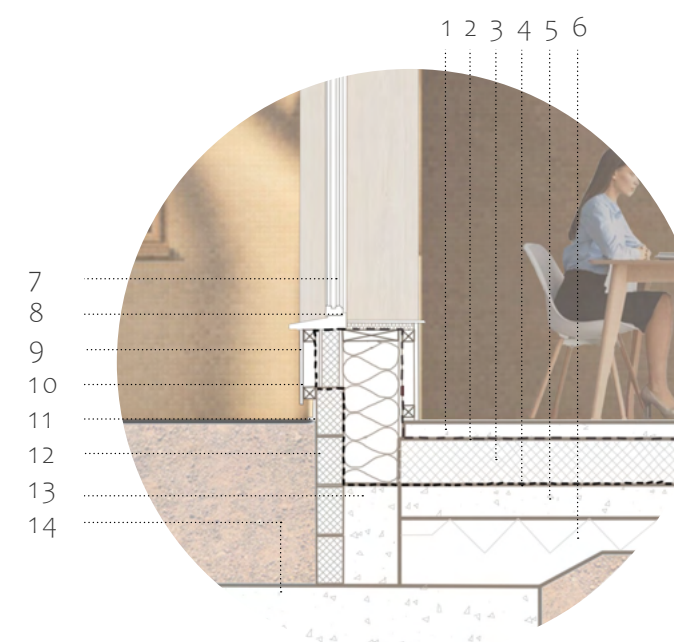
B- Garden Roof to Intermediate Floor Junction

- | | |
|--|---|
| 1 aluminium sill | 14 254x254 mm I beam |
| 2 damp proof course lapped under sill board | 15 20mm plywood wall panels |
| 3 25mm timber sill board | 16 100 mm Timber nogging 50x50 mm at 600 mm centers |
| 4 rigid insulation under sill board | 17 hemp insulation |
| 5 edge timber | 18 20mm plywood wall panels |
| 6 20mm oak board flooring | |
| 7 25mm plywood deck | |
| 8 50 x 100mm timber service battens at 400mm centers | |
| 9 75 mm rigid insulation | |
| 10 180 mm CLT | |
| 11 20 mm acoustic insulation | |
| 12 resilient clip with servicing space | |
| 13 20 mm oak panel ceiling | |



C- Garden Roof Junction

- | | |
|---------------------------------------|--|
| 1 cant strip | 16 parapet metal flashing |
| 2 300 mm wide gravel edge channel | 17 tapered rigid insulation |
| 3 metal flashing | 18 timber blocking |
| 4 108mm sedum and earth filter fleece | 19 horizontal timber battens at 600mm centres |
| 5 40mm reservoir board protection mat | 20 vertical timber counter battens |
| 6 water proof membrane | 21 vapour control layer |
| 7 250mm rigid insulation | 22 75 mm overlaid insulation |
| 8 vapour barrier | 23 18mm OSB sheathing |
| 9 25mm plywood deck | 24 250 mm hemp insulation between timber frame |
| 10 50mm furring | 25 254x254 mm I beam |
| 11 180 mm CLT | 26 18mm OSB sheathing |
| 12 timber handrail | 27 50 x 50mm timber service battens |
| 13 brimstone timber fin | 29 20mm plywood wall panels |



D- Floor Junction

- | | |
|-------------------------------------|----------------------------------|
| 1 75 mm Screed | 12 215 x 140mm foundation blocks |
| 2 vapour control membrane | 13 concrete up stand |
| 3 275 mm rigid insulation | 14 pile foundations |
| 4 damp proof membrane | |
| 5 150 mm concrete slab | |
| 6 150 mm hardcore | |
| 7 argon filled triple glazed window | |
| 8 oak window frame | |
| 9 lime render | |
| 10 18mm OSB sheathing | |
| 11 metal flashing | |

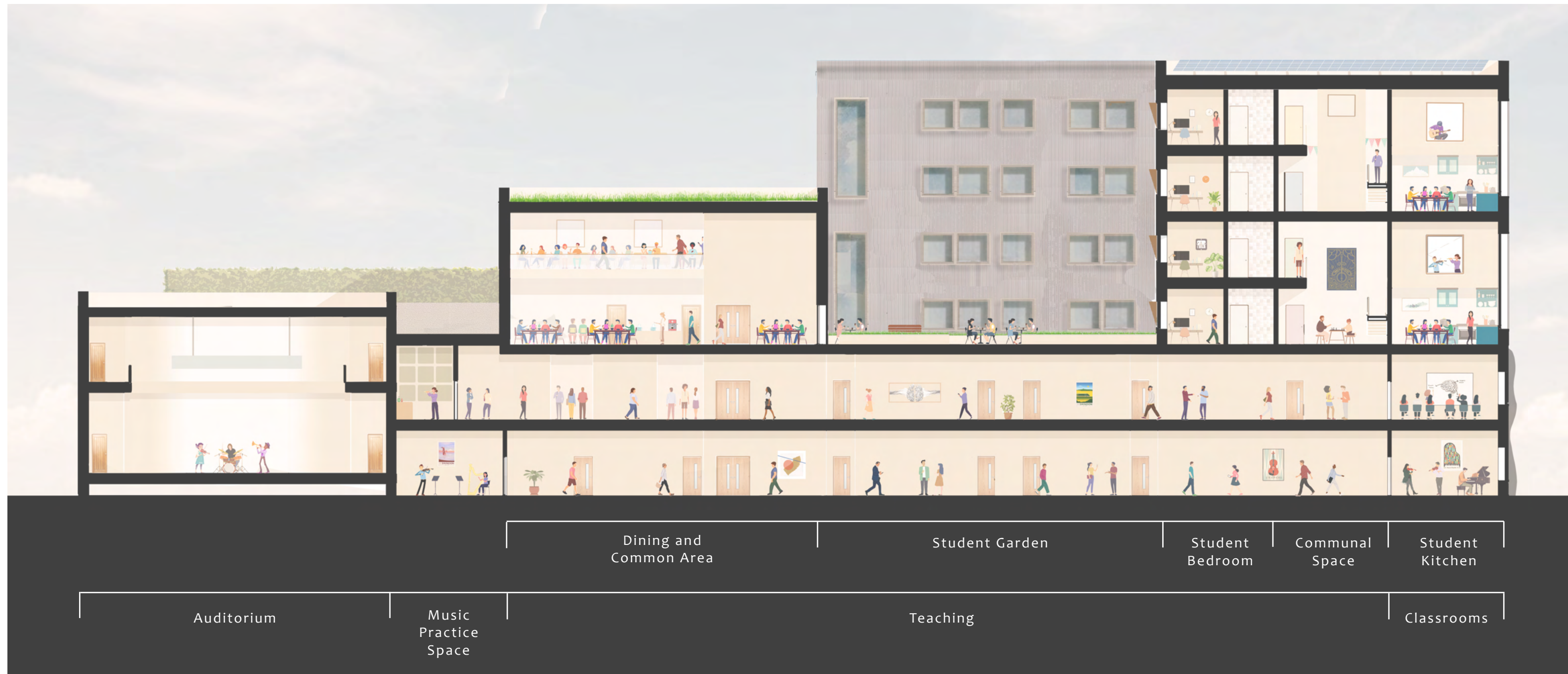
Student Living and Teaching Detail Elevation



Sections



East-West



North-South



Landscaping



Creating a heart



Increasing biodiversity



Organic form



Enhance wellbeing



Encouraging performance

Biodiversity Roof



Sedum acre



Knautia arvensis



Primula veris



Briza media

Ornamental Planting



Achillea 'Terracotta'



Hachonechloa macra



Sesleria autumnalis



Gaura 'Whirling Butterflies'

SUDs



Hakonechloa macra



Primula bulleyana

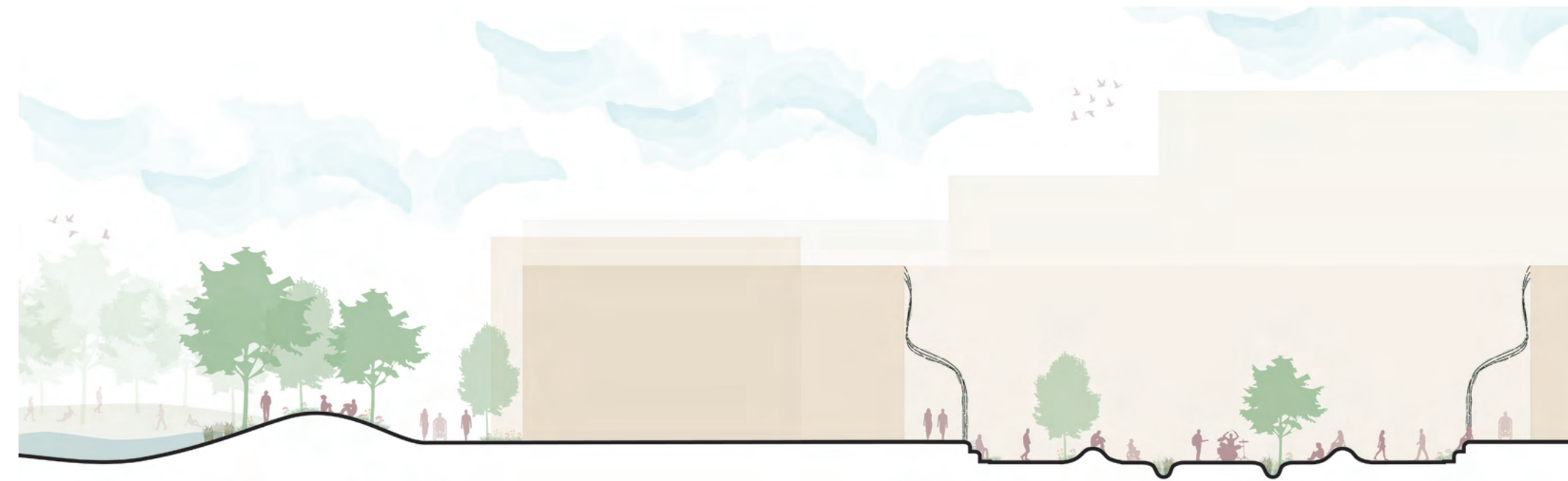


Molinia caerulea 'Moorhexe'



Juncus effusus

Biodiversity



Retention Pond | Man-made Mound | Path | Ornamental Planting | Proposed Building with Biodiversity Roof | Colonnade | Seating and Circulation | SUDs Performance Stage | SUDs | Seating and Circulation | Colonnade



Proposed Building with Biodiversity Roof | Cafe Terrace | Performance Space | Access to Site | Existing Road



Phytoremediation

Phytoremediation



Betula pendula



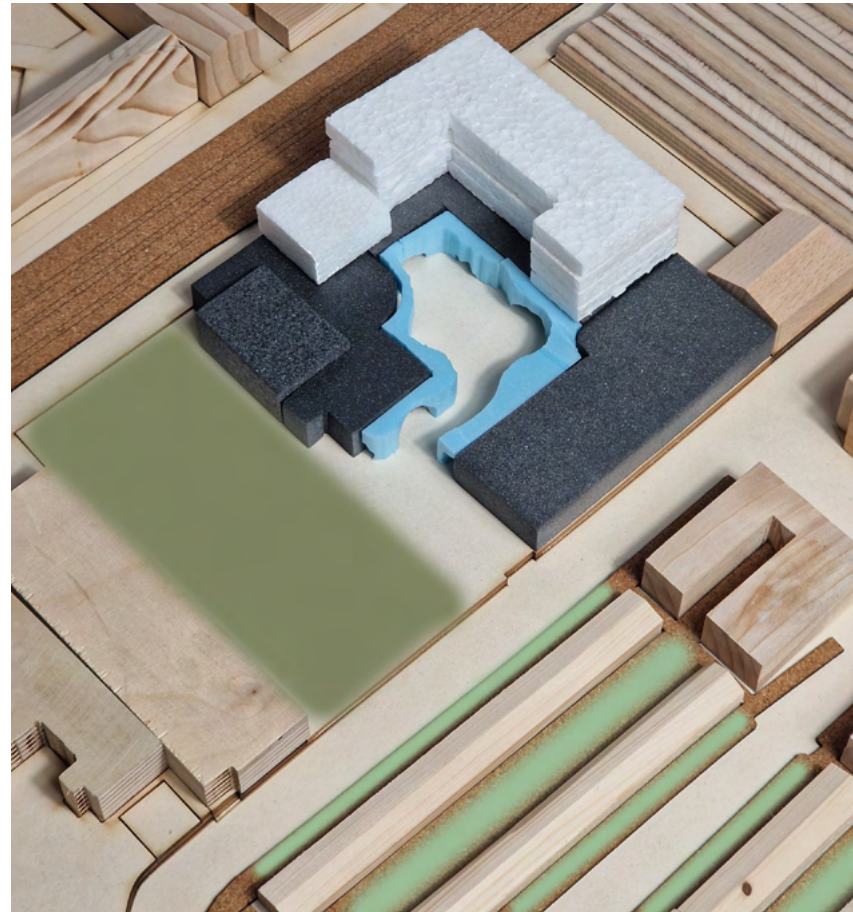
Cynodon dactylon



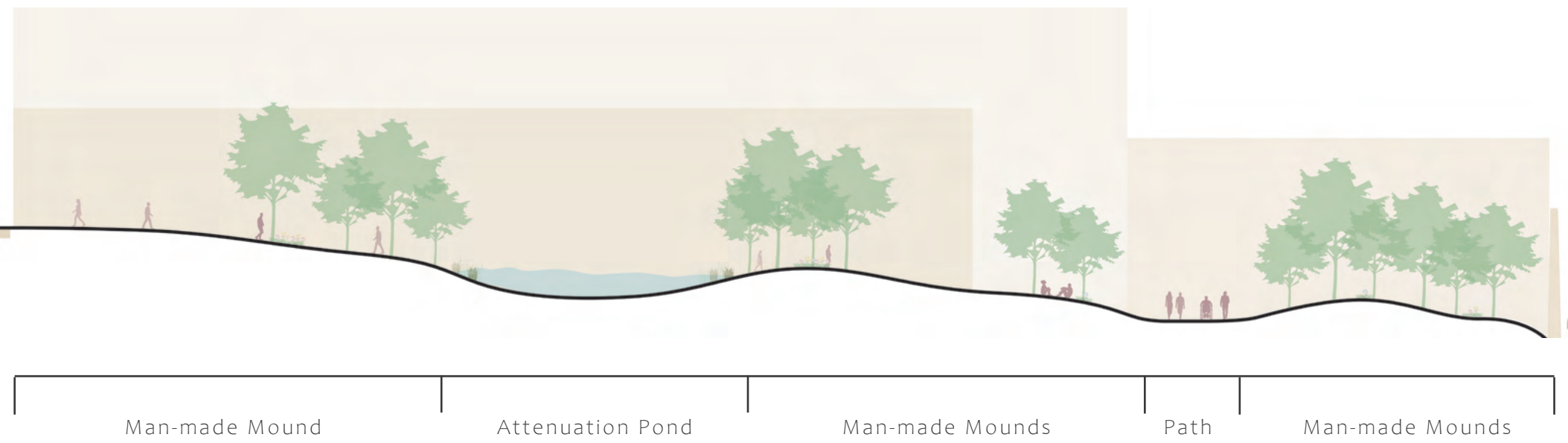
Brassica juncea L.



Helianthus Annuus L.



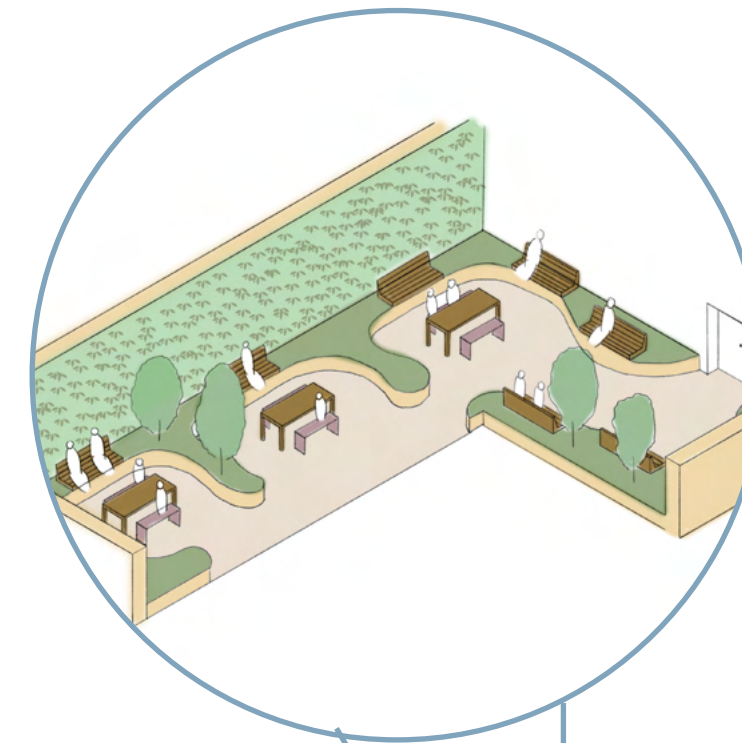
The madeground removed from the site will be repurposed on the adjacent public realm site, to create man-made mounds. The contaminated soil will go through a process of phytoremediation, by planting pioneering trees and vegetation. Community soil recycling will be offered, to replenish the contaminated soil in the surrounding houses front gardens.



Green Spaces

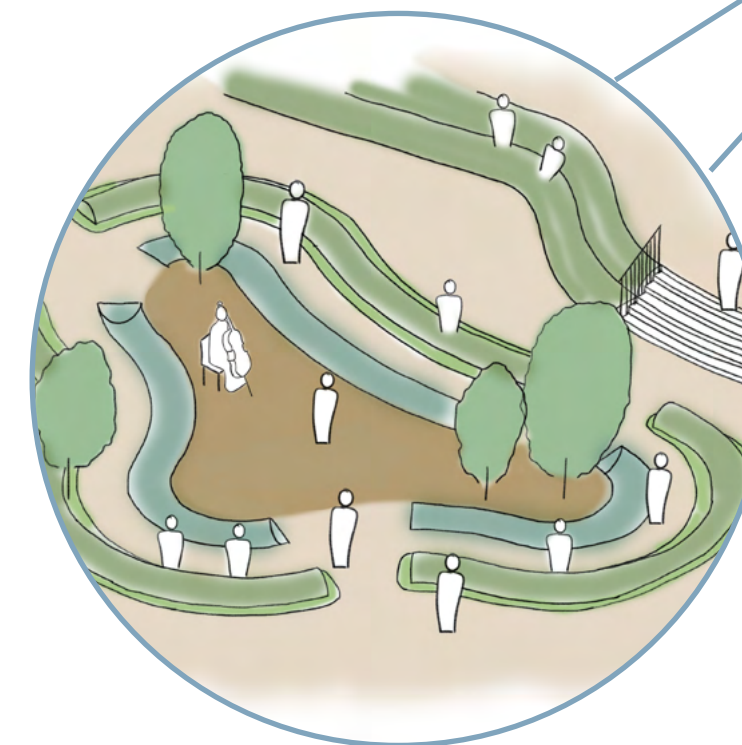
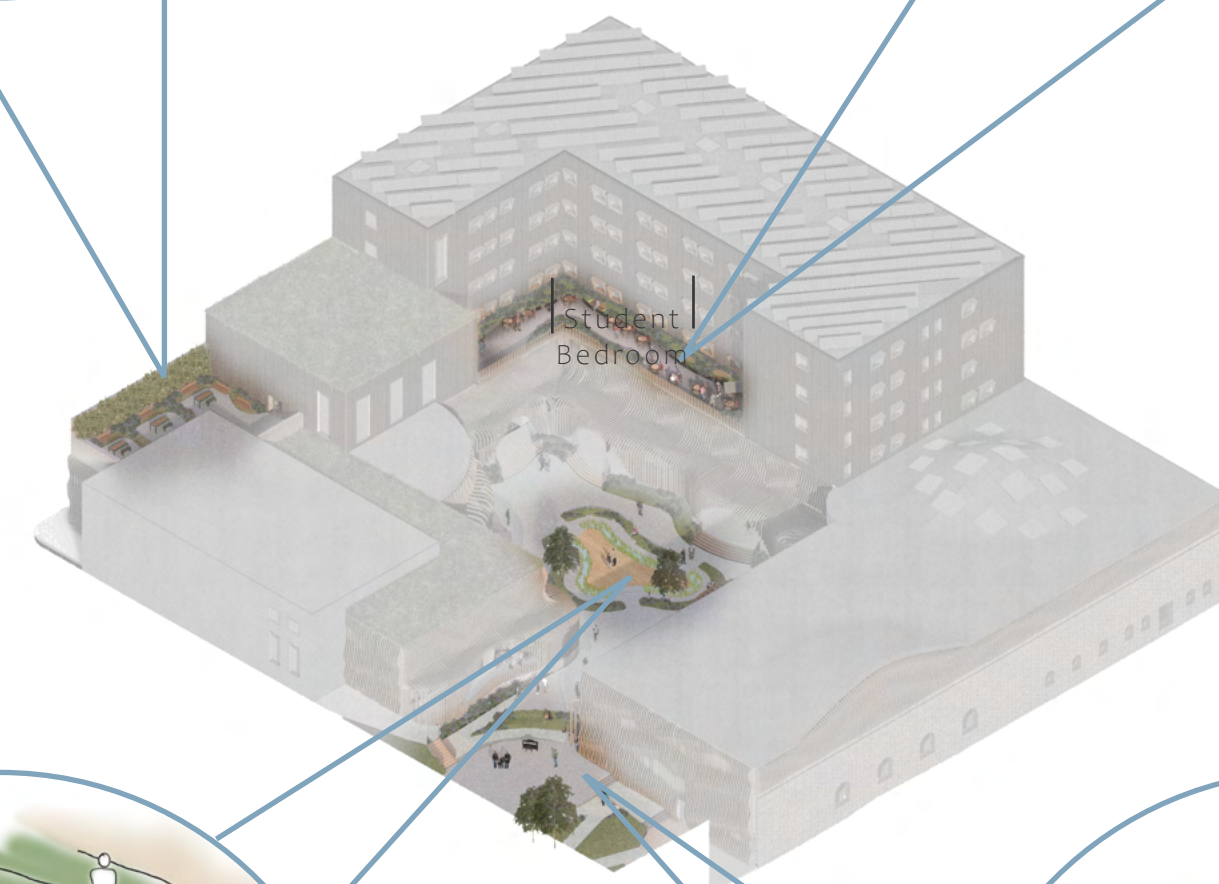
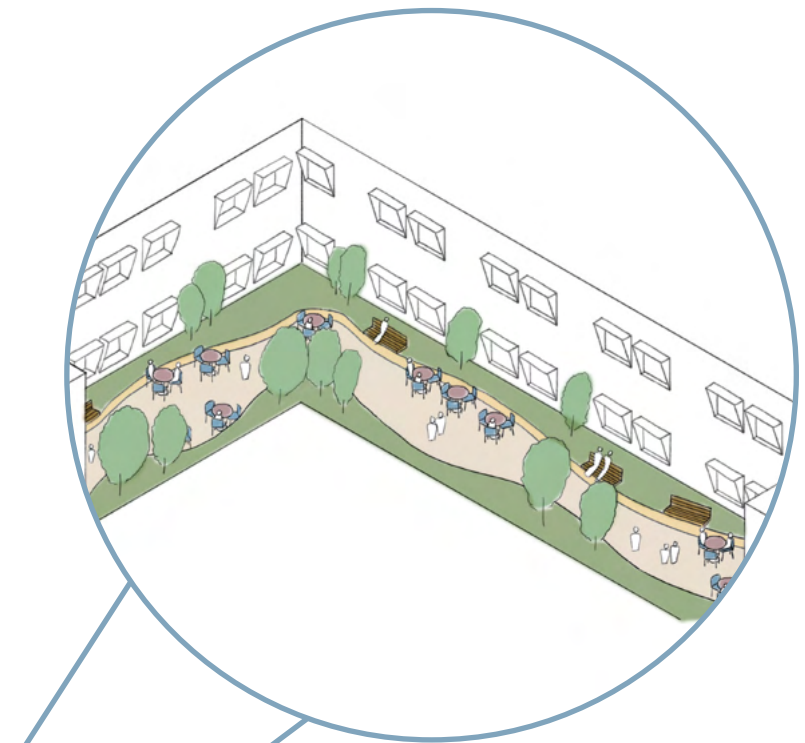
Student Terrace

A space to sit and reflect. A calm environment focusing on wellbeing.



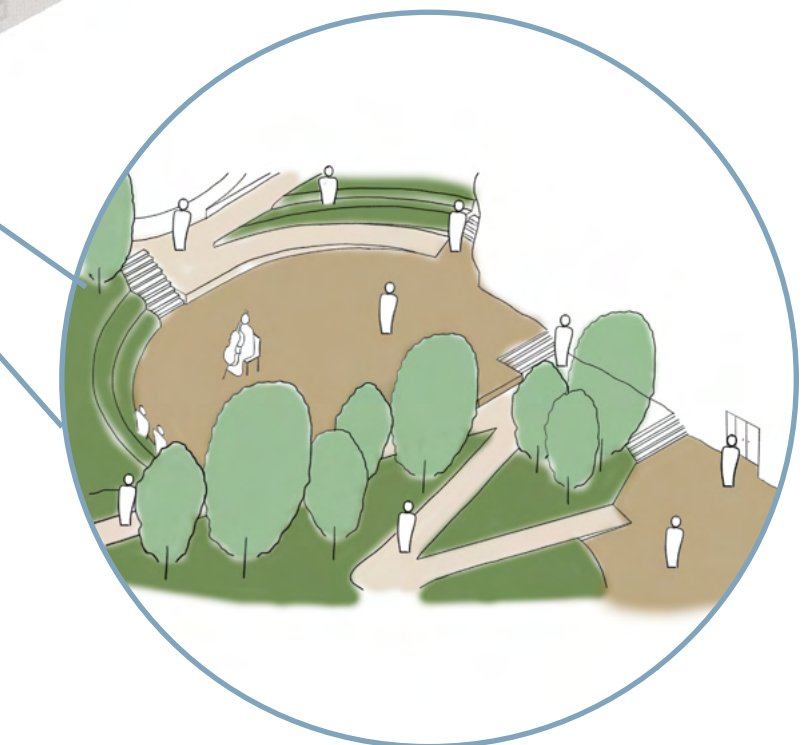
Dining Breakout

A space to eat, gather, chat, and observe. A social space overlooking the performance courtyard.



Performance Courtyard

A space to observe, perform and meet. A hub for collaboration.



The Entrance

A space to congregate, sit, and perform. A busy route for socialising and movement.

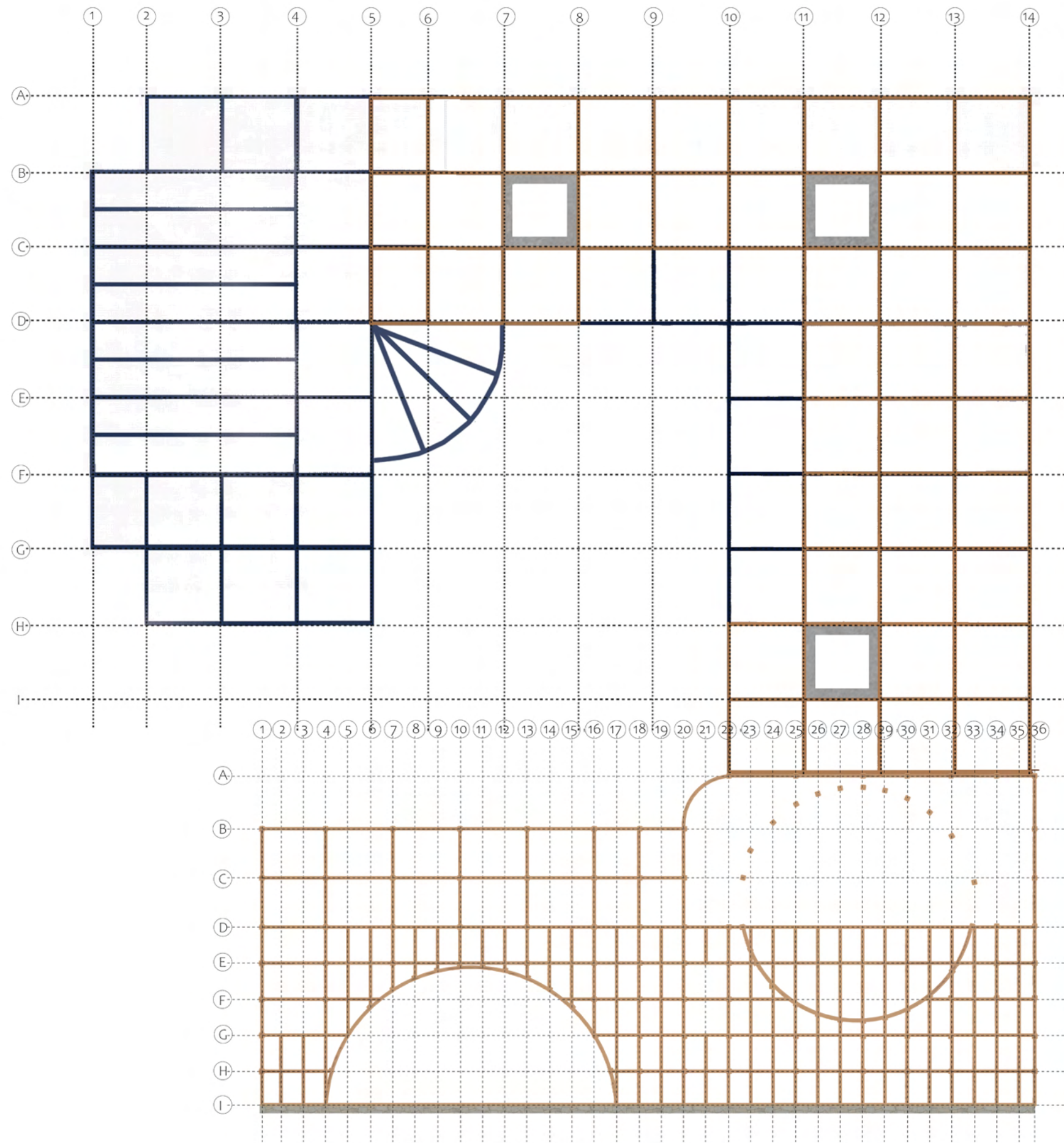




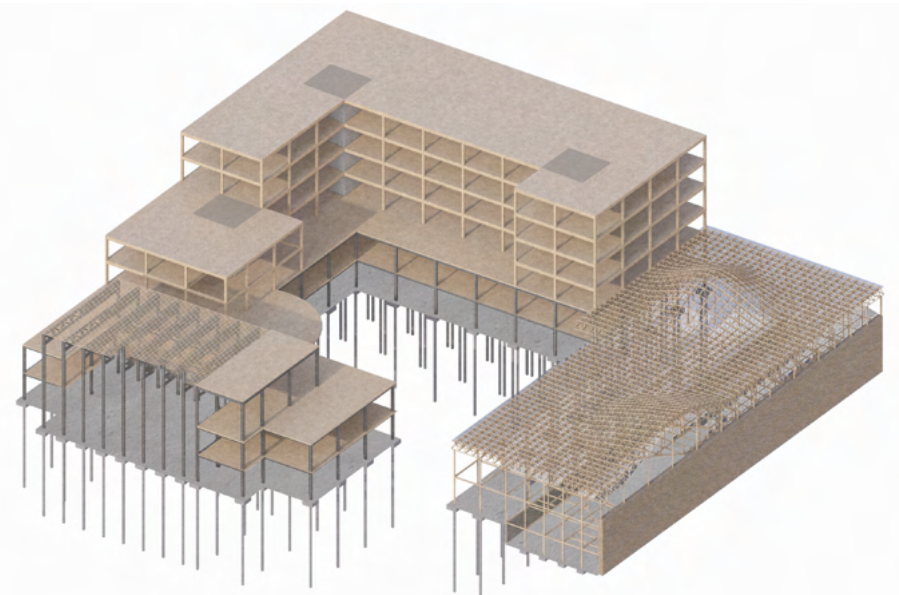
Overall Structure

Our integrated structural approach utilises the existing site conditions, and creates an efficient and elegant solution.

Structural Grid

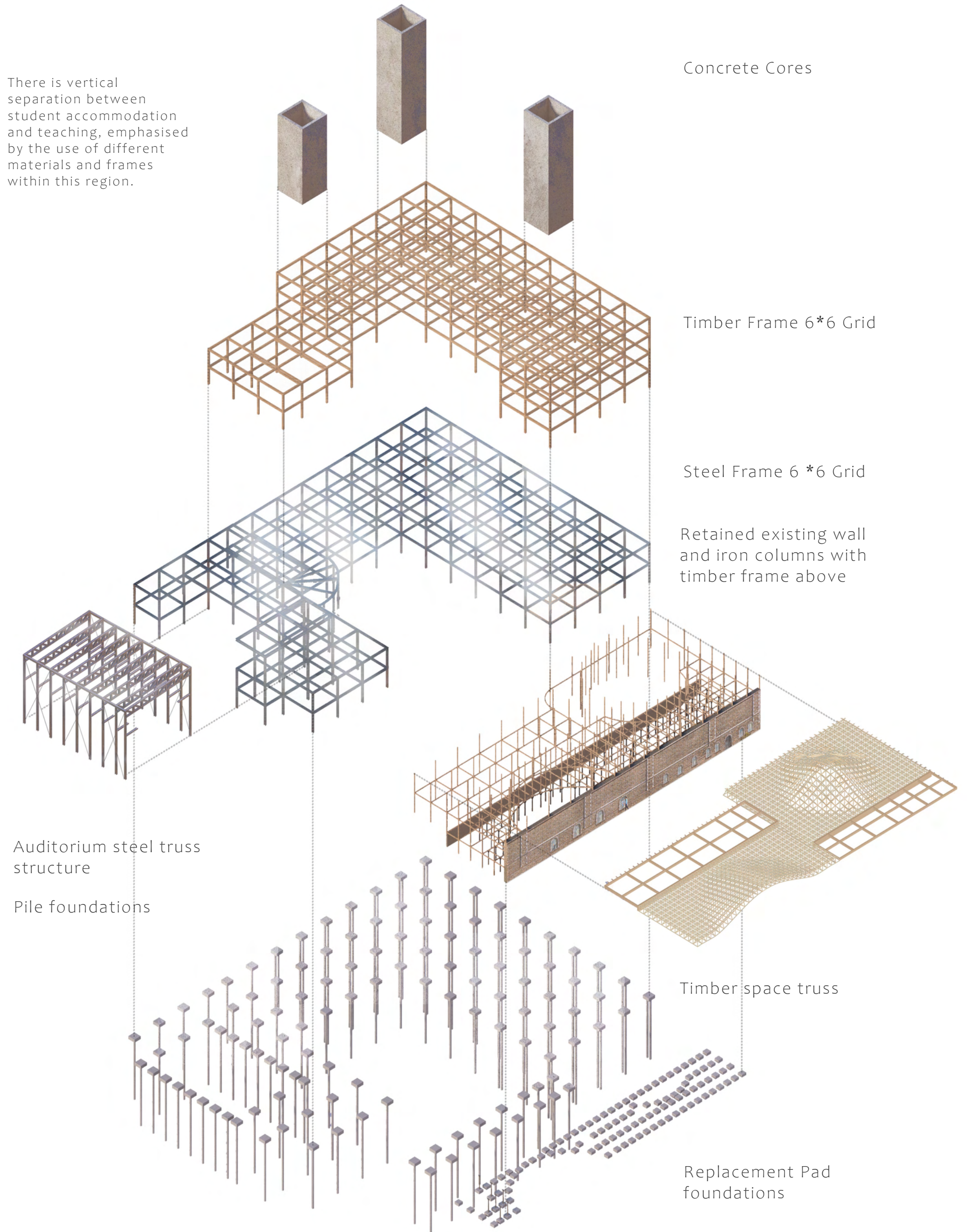


A core principle that the team wanted to achieve with the structural strategy is to provide a demountable structure. This drove our design strategy to focus on a steel structural base with bolt-only connections. The decision to have a core was a compromise to provide adequate fire security. The steel frame and concrete core tie in with the CLT floors for ease of construction. The generous grid allows for adaptability in space usage, in order to reassess and rezone spaces in the future.

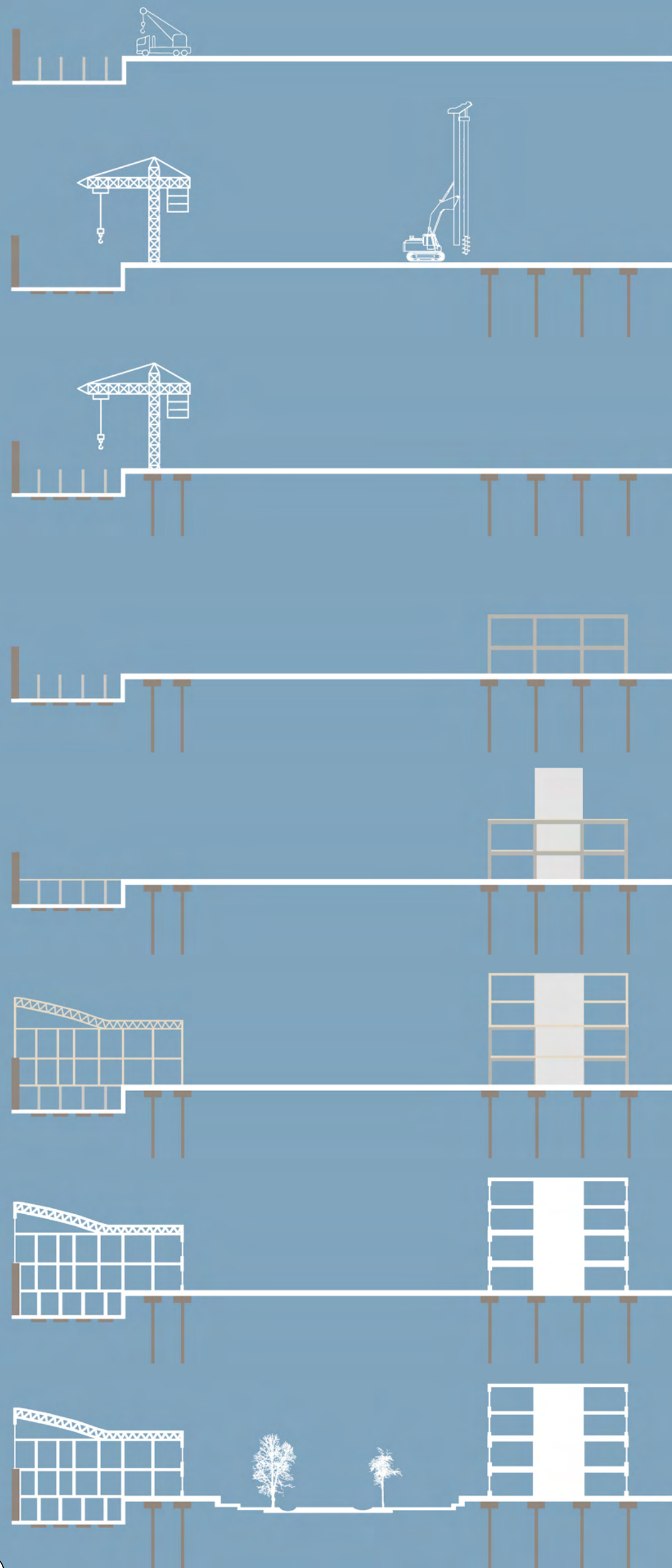


Structural Isometric

There is vertical separation between student accommodation and teaching, emphasised by the use of different materials and frames within this region.



Construction Sequence



Phase 1
Site establishment & excavation of asphalt surface, existing iron columns are removed and taken off site to be cleaned, restored and checked.

Phase 2
Aggregate is imported. Shuttering, steel trying and pouring of shallow and pile foundations is carried out.

Phase 3
Installation of repositioned iron columns.

Phase 4
Erection of prefabricated steel frame.

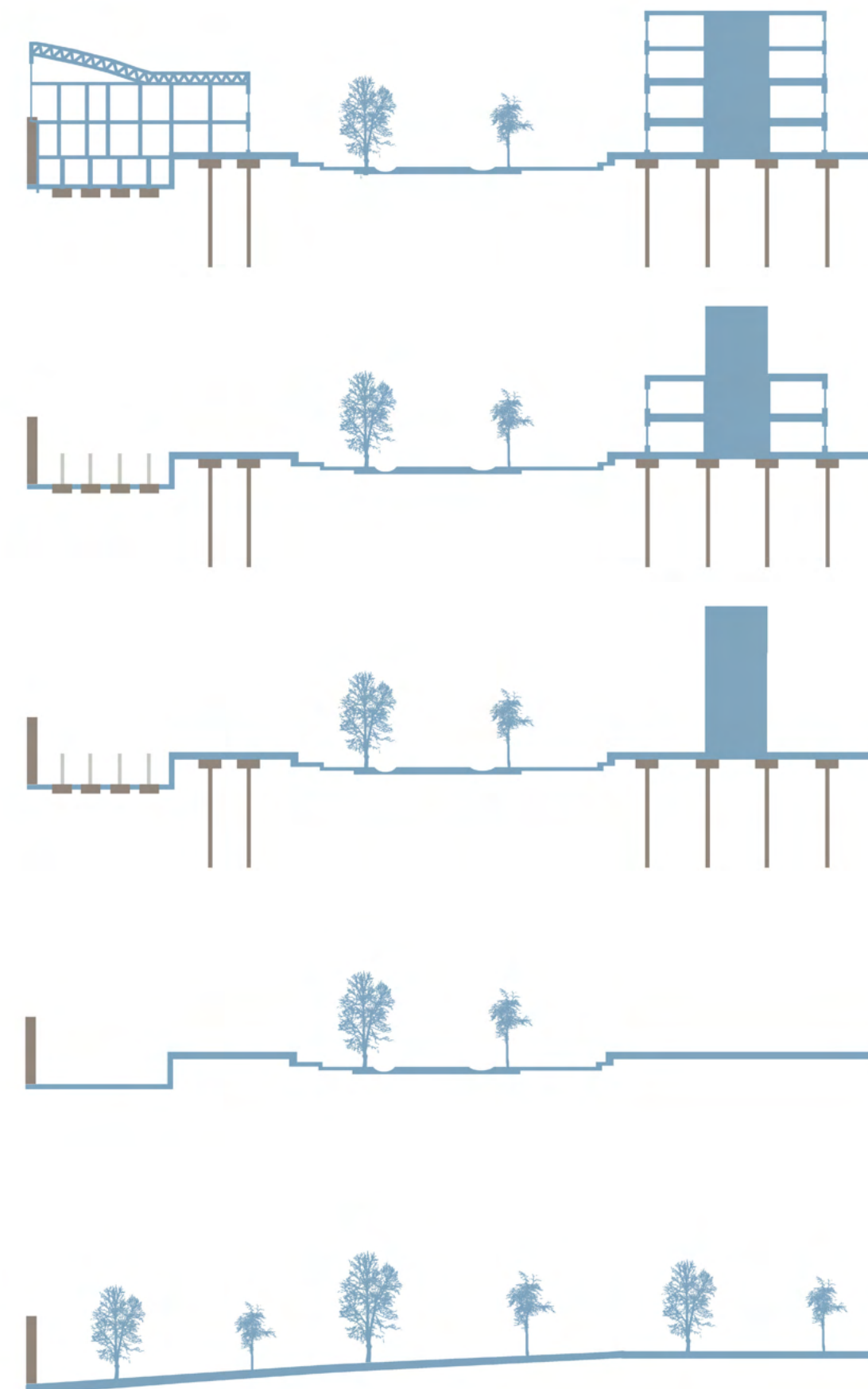
Phase 5
Concrete cores are created, CLT is installed in lower floors along with wall build-ups.

Phase 6
The timber frame will be constructed along with installation of CLT floors and panels.

Phase 7
Cladding, windows and services to be installed throughout the building.

Phase 8
Landscaping is completed.

De-Construction sequence



Phase 1
Remove internal walls to adapt student living into teaching space.

Phase 2
End of life - removal of timber frame for non-structural reuse.

Phase 3
Removal of steel frame for reuse structurally.

Phase 4
Removal of foundations, concrete cores and landscaping features.

Phase 5
Adapted for its next use





Environmental

The consideration of sustainability throughout the design process has resulted in the Resonance Institute having a low environmental impact.

Response to UN Sustainability Goals



11 SUSTAINABLE CITIES AND COMMUNITIES
Our institute provides safe and affordable housing for 124 students. Green roofs absorb Fine Particulate Matter pollutants, which are particularly prevalent in Swindon, reducing air pollution.

4 QUALITY EDUCATION
Our facilities inspire and facilitate the learning of music and neuroscience for 5750 students. Our library has free access for all.

6 CLEAN WATER AND SANITATION
Our design implements an attenuation and rainwater harvesting system to collect grey water for cleaning, flushing and irrigation.

7 AFFORDABLE AND CLEAN ENERGY
Our scheme implements CO2 heat pumps for water heating, space heating and cooling, and a solar photovoltaics system.

3 GOOD HEALTH AND WELL-BEING
Our innovation centre facilitates music therapy, which improves quality of life. A central courtyard and roof gardens provide reflective, comfortable spaces.



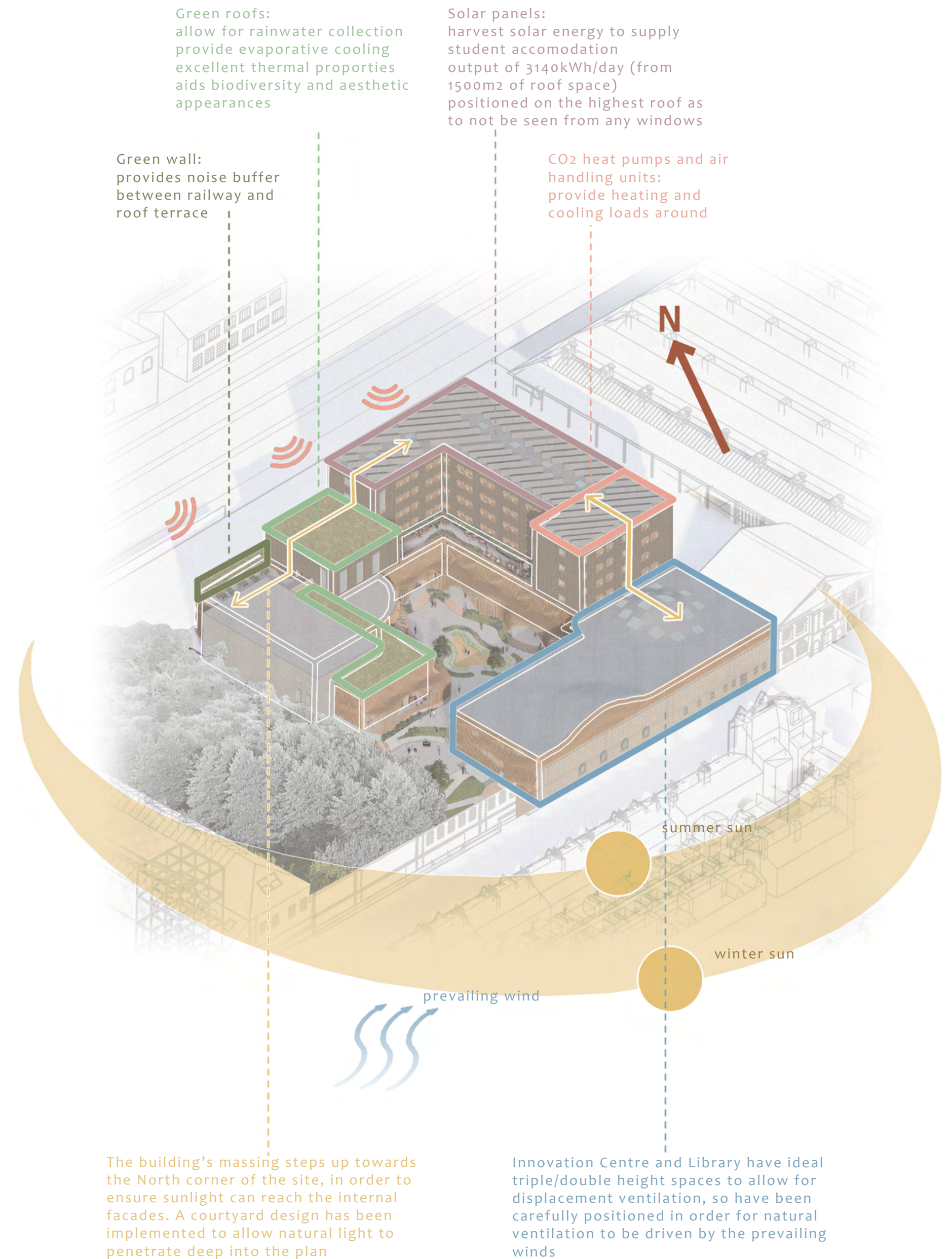
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
Our scheme can be demountable and recycled for reuse, since all connections are bolted and all members have standard section sizes.

13 CLIMATE ACTION
Our scheme has a low operational energy, with the massing arranged to allow natural light to penetrate deep into plans, and natural ventilation used where possible.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
Our innovation centre fosters scientific research and innovation, where novel ideas and past practices coalesce to solve present challenges.

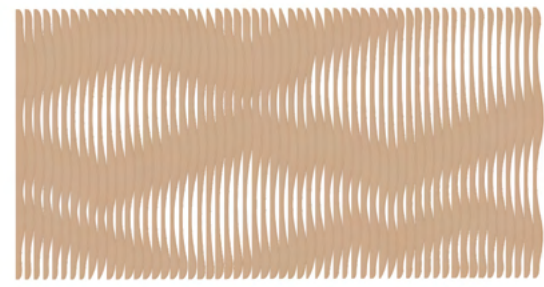
8 DECENT WORK AND ECONOMIC GROWTH
Our scheme provides access to quality education. The innovation centre offers space for skill sharing, whilst the cafe provides employment opportunities.

Environmental Response to Site

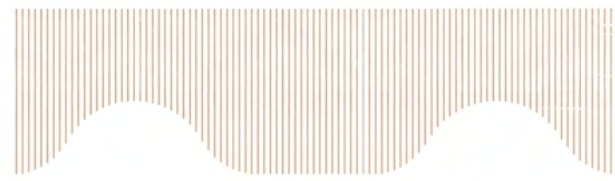


Shading, Solar Gains + Lighting

The facades of the ground and first floor feature a timber fin cladding system, which acts as a brise soleil to limit direct sunlight in summer, particularly on the SE and SW facing facades.



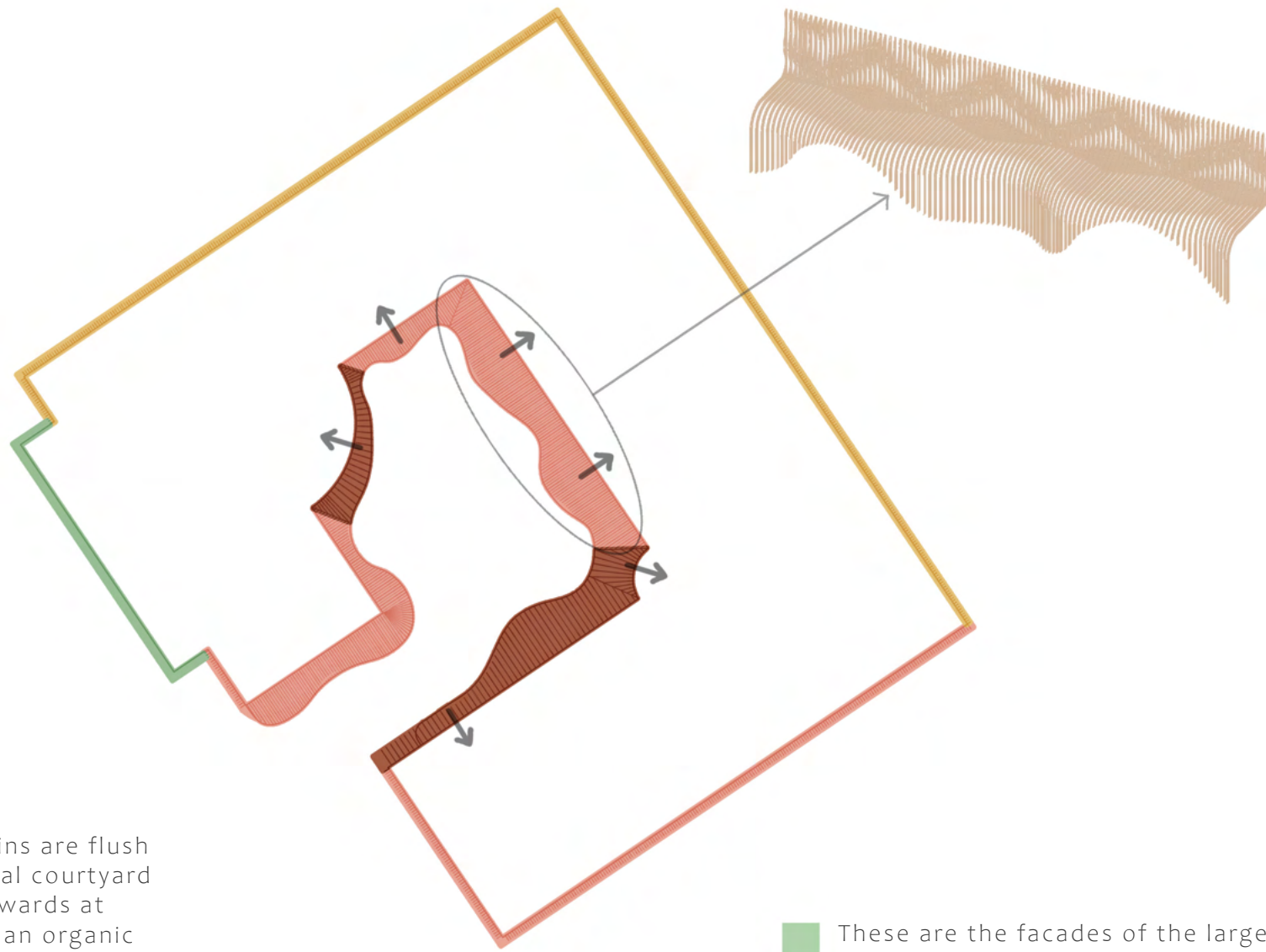
Fin cladding system to have organic wave pattern, creating an undulating ripple effect.



Elevation View: colonnade rises to form arches that line up with entry points.



Plan View: colonnade increases in width to highlight entry points into building.

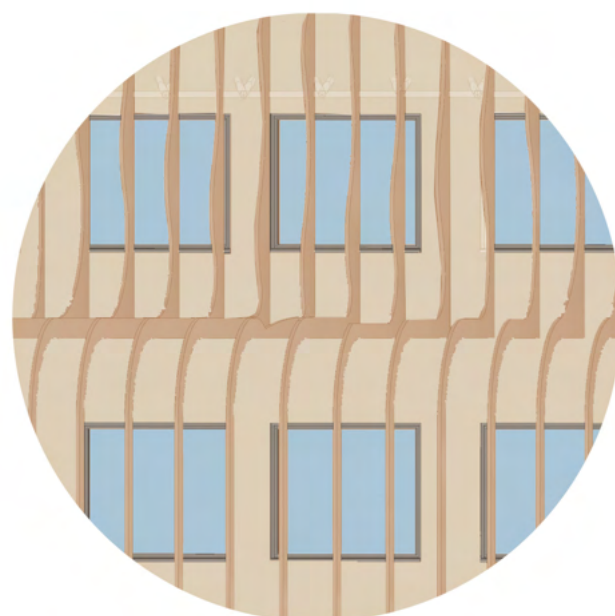


On the external facades, fins are flush to the walls. On the internal courtyard facades, fins protrude outwards at ground floor level to form an organic colonnade around the performance courtyard.

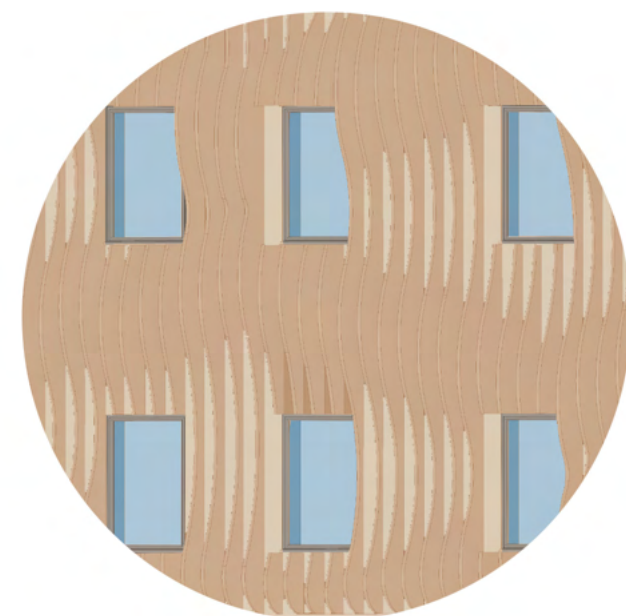
These are the facades of the large auditorium, which have no windows, since this space prioritises acoustics.



Shading
These facades are predominantly south facing so fins are spaced closely, at 300mm apart, for shading.

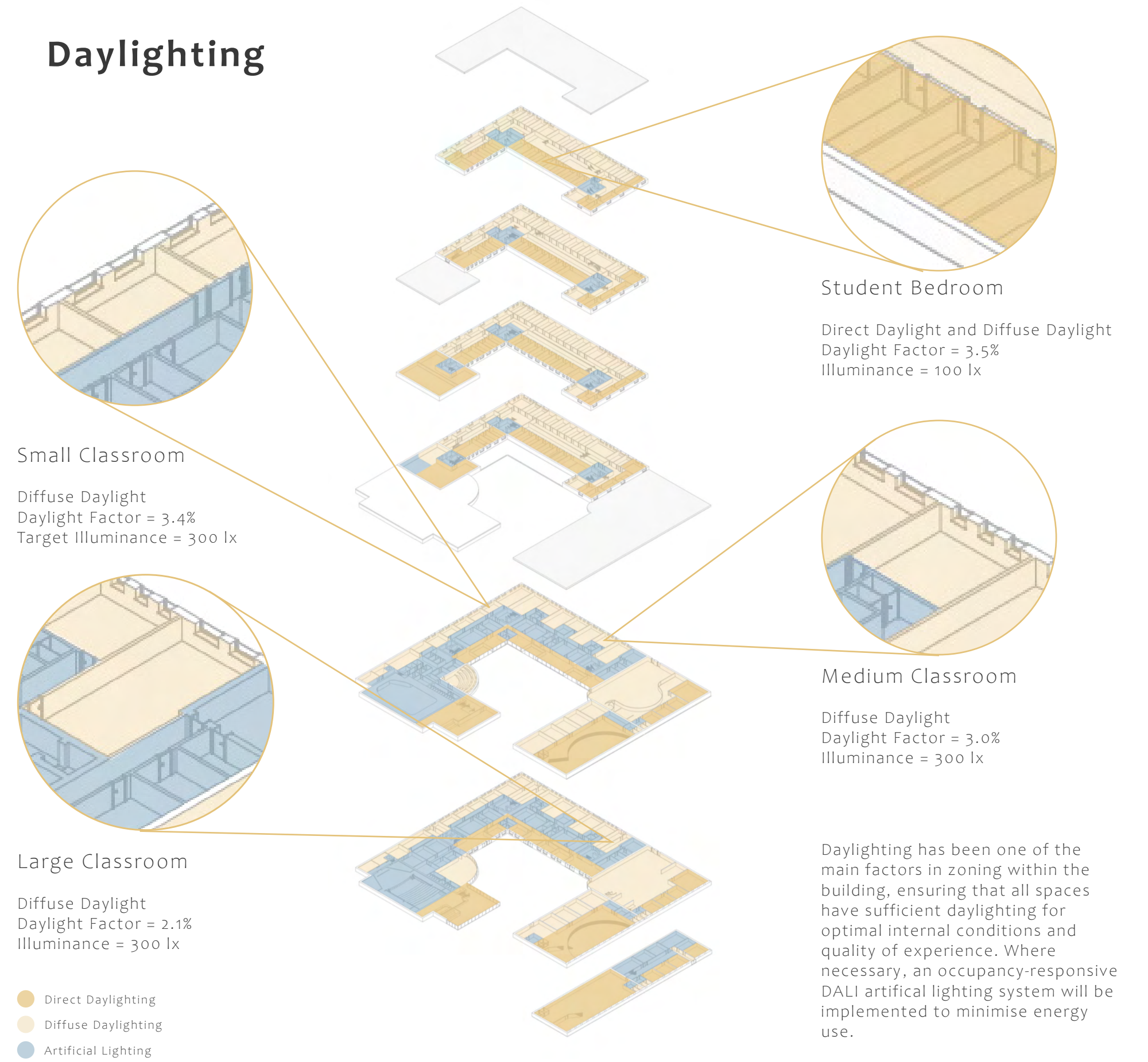


Some Shading
On the north-west facing facade of the library, every other fin is removed so the fins are 600mm apart, to reduce shading and maximise solar gains. The same occurs on the east facing facade of the foyer to mark the main entrance point to our institute.

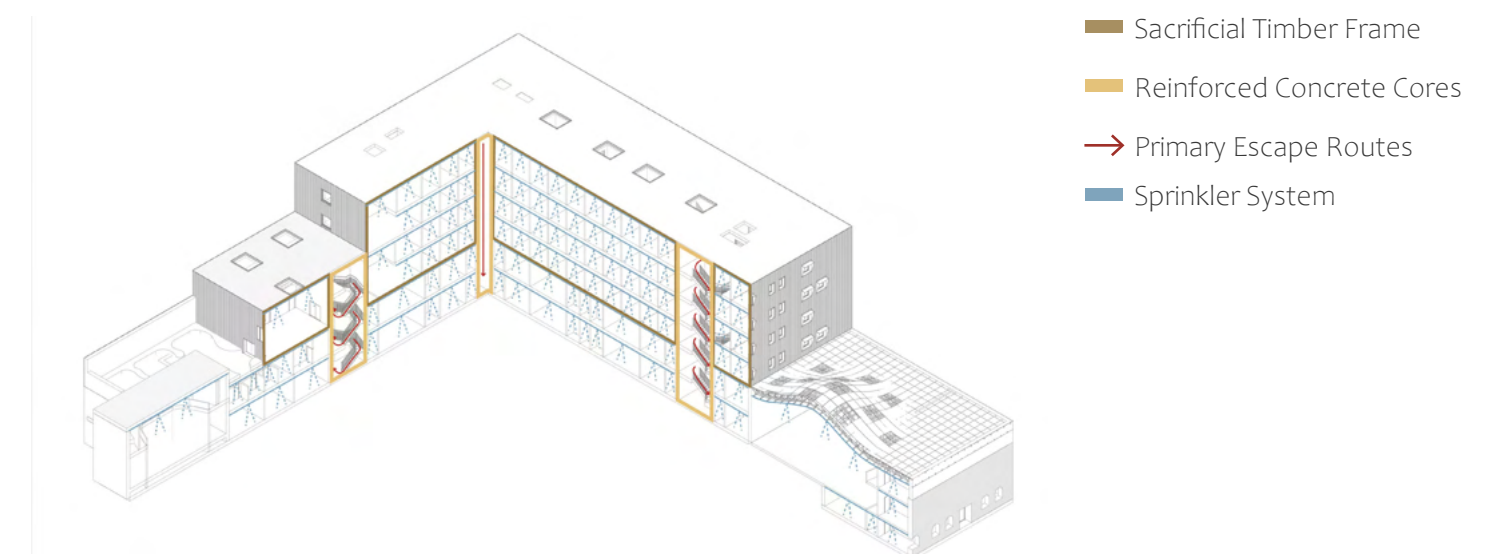


No Shading
These facades are predominantly north facing so there are voids in the fin cladding system where windows are installed to minimise shading and maximise solar gains.

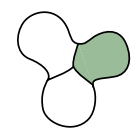
Daylighting



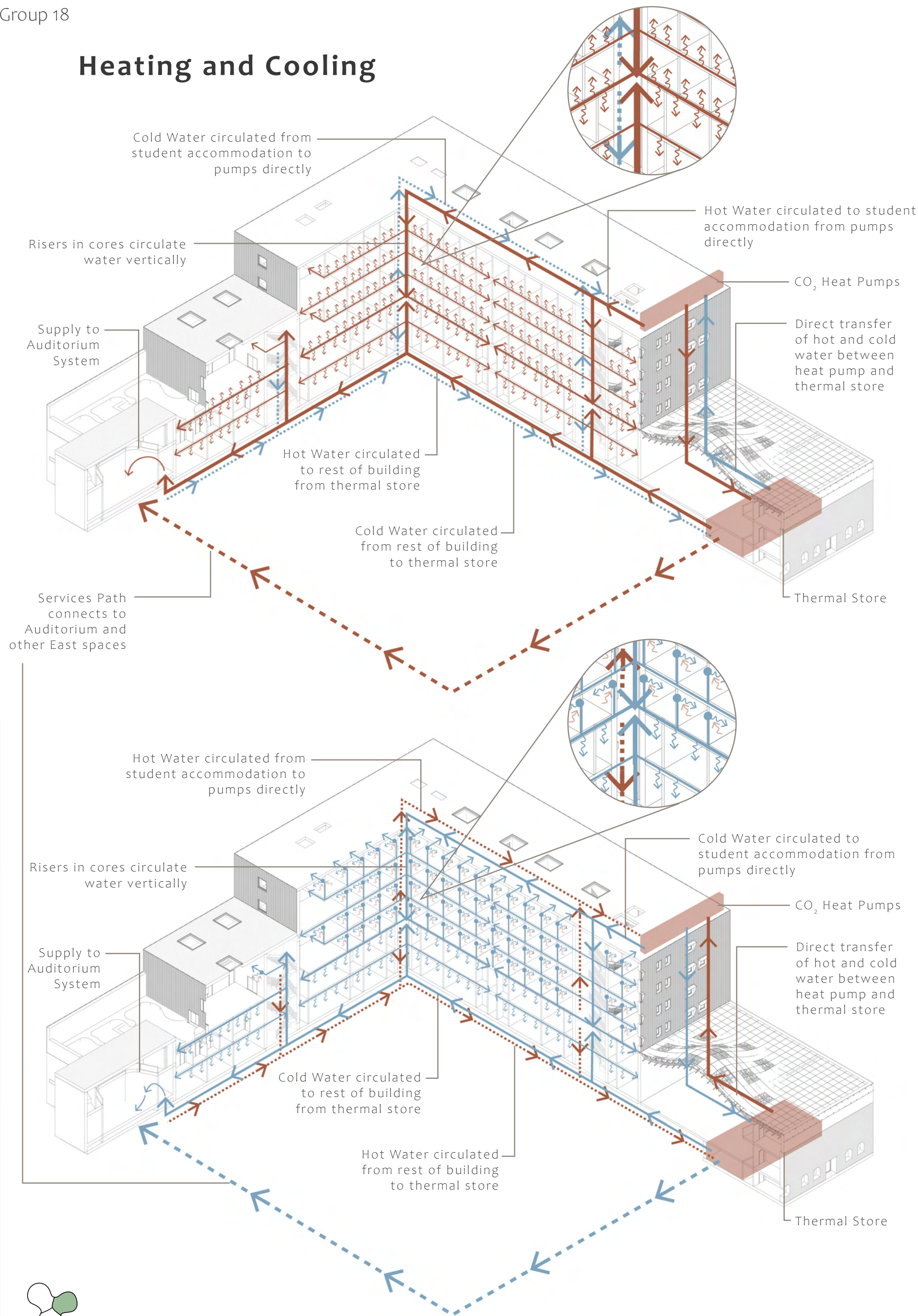
Fire Strategy



The three reinforced concrete cores provide escape routes for all floors of the building. Sprinkler systems are in place, and a sacrificial timber approach has been used on the upper floors.



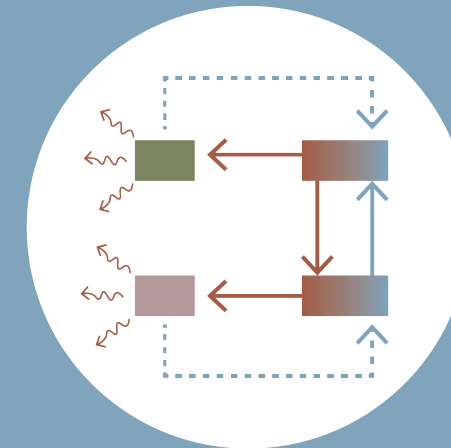
Heating and Cooling



CO₂ Heat Pump System

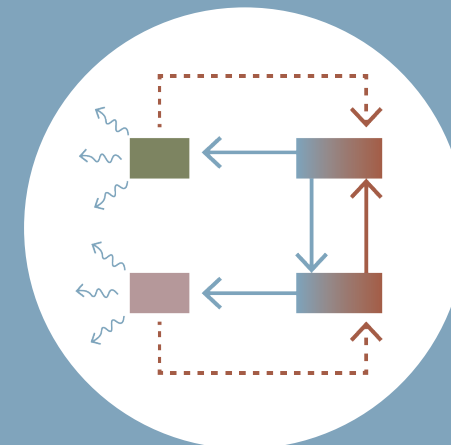
Chosen for its capacity to both heat and cool the building, an air source heat pump with CO₂ refrigerant operates in an integrated system across the entire scheme. The pumps, located on the student roof, are connected vertically to thermal stores in the basement. This store directly supplies the Lower Ground, Ground and First Floor spaces, with risers in the cores and other key locations transferring the water vertically. The student living is supplied by the pump directly, similarly making use of the cores to circulate between floors.

In response to changing thermal requirements throughout the year, and the future climate, this scheme can operate in a heating and cooling capacity, reversing the process when necessary.



Heating System

The CO₂ pumps heat the air extracted from the external climate, which is then used to heat water circulating through the system. This hot water is then distributed throughout the building as specified above, heating the spaces via a network within the suspended floor (student accommodation) or ceiling (other spaces). The cooler water is then drawn back to the pump in a circular process.



Cooling System

To cool the building, the system above is reversed, with cool water circulated and hot water extracted. The system will cool the warm air drawn in via a heat pump convector, which is then pumped back into the room as cooler air.

Ventilation

Dual-Purpose System

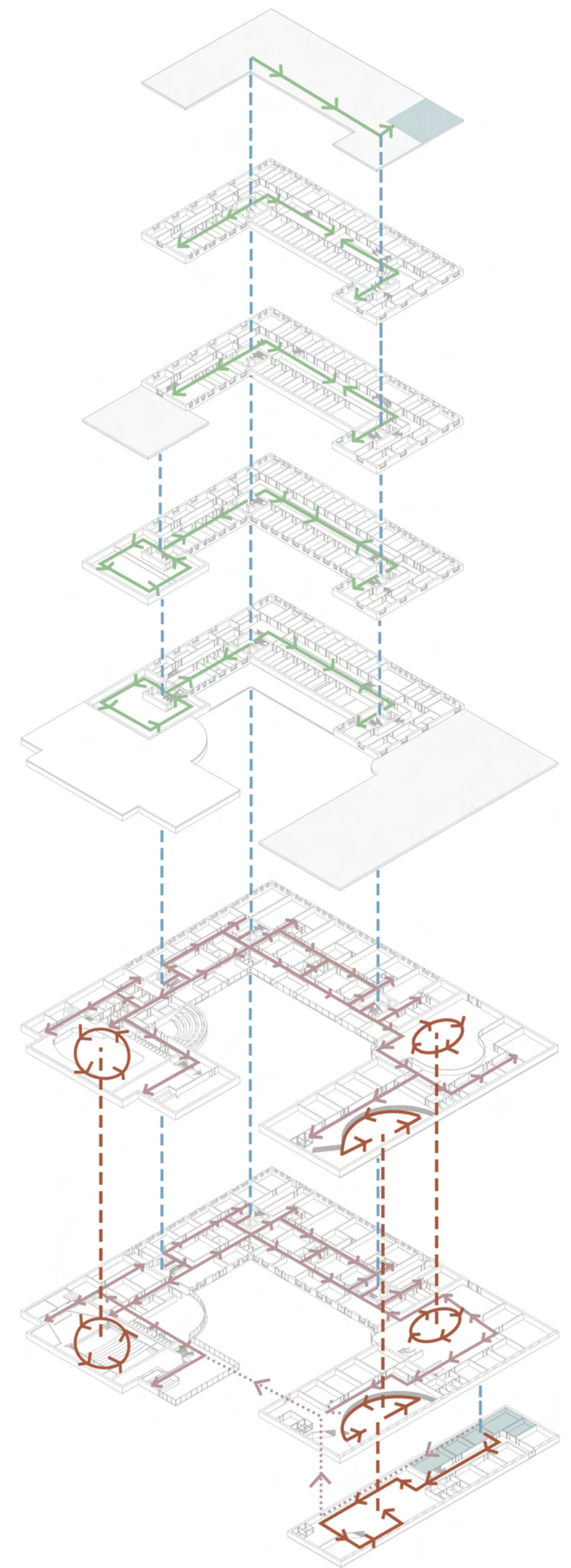
The ventilation services utilise the same system as heating-cooling (opposite). In the student accommodation, services sit within the suspended floor, with supply and extract ducts extending up to vents within the cavity walls. In other single-storey spaces, services are contained within the suspended ceiling.

Cores as Vertical Service Paths

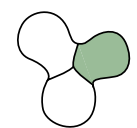
In the 6 storey parts of the building, RC cores contain risers which transfer services vertically. In other areas, risers are located appropriately to ensure logical service distribution.

Circulation as Horizontal Service Paths

To minimise the amount of services passing through partitions, the circulation routes will act as the primary service paths on each floor, from which individual rooms will be accessed.



- Suspended Floor Ventilation
- Suspended Ceiling Ventilation
- Displacement Ventilation
- Vertical Service Path
- CO₂ Pumps and Thermal Store



Fabric

To achieve minimal heat loss, each element of the building has been considered in detail with the aim of high thermal performance. Each U-Value has been compared to LETI standards for this building's typologies, improved where necessary from conventional details. This is carried through into the overall strategy for the design and its tectonic.

| Fabric | U Value (W/m²K) | Area (m²) | Heat Loss (W/K) |
|--------------------------------|-----------------|-----------|-----------------|
| Floors | | | |
| - type 1 | 0.12 | 3337 | 400 |
| - type 2 | 0.12 | 1478 | 177 |
| Walls | | | |
| - type 1 | 0.11 | 1801 | 198 |
| - type 2 | 0.11 | 501 | 55 |
| - type 3 | 0.14 | 496 | 122 |
| - type 4 | 0.08 | 477 | 38 |
| - type 5 | 0.10 | 2345 | 235 |
| Glazing | 0.8 | 1194 | 955 |
| Roofs | | | |
| - type 1 | 0.11 | 1504 | 165 |
| - type 2 | 0.10 | 768 | 77 |
| - type 3 | 0.12 | 1623 | 195 |
| - type 4 | 0.08 | 507 | 41 |
| Total Fabric Heat Loss | | | 2658 W/K |
| Annual Fabric Heat Loss | | | 130,901 kWh |

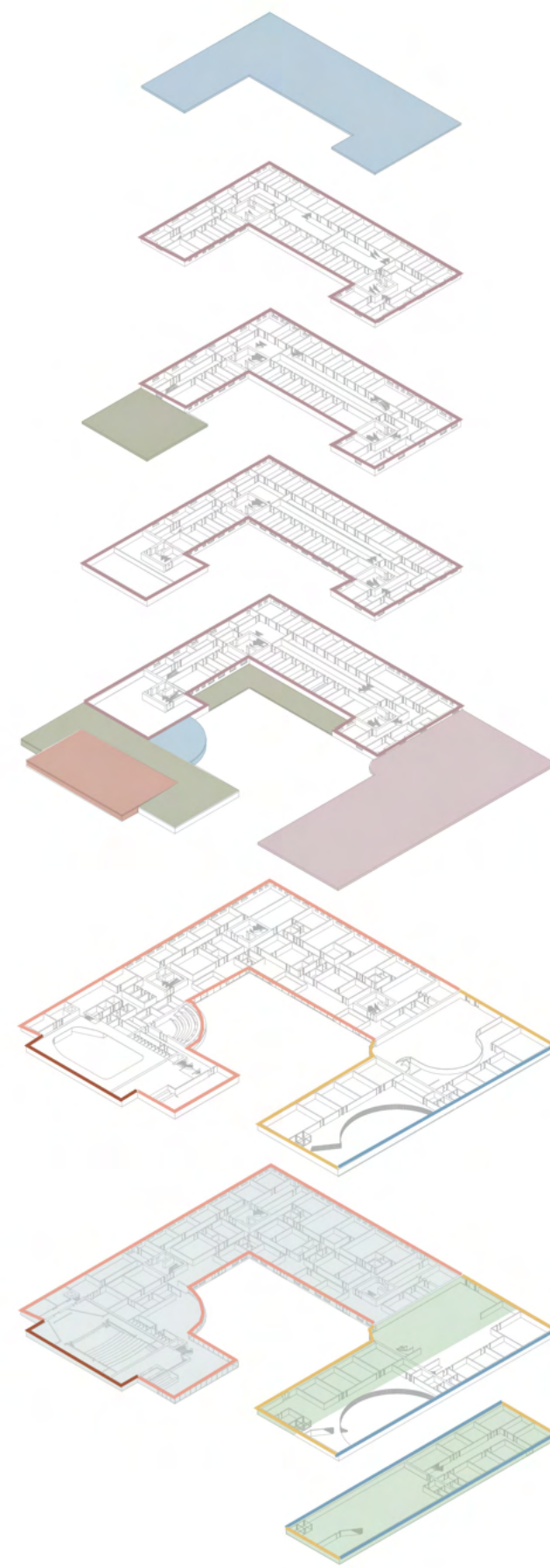
Floor Type 1: Concrete Floor System with Screed
Floor Type 2: Concrete Floor System with Timber Finish

Wall Type 1: Steel Frame with Lime Render (ext) and Cork (int)
Wall Type 2: Timber Frame with Lime Render (ext) and Plywood (int)
Wall Type 3: Historic Wall with Plywood (int)
Wall Type 4: Auditorium Wall with Zinc (ext) and Plywood (int)
Wall Type 5: Timber Frame with Hemp Panels (ext) and Plywood (int) *see derivation of U Value below

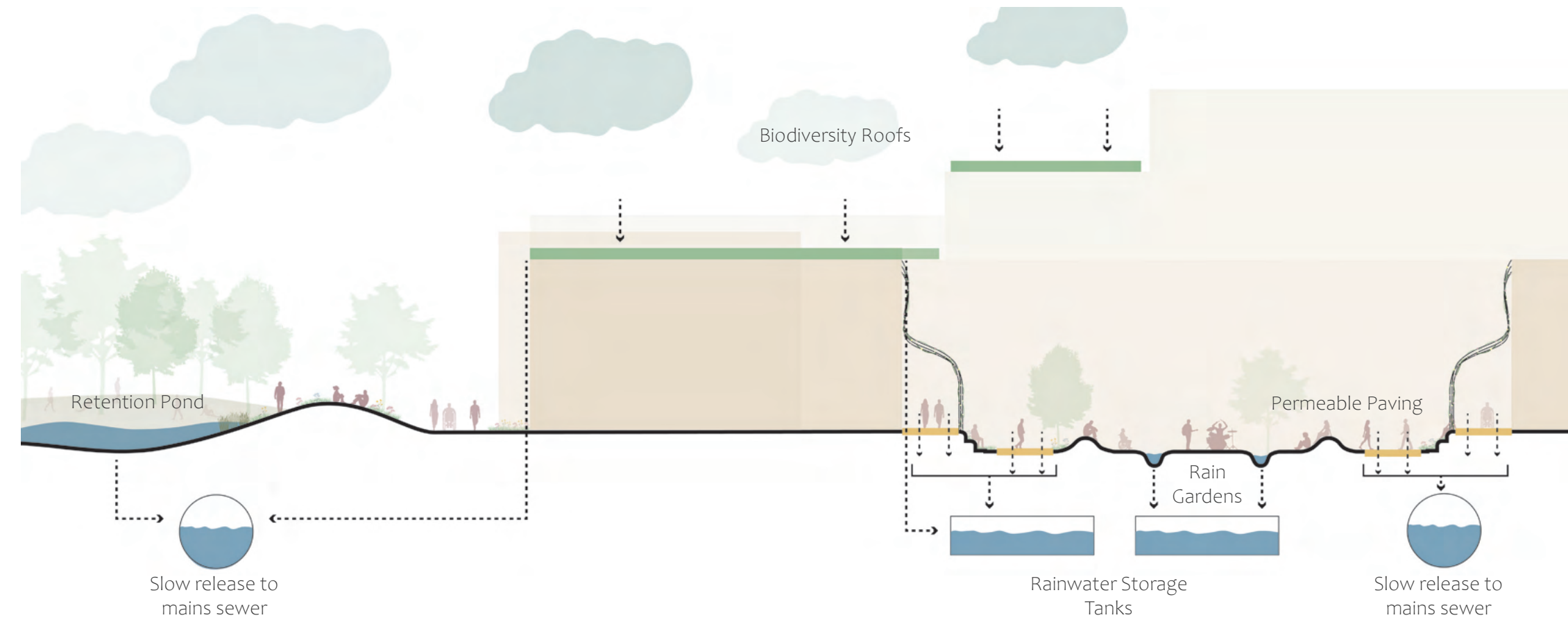
Glazing: Triple Glazed with Argon Infil and Low E Coating

Roof Type 1: Timber Space Truss with Zinc (ext) and Plywood (int)
Roof Type 2: Sedum Green Roof with Plywood (int)
Roof Type 3: Timber Frame and CLT with Gravel (ext) and Plywood (int)
Roof Type 4: Steel Truss System with Zinc (ext) and Plywood (int)

| Element | Thickness (mm) | Thermal Conductivity (W/mK) | Resistance (m²K/W) |
|-------------------------|----------------|-----------------------------|--------------------|
| Hemp Panels | 2.5 | 0.08 | 0.03 |
| Rigid Insulation | 75 | 0.035 | 2.14 |
| Hemp Insulation | 300 | 0.039 | 7.69 |
| Sheathing Board | 3 x 18 | 0.13 | 0.415 |
| Plywood (finish) | 12 | 0.17 | 0.07 |
| R(si) | - | - | 0.14 |
| R(so) | - | - | 0.04 |
| Total Resistance | | | 10.5 m²K/W |
| U-Value | | | 0.095 W/K |



Water Strategy

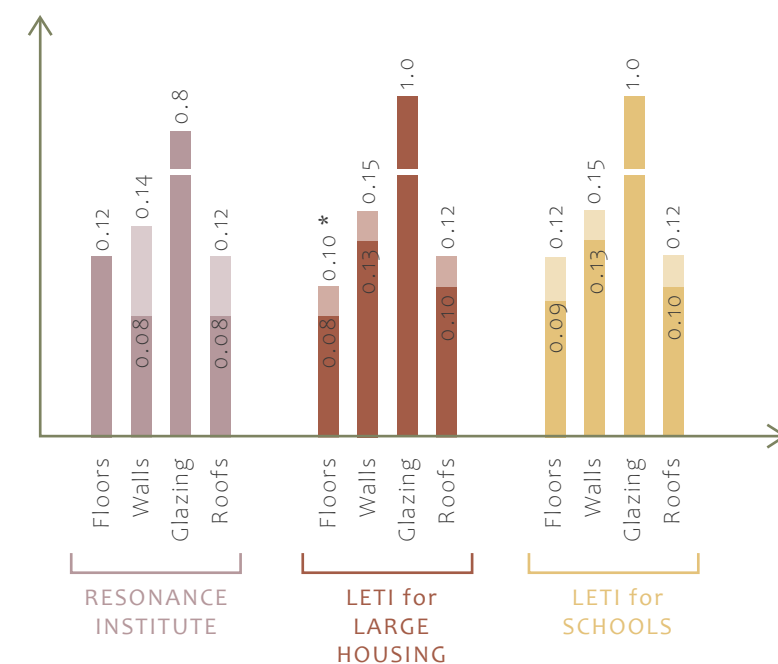


The retention pond located on the adjacent public realm site will provide further water storage, and reduce the impact of heavy rainfall on the mains sewers.

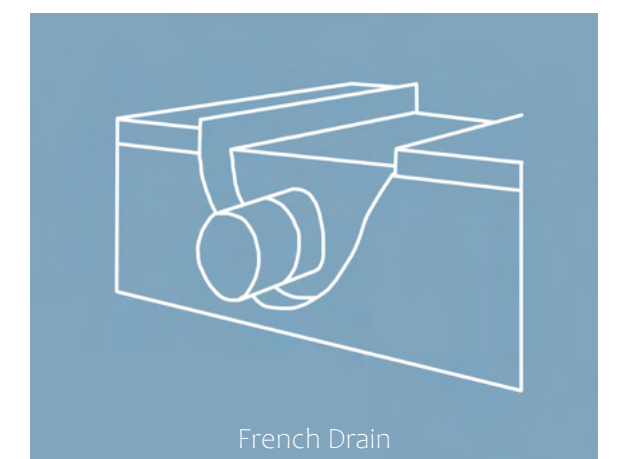
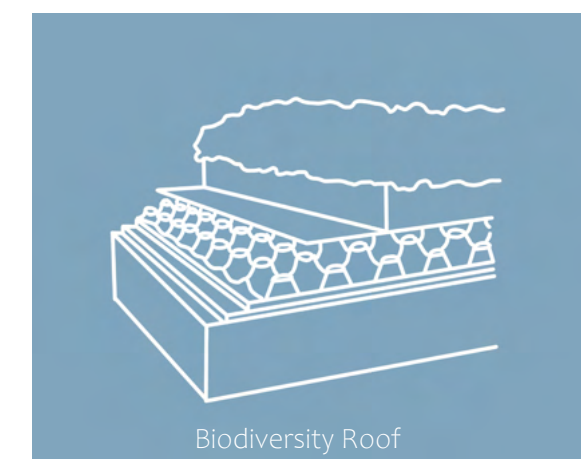
Biodiversity roofs provide rainwater absorption, in optimum periods they can retain up to 75% of stormwater. The run-off is slowed too, resulting in reduced stress on the mains sewer.

Interception by trees slows the rainfall, and reduces the risk of surface water. The permeable pavements ensure the courtyard remains accessible.

A rainwater attenuation and harvesting system is implemented in our design, to reduce the need for water from the mains. There are 4 tanks located underneath the courtyard, with a total capacity of 3500l (80% of the total roof area). This water will be brought down via gutters and pipes, and used for toilet flushing, irrigation and washing cycles.



* Not applicable as no external heat loss via student floor

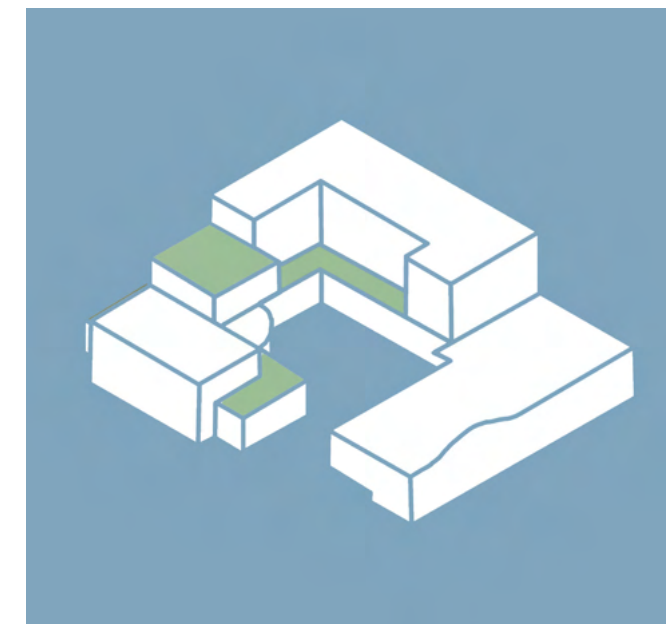
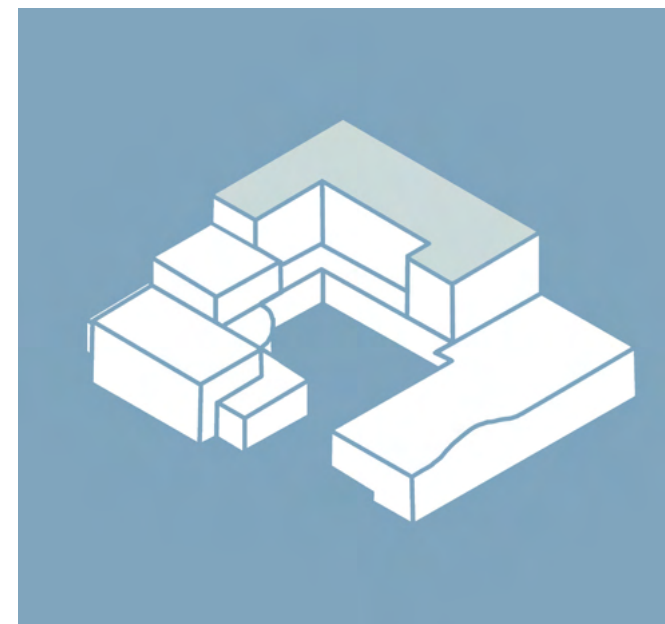
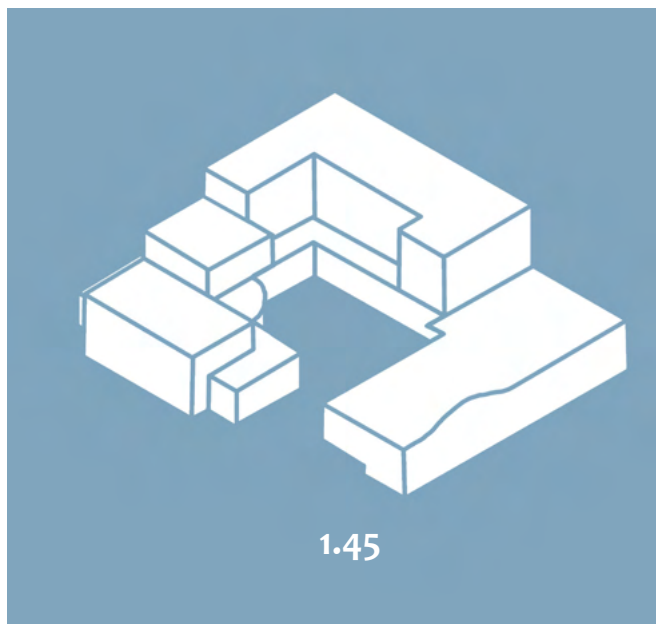


Form Factor

Solar Strategy

Green Strategy

Embodied Carbon



Our form was driven by environmental consideration of daylighting and shading. We aimed to achieve Passivhaus standards for Form Factor, of ≤ 3 . With an external surface area of 16,135.5 m², and an internal usable floor area of 11,111 m², we have been able to reach this benchmark.

Each panel produces 350W per day, placed at the optimum angle of 37 degrees and south facing. The total output from the 1300m² roof is 1402Wh/day, a total of 512,000 kWh of electricity per year. Students use 8.68 kWh per day, leaving 360.4 kWh per day available for the rest of The Resonance Institute.

The site achieves a 39% greenery coverage, through the use of green roofs and open space. With 120 residential rooms, each student has 7.88m² of outdoor space at roof level, and the courtyard provides 4.83m² for the student body of 6,000.

| Material Type | Key Element Description | Volume (m ³) | Product Stage (Cradle to Gate) | | | End of Life: Transport and Waste Processing | | Beyond the Life Cycle |
|-------------------|-------------------------------|--------------------------|--------------------------------|------------|-----------|---|-------------|-----------------------|
| | | | A1-3 | A4 | A5 | A1-5 | C2-4 | |
| Concrete (C32/40) | Concrete Floor Slab and cores | 1507 | 643 | 27 | 39 | 709 | 70 | 96 |
| CLT | Floors and Walls | 1787 | 208 | 134 | 4 | 345 | 1385 | -435 |
| Glulam | Frame | 776 | 83 | 48 | 1 | 132 | 494 | -66 |
| Steel | Frame | 16 | 220 | 4 | 2 | 227 | 2 | -116 |
| Glazing | Windows | 55 | 197 | 4 | 11 | 212 | 2 | 0 |
| Finishes | Hemp Cladding | 10 | 0 | 0 | 0 | 0 | 3 | 0 |
| Total | | | 1351 | 217 | 57 | 1625 | 1956 | -521 |

| | |
|---|--|
| Total Building Area | 15524 m ² |
| Total Embodied CO ₂ per m ² | 105 kgCO ₂ e/m ² |

Worst Case Scenario

| Material Type | Key Element Description | Volume (m ³) | Product Stage (Cradle to Gate) | | | End of Life: Transport and Waste Processing | | Beyond the Life Cycle |
|-------------------|-------------------------------|--------------------------|--------------------------------|------------|-----------|---|-------------|-----------------------|
| | | | A1-3 | A4 | A5 | A1-5 | C2-4 | |
| Concrete (C32/40) | Concrete Floor Slab and cores | 1507 | 385 | 27 | 39 | 452 | 70 | 96 |
| CLT | Floors and Walls | 1787 | 208 | 134 | 4 | 345 | 1385 | -435 |
| Glulam | Frame | 776 | 83 | 48 | 1 | 132 | 494 | -66 |
| Steel | Frame | 16 | 220 | 4 | 2 | 227 | 2 | -116 |
| Glazing | Windows | 55 | 197 | 4 | 11 | 212 | 2 | 0 |
| Finishes | Hemp Cladding | 10 | 0 | 0 | 0 | 0 | 3 | 0 |
| Total | | | 1094 | 217 | 57 | 1368 | 1956 | -521 |

| | |
|---|---------------------------------------|
| Total Building Area | 15524 m ² |
| Total Embodied CO ₂ per m ² | 88 kgCO ₂ e/m ² |

Best Case Scenario

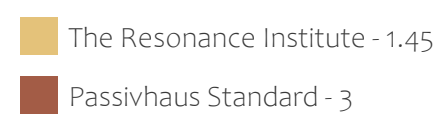
Embodied carbon was a key driver for our decisions throughout the design process. Our goal was to achieve the RIBA 2030 embodied carbon target of 156 kgCO₂e/m², and our calculations evidence that our design meets this goal. In both our best and worst case scenarios, the building surpasses our target, a result of our consideration at every stage of the project.

Our worst case scenario does not include carbon sequestration, or the specified low-carbon cements. In reality, this would likely not be the case, and it is fair to consider carbon capture within the timber frame and the use of calcined clays (reducing the D and A1-3 values).

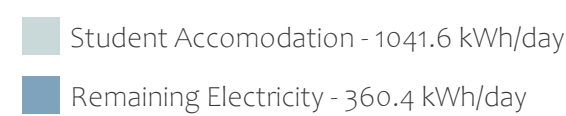
The end-of-life concept within our scheme is driven by our entirely demountable structure, suggesting the steel elements would have a second structural life too. This would reduce the associated embodied carbon per year, but cannot be predicted accurately, so remains as the worst case scenario.

Low embodied carbon drove our material choices, utilising natural materials wherever possible. From our hemp cladding system, timber fins and hemp insulation.

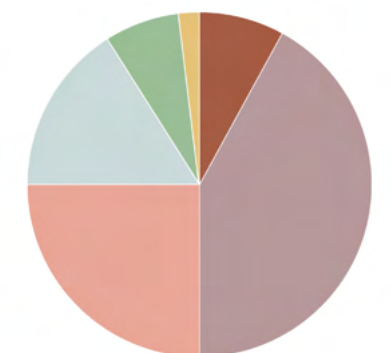
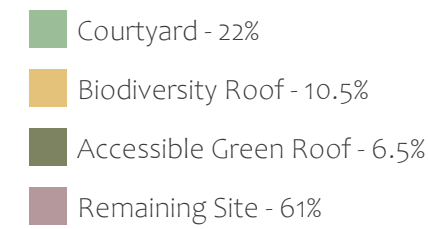
Comparison of Form Factor



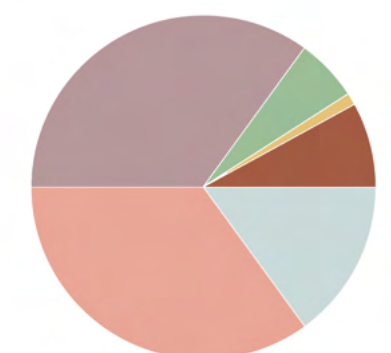
Solar Panel Electricity Provision



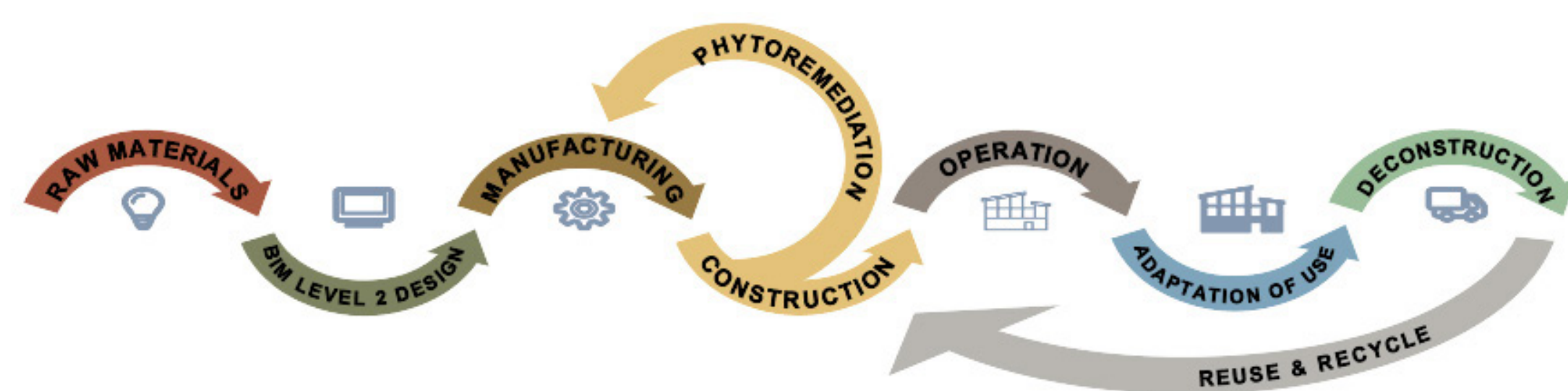
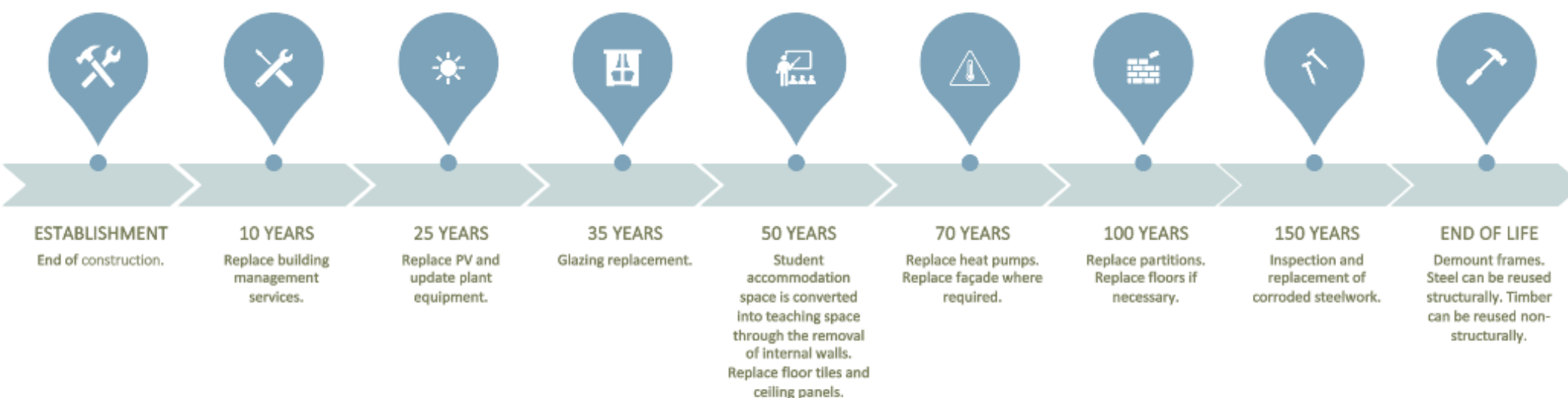
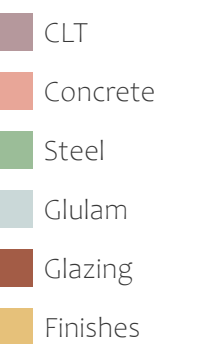
Site Greening



Worst Case Scenario



Best Case Scenario





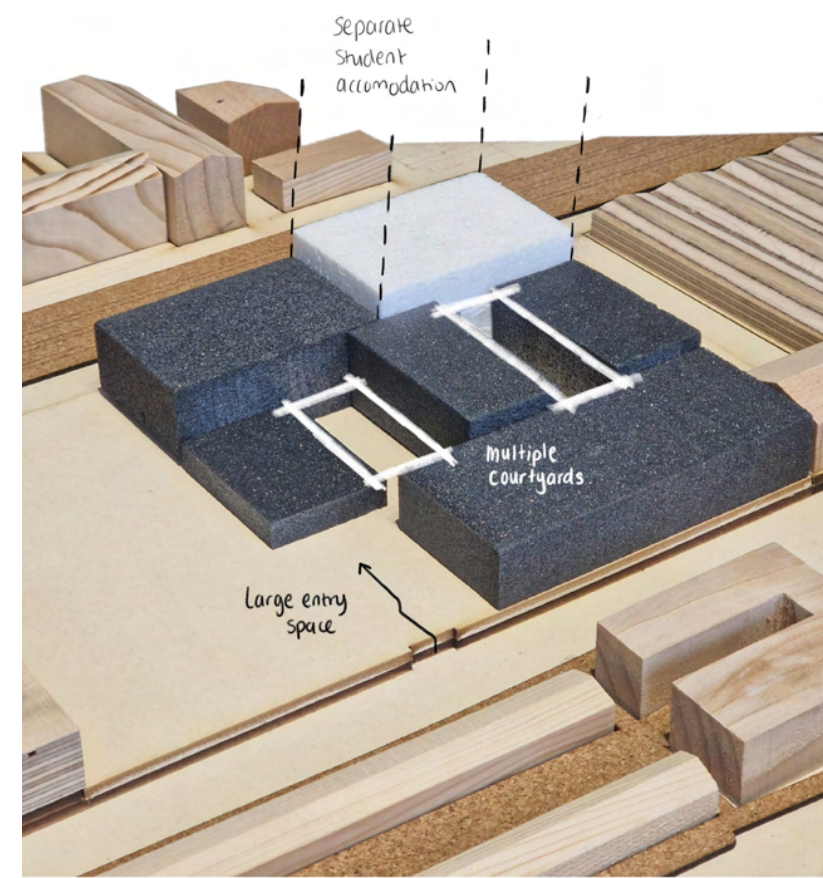
Process

Working collaboratively as a team, many iterations of the institute were explored. The refining of the design resulted in a cohesive and attentive design.

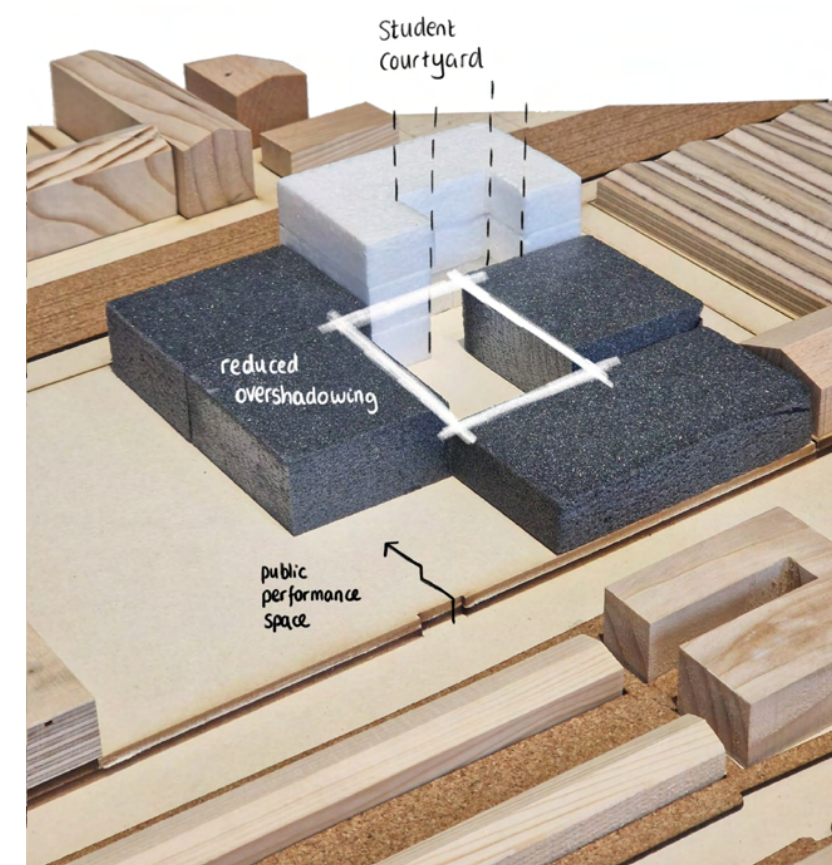
Development

To track how our design evolved and analyse each idea, we created massing models as our design developed. This allowed us to see the proposals in the context of the site, and how they interacted with the surroundings.

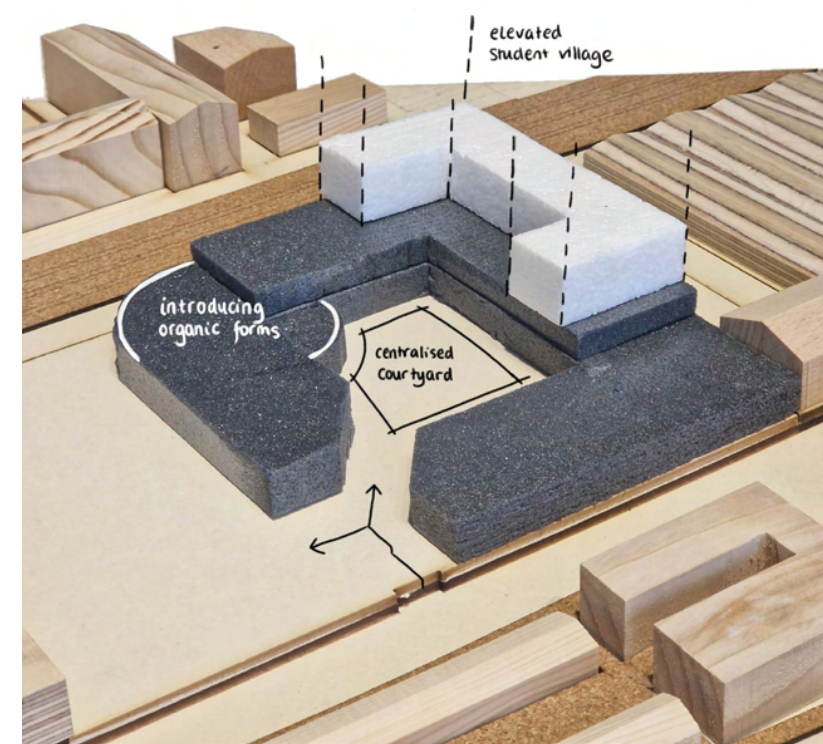
Beginning with the mass of the site, we prioritised access to light and privacy. This resulted in two courtyards, however overshadowing was a clear issue which led to just a singular courtyard. Separation for the students became vertical, creating a village above the teaching. Organic forms then came in, a result of our subject choices, which we introduced in the building form to begin with, and then the colonnade.



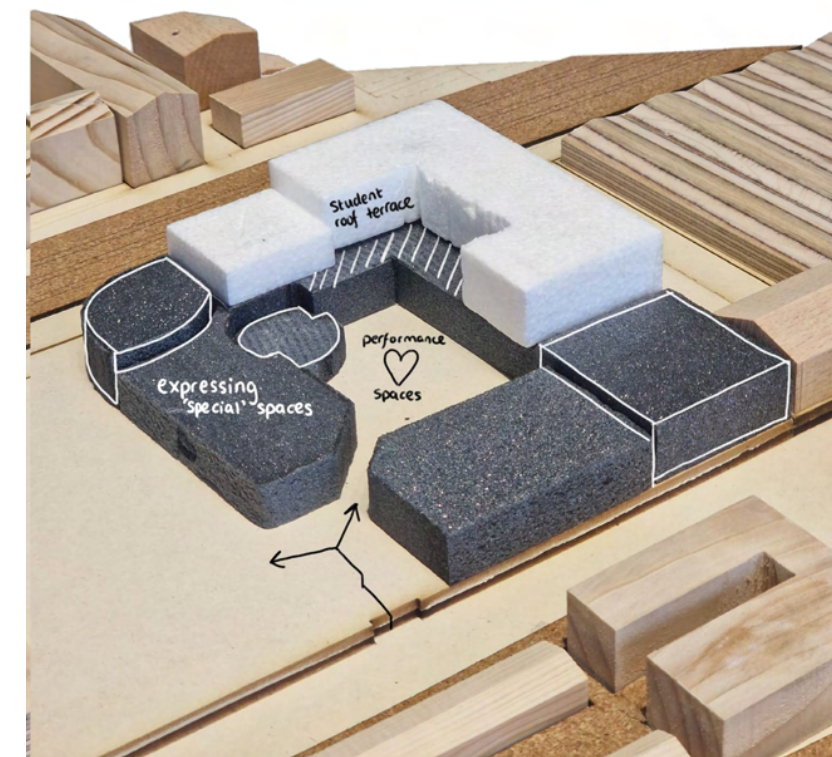
Gauging out of a singular mass



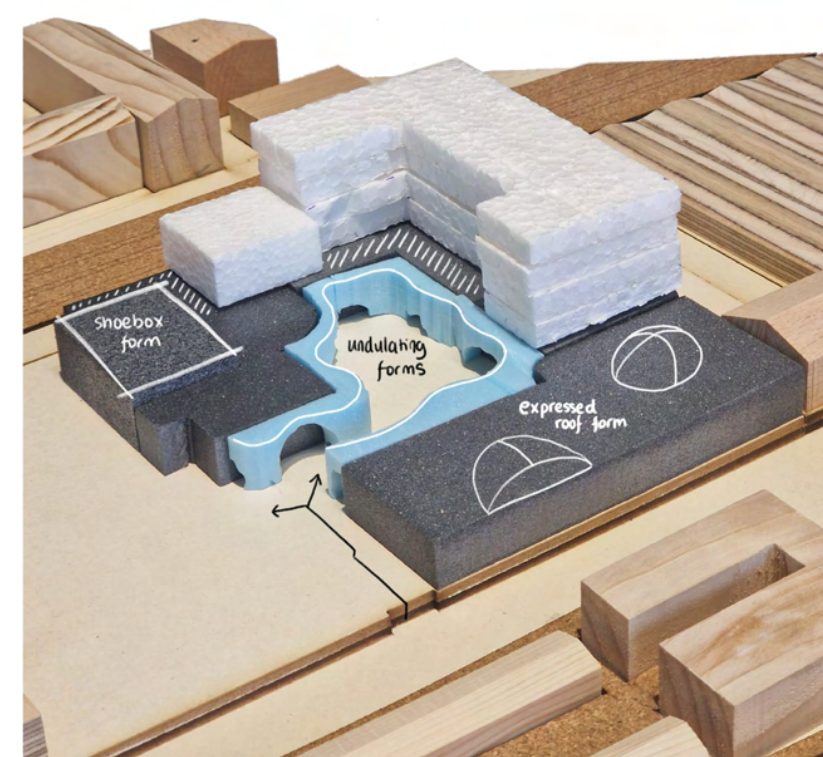
Merging of two courtyards



Higher massing towards the North East



Sculpting the roof



Linking the inner perimeter

Week 1

Addressing the Brief

Having never dealt with a building of this scale, we entered the project optimistically. In later weeks we came to realise how naive we were, however our attitude made for a good start to the project!

Choosing our Subjects

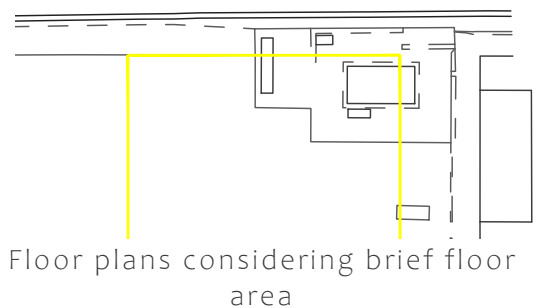
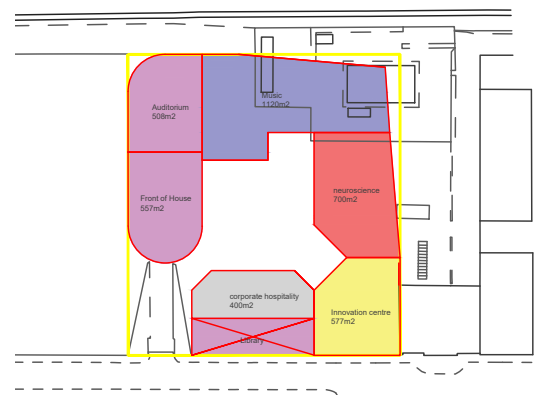
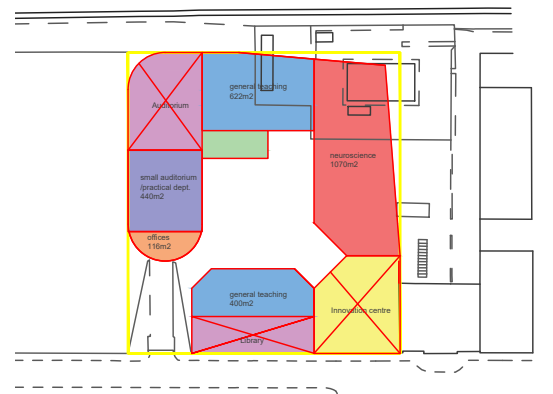
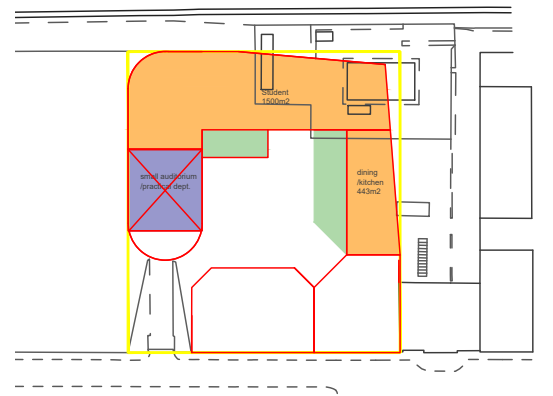
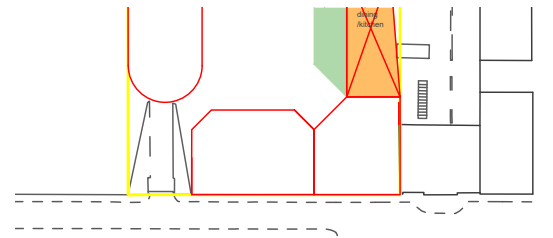
Having researched the available higher education, and ruling these subjects out, we quickly landed on music. We were excited by the interesting spaces it would allow us to design, and the potential for community engagement. Swindon's railway heritage is linked to the founding of the NHS and so we explored subjects around health. We liked the link that neuroscience shared to music, and the collaboration we could create with the design.

Visiting the Site

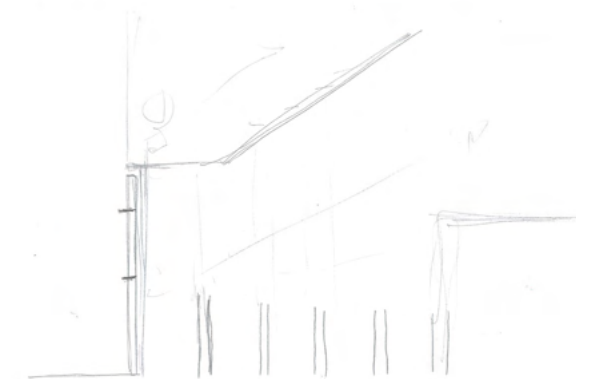
Our day in Swindon spent exploring the site (and the shops) allowed us to see the context we were designing in. The neighbouring railway village stood out to us as a key characteristic of the area, as well as the adjacent warehouses and railway. The height of the surrounding buildings stuck in our minds too, and respecting this became important to our design process.

Working as a Team

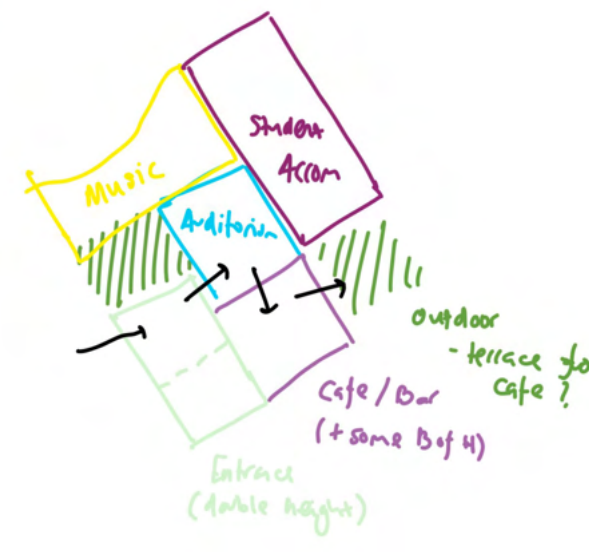
As a group, some of us had never met each other, let alone worked together. This first week of getting to know one another was fun, featuring our group dog!



Analysing the public frontage and access to site



Historic wall treatment ideas



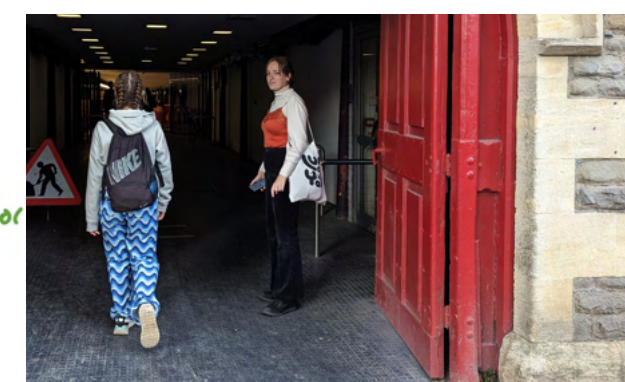
Early site plan



Group bonding, feat. Stella



Looking into the site entry



Exploring Swindon



Measuring the underpass columns (next time bring a tape measure...)

Week 2

Working with the Context

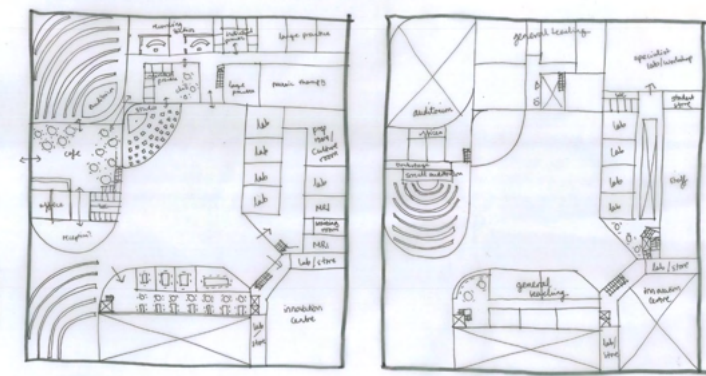
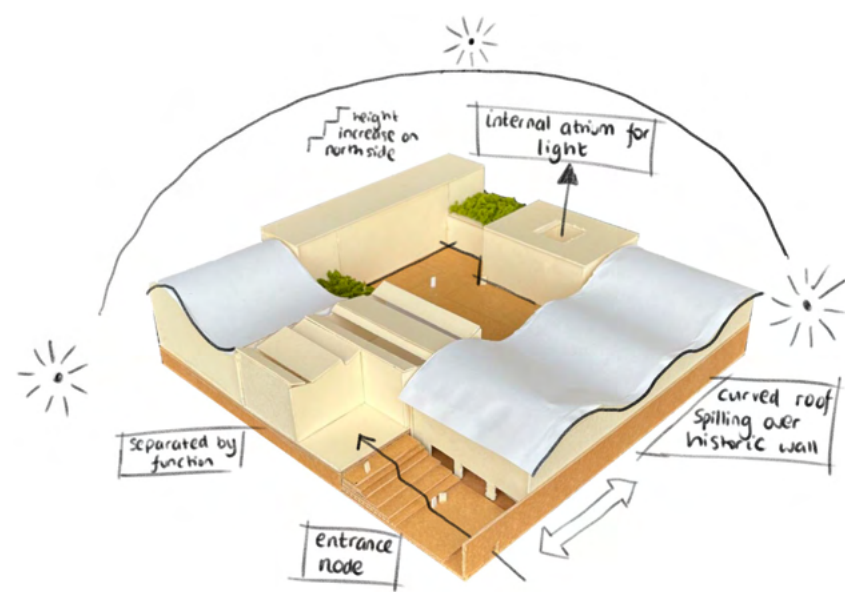
Having analysed our site visit, we were able to ensure our zoning plan responded to the context. We were keen to have two main public frontages for the library and auditorium, with a more secluded area for student living and teaching. Engaging with the surrounding community was important throughout the design process, especially after further research into the history of the GWR.

Addressing the Massing

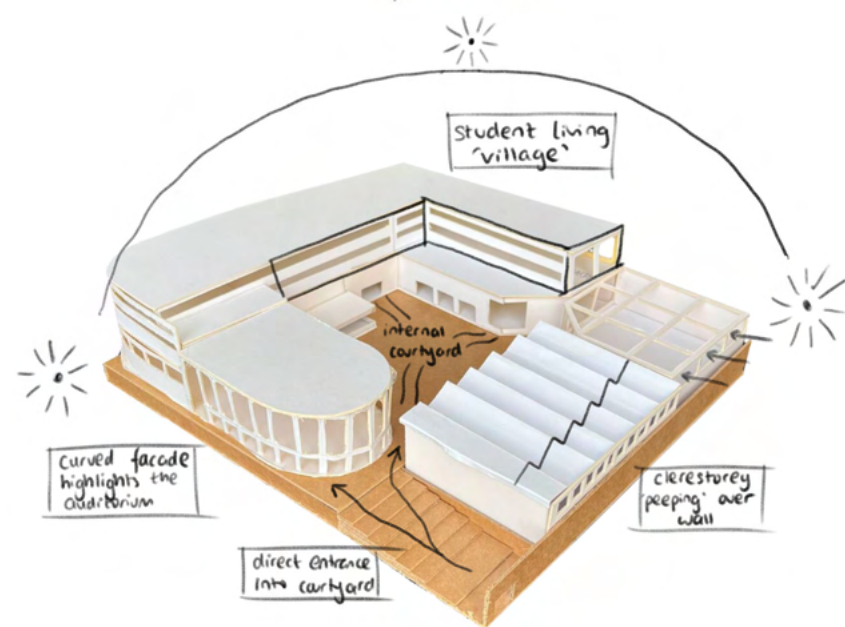
We created concept models to experiment with form and roof structures. They combined our main concepts of the week - vertical separation, courtyard spaces and organic forms.

Resolving the Zoning and Arrival

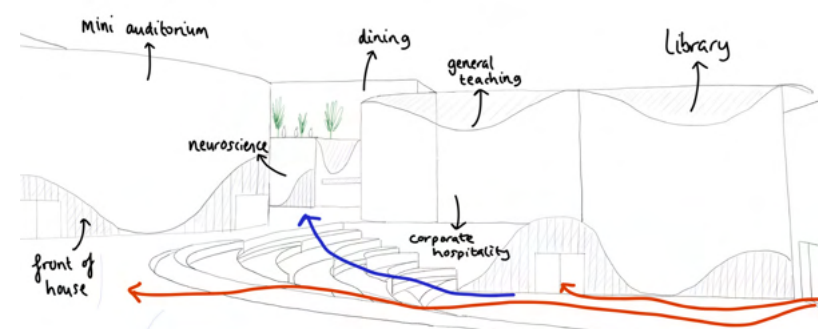
Having explored different variations of zoning and massing (which can be seen in the introduction) we resolved the overall plan fairly early on in the process. This allowed us to begin exploring the landscaping and arrival, as well as some facade treatment ideas.



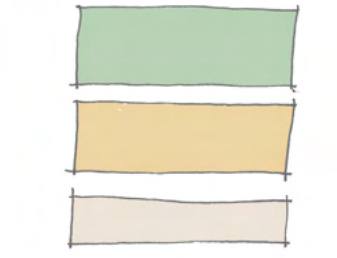
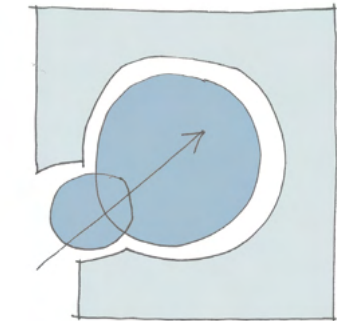
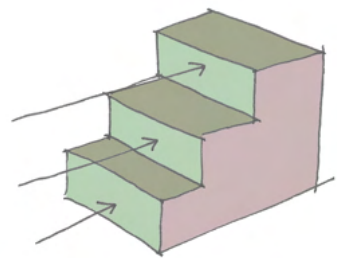
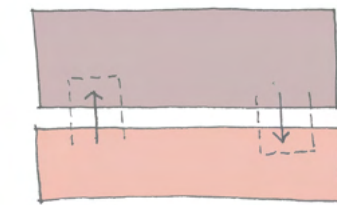
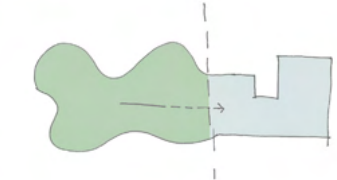
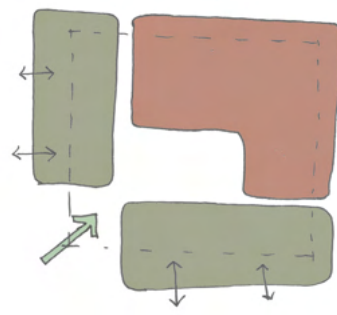
An option for the plan



Annotated concept models



Arrival perspective



Parti diagrams

Week 3

Refining the Plans

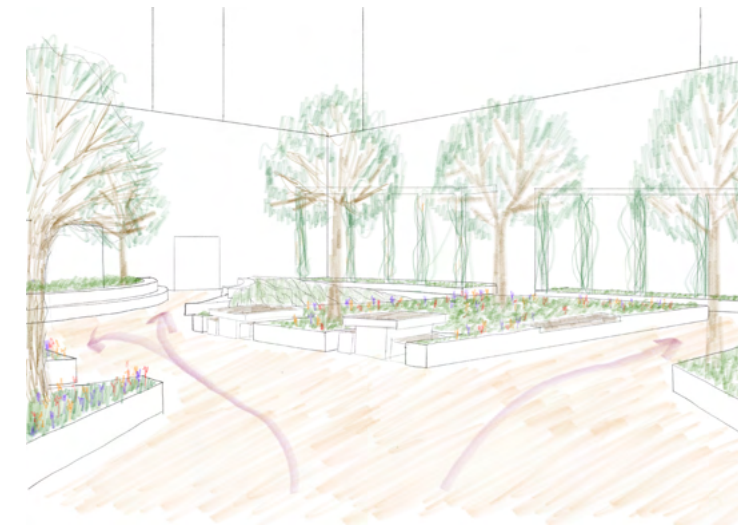
We found ourselves in a good position, however the combination of the curves and linear forms needed to be resolved. By making the curves more specific to only the performance spaces the plans developed. The student accommodation was changed too, in order to maximise the east and west facing edges. Overall, the plans became more particular and specific.

Experimenting with Structure

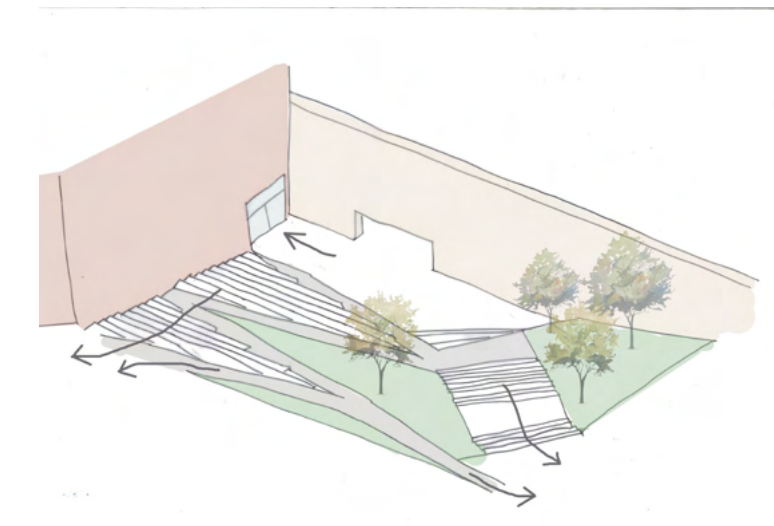
Building on the previous weeks feedback that the engineering needed to drive the project more, we explored different strategies. The innovation centre lent itself to an expressive form which reflected the innovative work taking place in the space, and at this point we found tree trusses.

Focus on Landscaping

The large courtyard space began to be developed, creating a green area in a midst of the urban landscape. The arrival sequence of the scheme, and the link into the adjacent public realm was an important part of the week's progress.



Courtyard perspective



Entrance visual



Group discussions descending into chaos

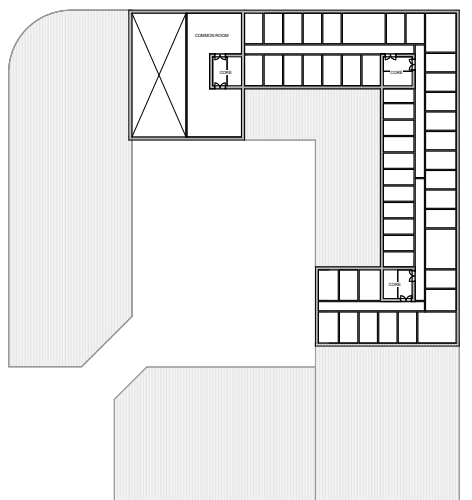
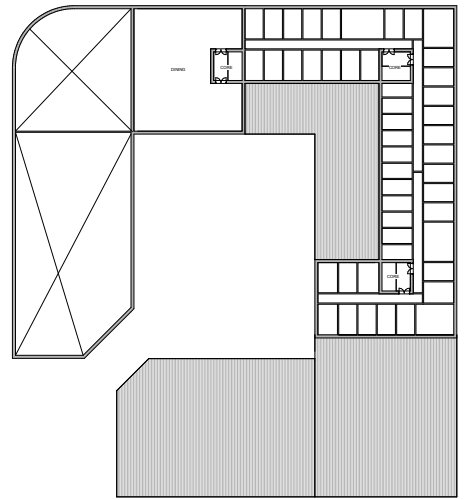
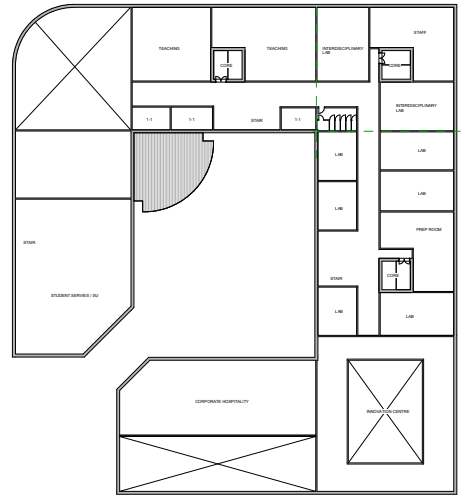
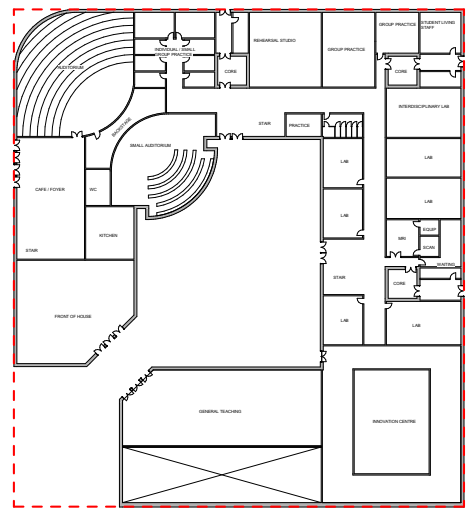


Tree truss precedent (Ridi Group, n.d.)

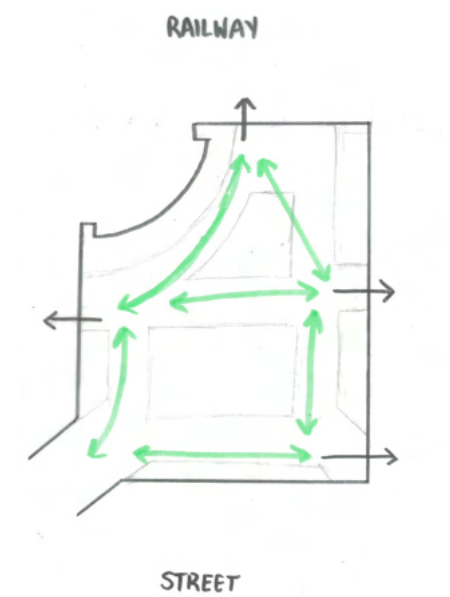


Elevation sketch

Resonance



Floor plans



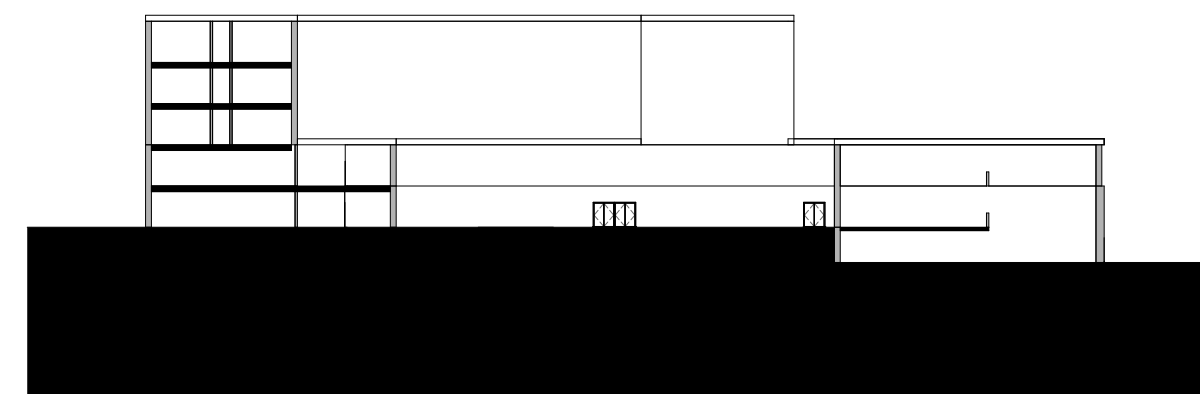
Courtyard movement analysis



Many group meetings!



Resolving the plans



North-South section



More group time!

Week 4

Getting Creative

Our design was lacking in character, and this led us to rethink several spaces. Our teaching became more integrated, capturing the link between neuroscience and music. The student accommodation had a more innovative approach with two-storey flats that integrated music and encouraged a community atmosphere.

Preparing for Interim

We had a busy week developing our scheme and preparing our drawings for review. It was worth the long hours though, because we were able to effectively communicate and present a design that we were proud of.

Coordinating the Design

Having divided up the design, in order to manage workload, it needed to be combined into one cohesive building. It was a week of bringing all of the pieces together, and making everything specific to our scheme.



Floor plan

Week 5

Maintaining the Direction

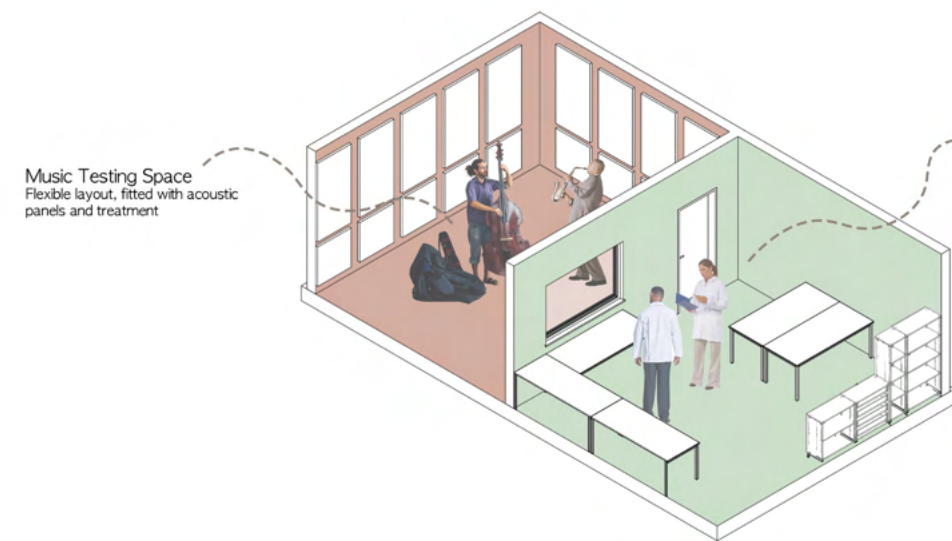
After our interim review, we recollectd as a group and renewed our motivation. It was the middle point during our project so we ensured everyone felt supported in order to continue making progress. We took time to take a step back from our project and evaluate everything that we had done so far, giving us new insights into our design.

Group Discussions

Acting on the feedback of the interim required a lot of group meetings. We needed to utilise the courtyard and make it into the heart of the scheme, which we achieved through integrating performance spaces into it. Our work focused on structural strategies too, developing the space truss of the innovation centre. We re-thought our auditorium, and allowed it to be driven by purely acoustics, resulting in a new shoe-box shape.



Her face says it all...

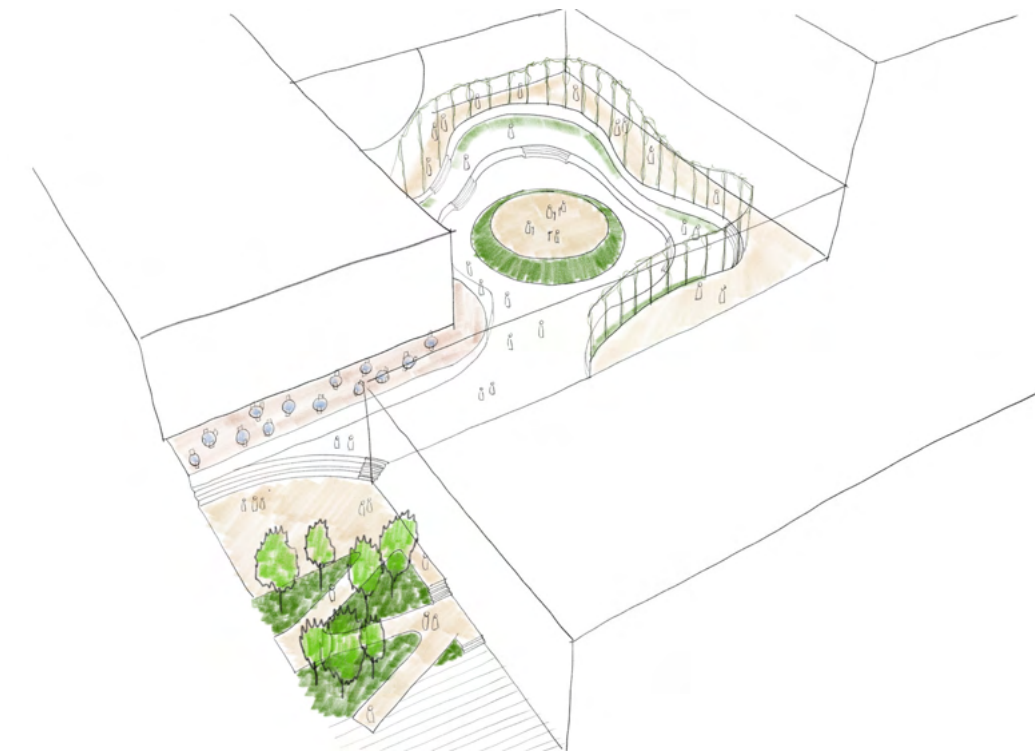


Integrated lab

Lab Observation Space
Small-scale lab facilities, specialist recording equipment



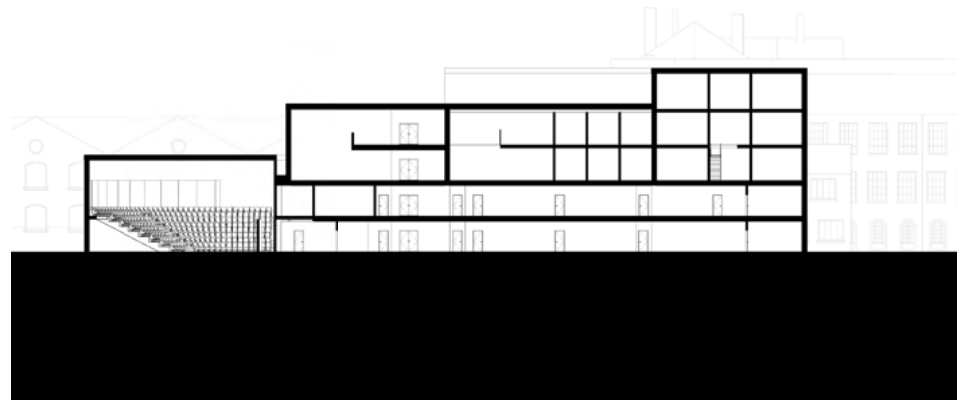
Vertical circulation in accommodation



Site isometric



Group meeting



East-West section



Street-facing elevation

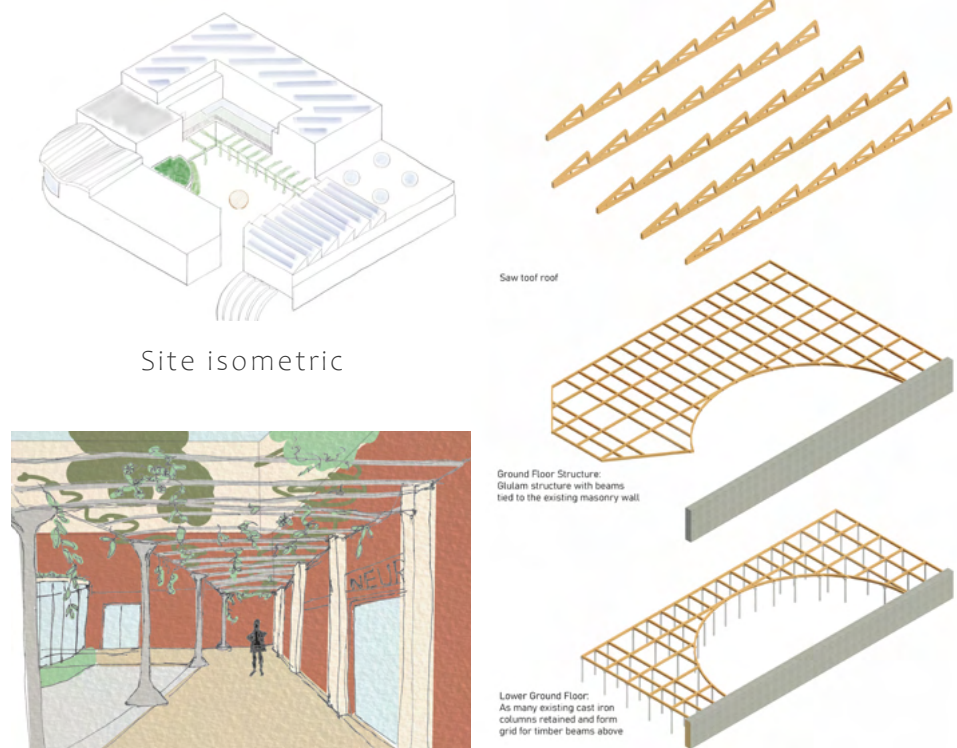


Landscaping concept



Instrument library precedent (Visit Phoenix, n.d.)

"You know your group is crazy, right?" - Anonymous architect

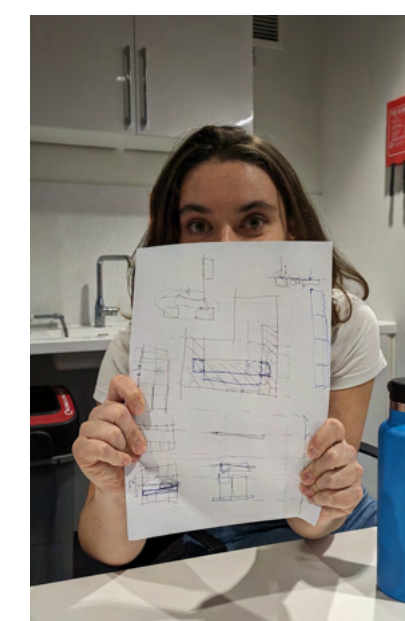


114 colonnade perspective

Library structural strategy



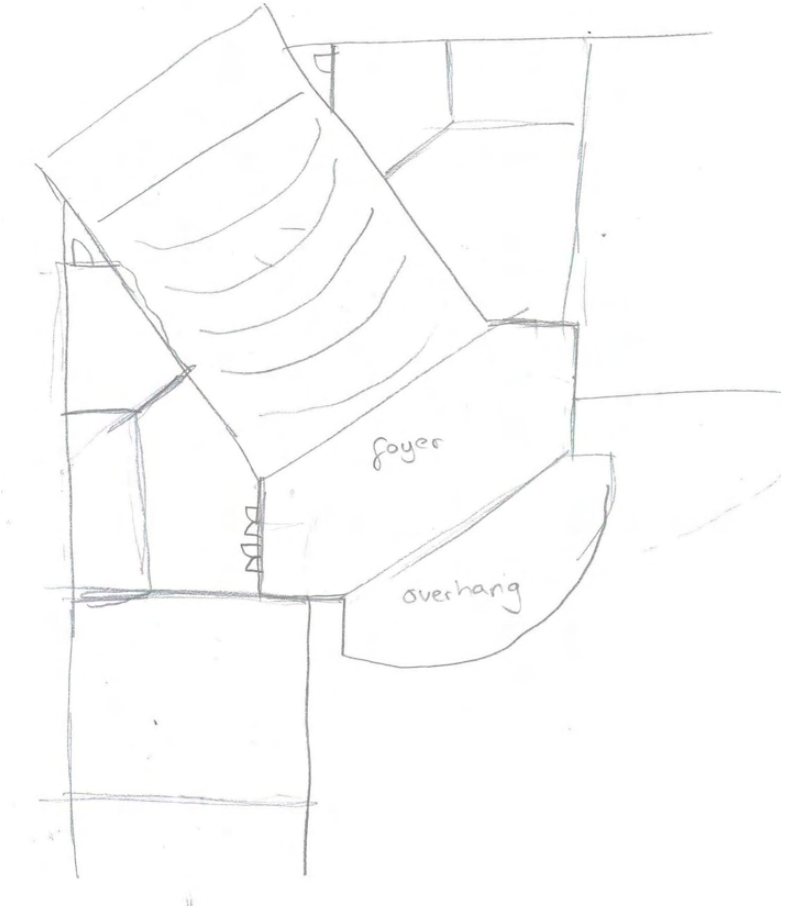
Team work!



Reworking the plans



Perspective from the courtyard



Sketch plan

Week 6

Keeping Spirits Up

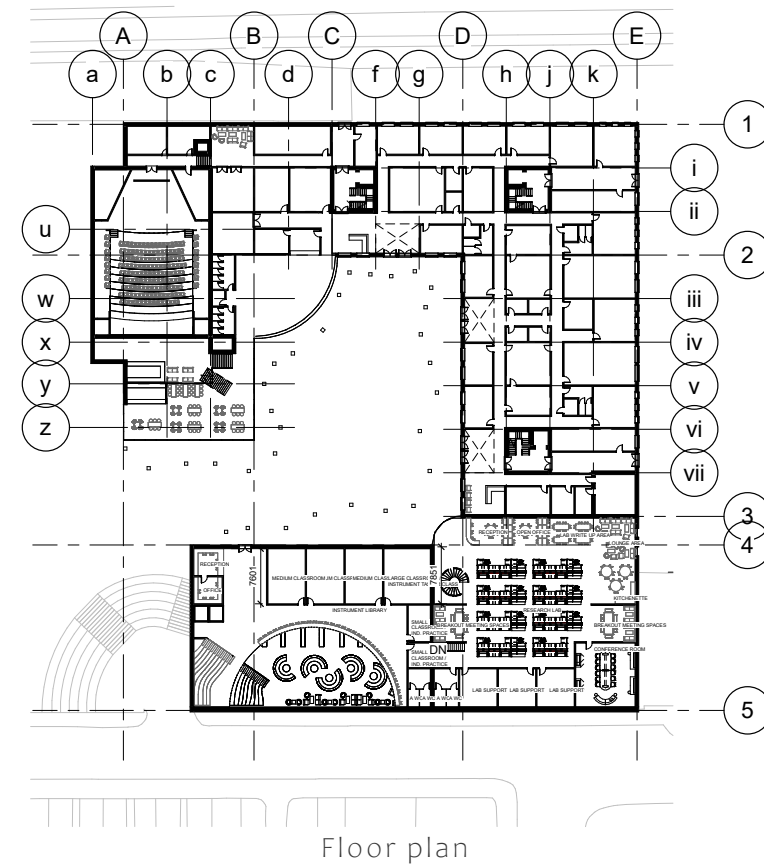
Going into this week, it was important to push ourselves to develop the design. This resulted in a new approach to many areas of the building, and our sanity was kept intact by chocolate runs and outdoor walks as motivation.

Elevational Strategy

Our elevations had been neglected in our process, so a lot of emphasis was put on resolving them. We designed an intricate fin facade system, which undulates and forms the colonnade too. The material choices were hemp cladding at the student levels, and recycled aluminium fins for the lower floors of the building.

Experimenting with Roof Form

Having designed a saw-tooth roof, we decided the organic form emerging in our facade treatment required a different roof strategy.



Floor plan

Week 7

Pulling Together Our Scheme

We made some last minute changes to the scheme, based upon feedback from tutorials. Environmentally, our recycled aluminium did not align with our principle of achieving a low embodied carbon. This resulted in the decision to use timber for the fins instead, and recycled zinc for only the auditorium and library/innovation centre roof. We also wrapped the fin facade around the entire building too, creating a cohesive elevation response.

The Design Freeze

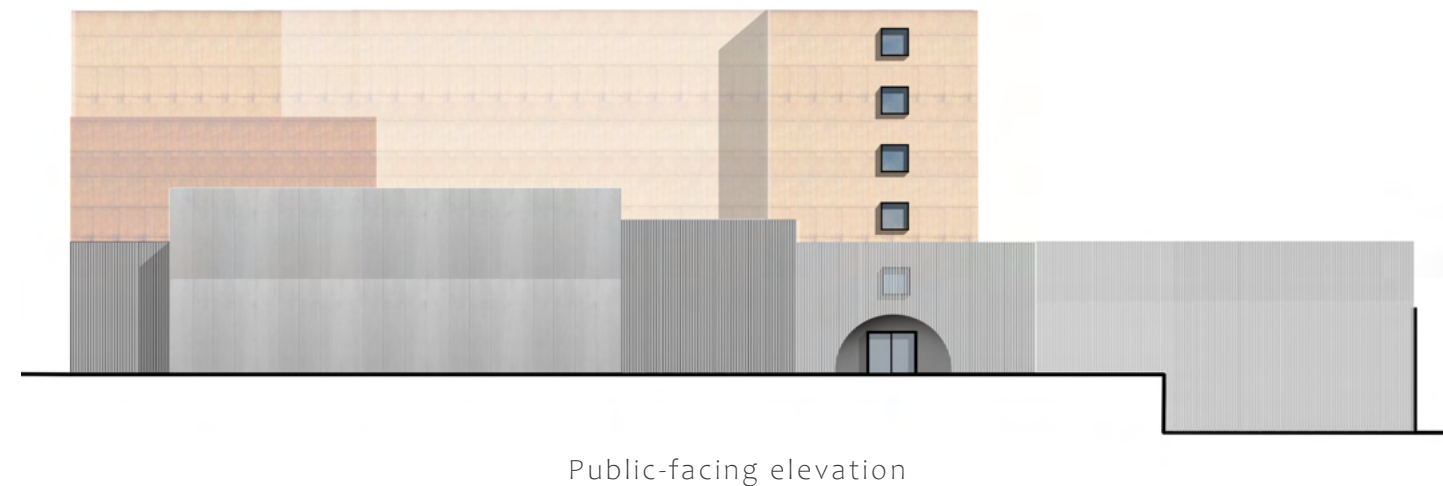
Ensuring everything was finalised for the design freeze required a final push to ensure our design was in the best place possible. Following the timetabled freeze was beneficial for us, as we were able to begin producing final drawings early on, in preparation for the review.

Group Bonding

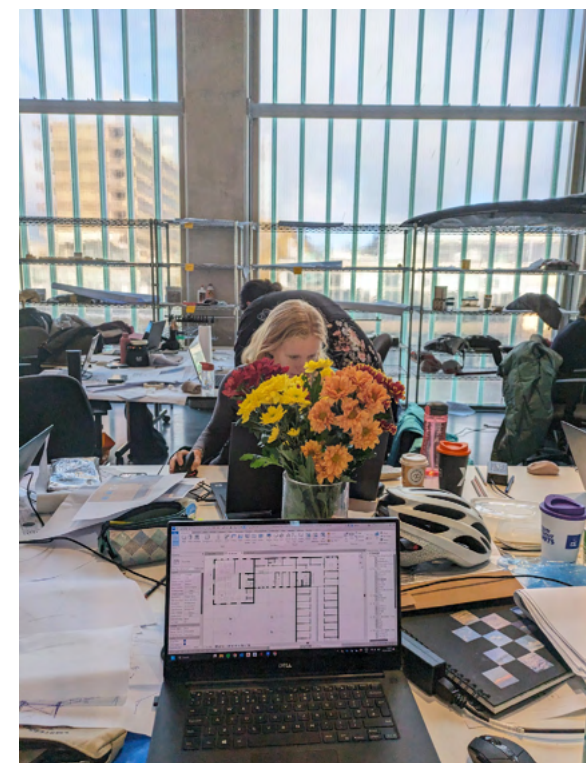
At the end of a long week, a group meal allowed us to relax and reflect on the design we had created!



Putting the mental health garden to use...



Public-facing elevation



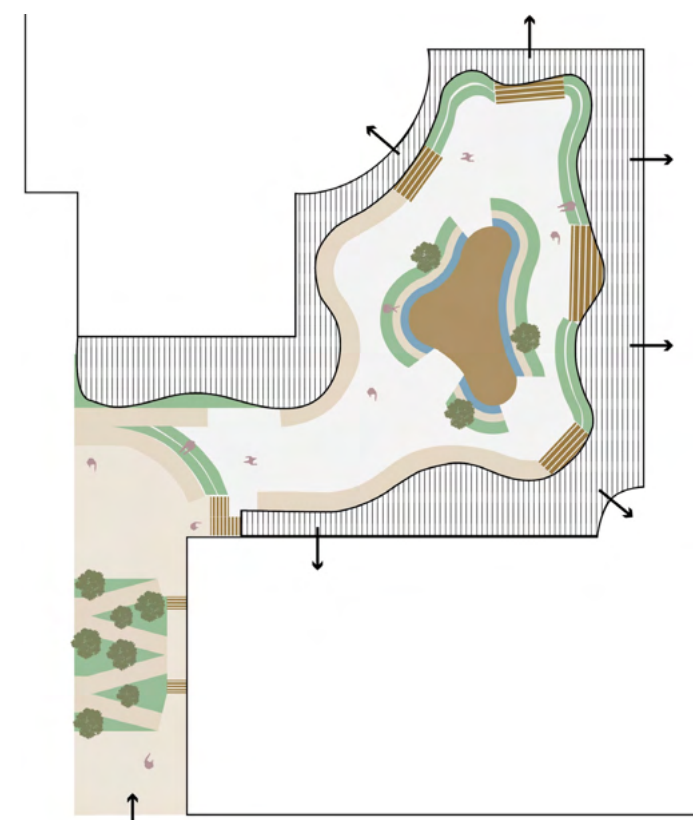
Motivational flowers!



Celebrating the design freeze!



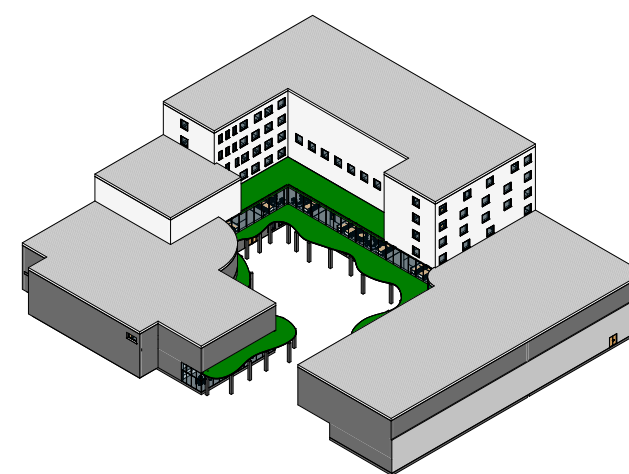
Courtyard perspective



Landscape plan



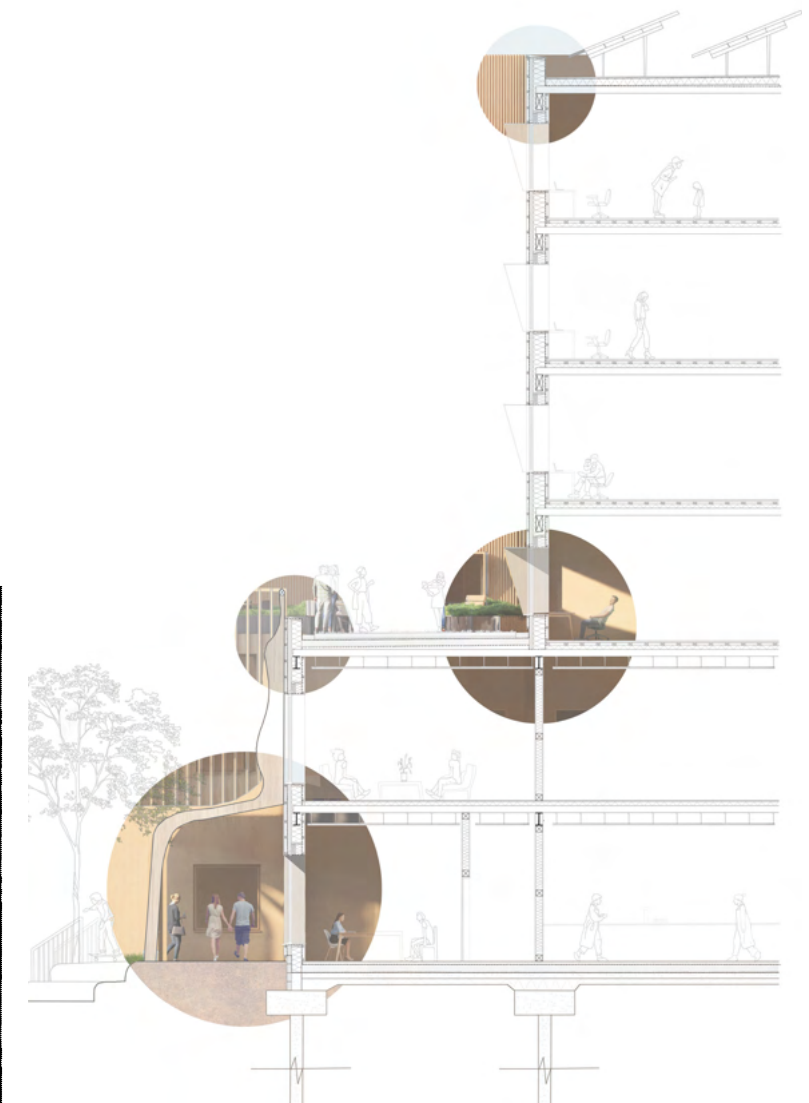
Fin facade precedent (ArchDaily, 2017)



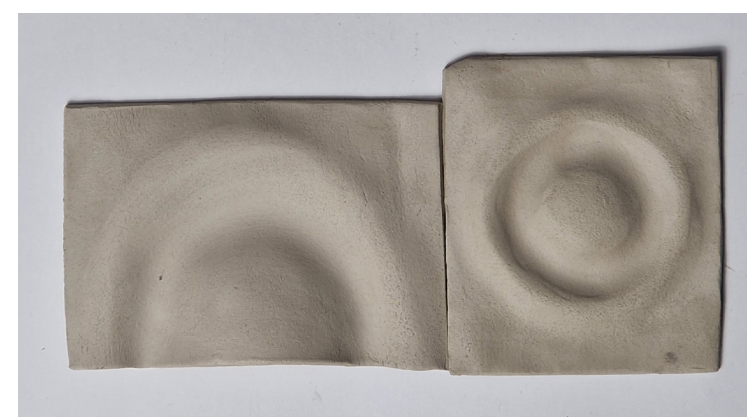
Updated site iso



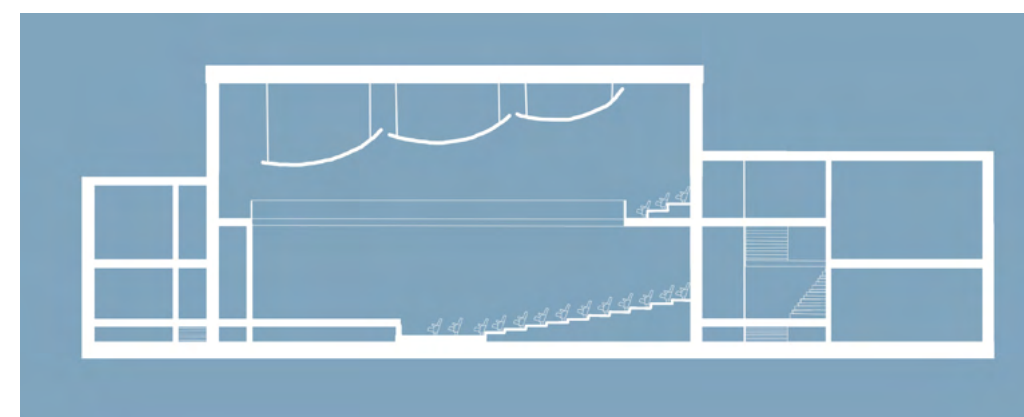
Public-facing elevation



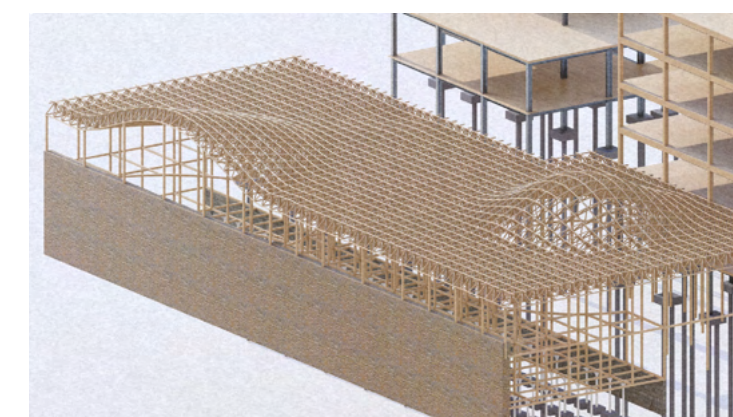
Student-teaching detail section



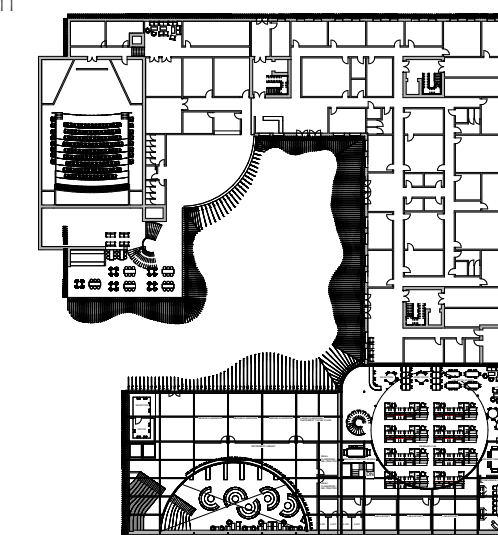
Concept model of library and innovation roof



Auditorium section



Library and innovation centre roof



Floor plan

Week 8

Model Making

Creating a model of our final proposal bought our scheme to life, and whilst it was very intricate to make it effectively communicated the design. The model was a true example of team work too, with a production line to stick on every single fin to the building.

Preparing for Final Review

Having spent our time creating drawings for the engineers, it was time to finalise our presentation for the final review. After a long week making sure everything was in place, the design was well-received. The late nights were worth it, and allowed us to be proud of the scheme we presented.



Finally bedtime!



Modelling process



Performance space perspective



Street-facing elevation

"Are you smiling because you're happy, or because you're delerious?" - Daniel Wong



Mid-review!



"The most geometrically exciting scheme I've seen all day" - Kai, structural tutor

Reflections



Adam

The TED project was a challenging and inspiring process where I enjoyed the opportunity to work alongside talented architects and engineers. I delved deep into how to effectively design the building environment for a scheme which was eye opening to a type of engineering I never thought would interest me. What I will take away from this project is the importance of communication to be able to work with a design team to create a cohesive design. Overall, I enjoyed creating the scheme design and would love to work on similar projects in the future.

Beth

TED has been an incredibly rewarding experience which has given me lots of insight into what it is like working within a multidisciplinary team. It has been one of my favourite projects so far at university, and I have learnt a huge amount over the last 8 weeks. Not only have I developed my engineering skills, but I also think that I have gained a lot of knowledge on the environmental and architectural side of the project. I think that we worked well as a team, and I am very proud of the scheme that we have come up with. The reason behind our chosen subjects is very clear, and I think that our building incorporates them very well.



Callie

It was very exciting working in the largest group dynamic to date, which proved to be rewarding most of the time but occasionally quite frustrating. I feel blessed to have such great group members to lean on when times got rough and the workload was very overwhelming. Our scheme got divided between the group members quite naturally, with a good amount of switching up who did what, depending on who managed to get through their list which worked quite effectively.

Working with the civil engineers really influenced our design from the early stages, and it was interesting to hear their input into everything. Developing the cross over between our two subjects, and seeing how far we could push it was thrilling.

This project was an exciting challenge and honestly I just want to go and sleep.



Éabha

I was nervous to begin this project, entering into such a large group with many unknowns. Having never worked with most people in the group, I am glad to have come out of the project with new friends and new knowledge.

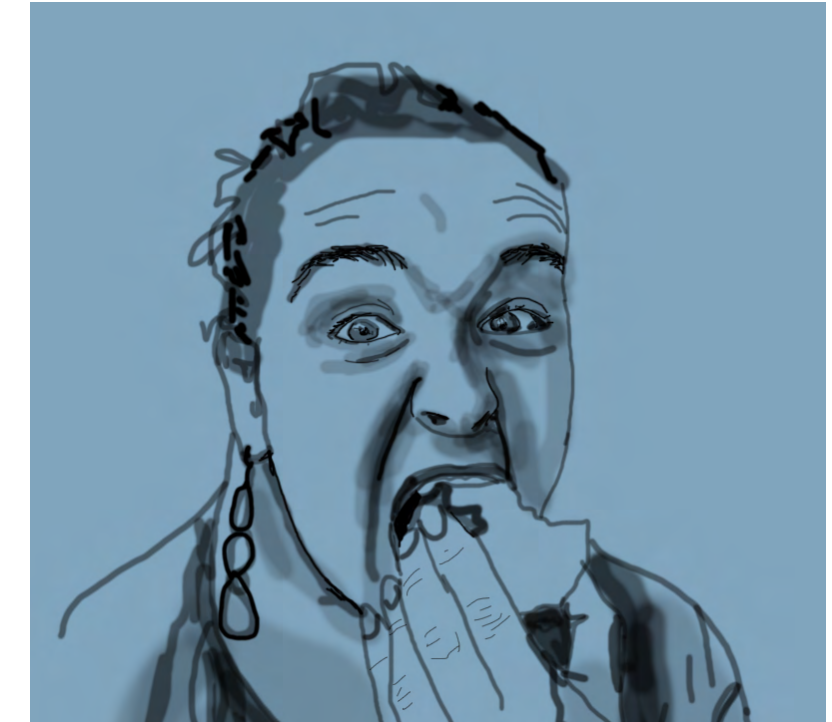
Working alongside the engineers opened my eyes to their perspective on design. Whilst our group discussions were often tense, the final design reflects all of the hardwork we put into resolving the issues. I enjoyed learning how to design with their consideration in mind, and they were great at supporting most of our crazy ideas.

As a group, our dynamic was very successful. From the offset we played to our strengths, and the work was divided up in a natural way based on our individual experiences. We helped each other out whenever it was needed, and the attitude that we were all in it together made the long hours easier to manage.

I am proud of the scheme that we designed, this has been the simultaneously the most challenging and most rewarding project I have had the pleasure to do.

Emma

Throughout the 8 weeks I have enjoyed the opportunity of working collaboratively with engineers, developing environmental and structural responses alongside our design. Despite varying opinions, our design came together well through thorough discussions and explorations of ideas. We defined our key concepts early and so were able to fully integrate them into our scheme. We continued to push our scheme as far as we could, taking on advice from our tutors, or at least exploring suggestions before out ruling them. The team adapted well to challenges as our design developed, and shared the workload. I enjoyed the conceptual stages, as we made sure that everyone's initial ideas were integrated early on, and it was exciting to throw around ideas and bounce off of each other. Overall, despite the lack of sleep, TED has been my favourite project yet and I am grateful to my teammates!



Tara

As our longest and most complex project so far, TED has been a whirlwind of development, creativity and collaboration. Working with civil engineers again this year has been a highly rewarding and informative experience, allowing us to implement dynamic, engineering-driven design features from an early stage. This proved vital throughout the project and gave us the chance to challenge the brief in new and exciting ways. I have also appreciated the opportunity to engage with brief resolution in greater depth than previous years, with time to interrogate the scheme at every scale and develop the driving concepts and design intent.

While there have been moments of frustration and stress throughout the past 10 weeks, my overall experience of the project and group dynamic has been highly rewarding and enjoyable. I am very grateful to have experienced the TED project alongside this excellent, (mildly) crazy team, and am truly proud of the scheme we have created!

Rishi

While often challenging, my experiences throughout the project have proven to be innovative and transformative. It's been a joy to develop engineering strategy alongside architectural concepts, to drive a design that engages the entire team. Working to our collective strengths allowed us to achieve our ambition of a music and neuroscience inspired institute with a sustainable end-of-life strategy. In the last 8 weeks, I've learnt a great deal and have come to appreciate the architectural process even more. I am proud of the efficient and creative collaboration that underpins the interconnectedness of engineering, architecture, and environmental factors, providing invaluable lessons for the future.



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