Spartan Works Reuse
No Plastic Architecture
Women in Construction

Louise Holden
Masters of Architecture
Professional studies 2

Content and Foreword

The colour code

- The Common Approach
- The Uncommon Material
- Women in construction
- Women as the user

Definition of commons:
The popular and well used choice
...
People with neurodiversity find fonts that resonate with handwriting easier to read so the font of this portfolio is selected for that purpose, along with handwritten notes and annotations
This project is designed with the understanding that you cannot design for everyone, no two people with neurodiversity are the same.

Material analysis will be asessed using this ranking system, the more colour the better

Material

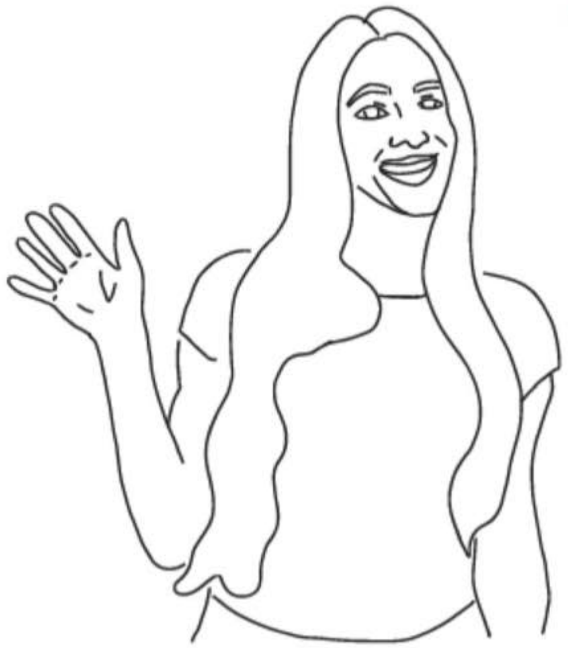
Durability	○○○○○
Cost	○○○○○
Sustainability	○○○○○
Carbon	○○○○○
Fire resistance	○○○○○
Breathability	○○○○○

PS1 Summary

Project summary

For my PS1 project, I looked into creating a space for Women with Neurodiversity. It was an inclusive space where they can explore workshop skills, a space often taken over by men.

The final space included calming and stimulation rooms, with sound proofing and controlled lighting. These were things that were important environmental factors for this project.



Reintroducing the actor

Jenny was my actor for PS1, following her experience and journey through the site. I used research from books such as 'a feminists guide to ADHD' to help explain how not all designs can suit everyone as all needs are different.

Existing Materials

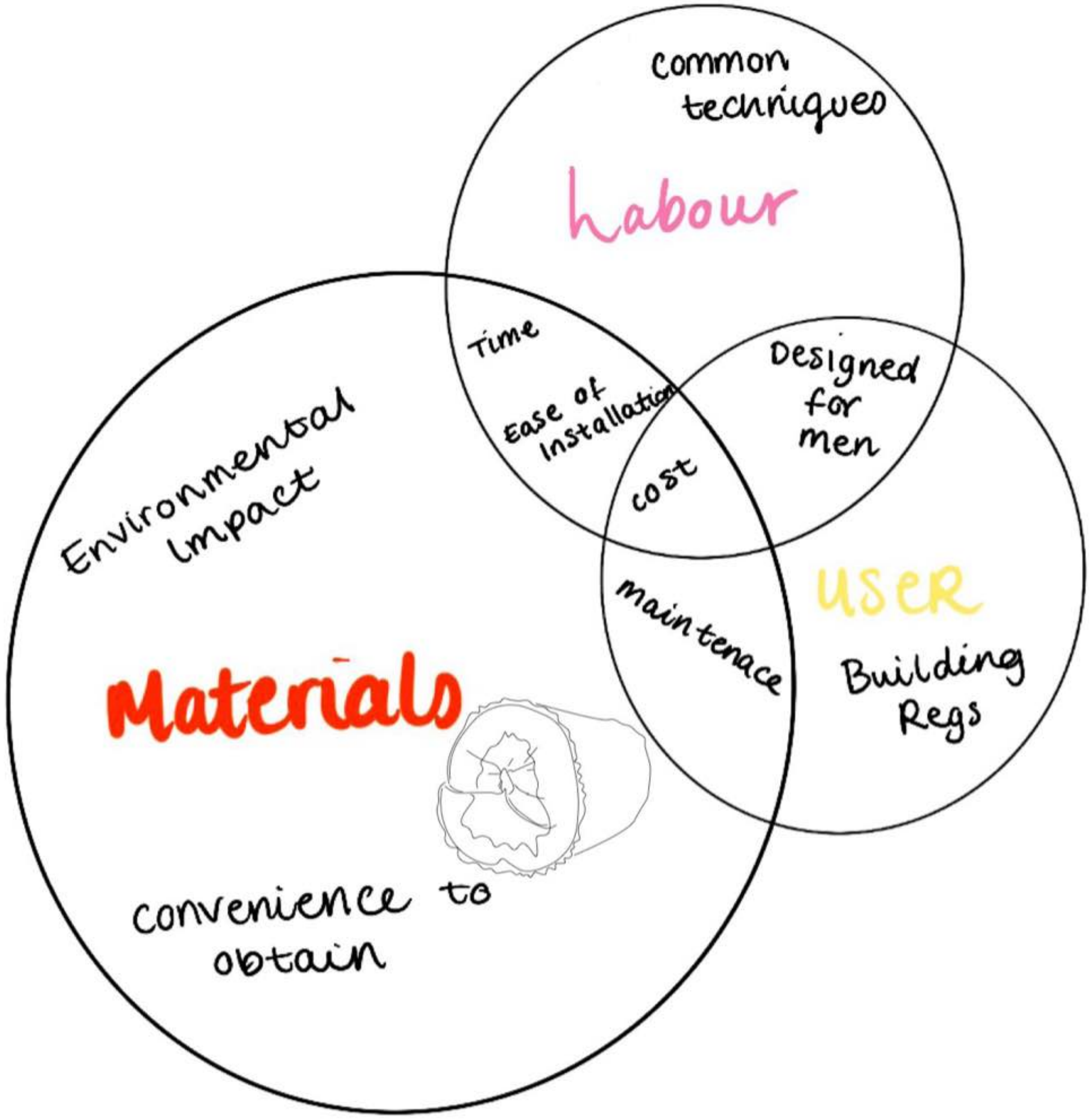
My Project looked at the reuse of the existing materials such as:
- Corrugated steel roofs
- Existing brick
- Existing steel structure
- Rebar steel for hand rails
- Concrete flooring

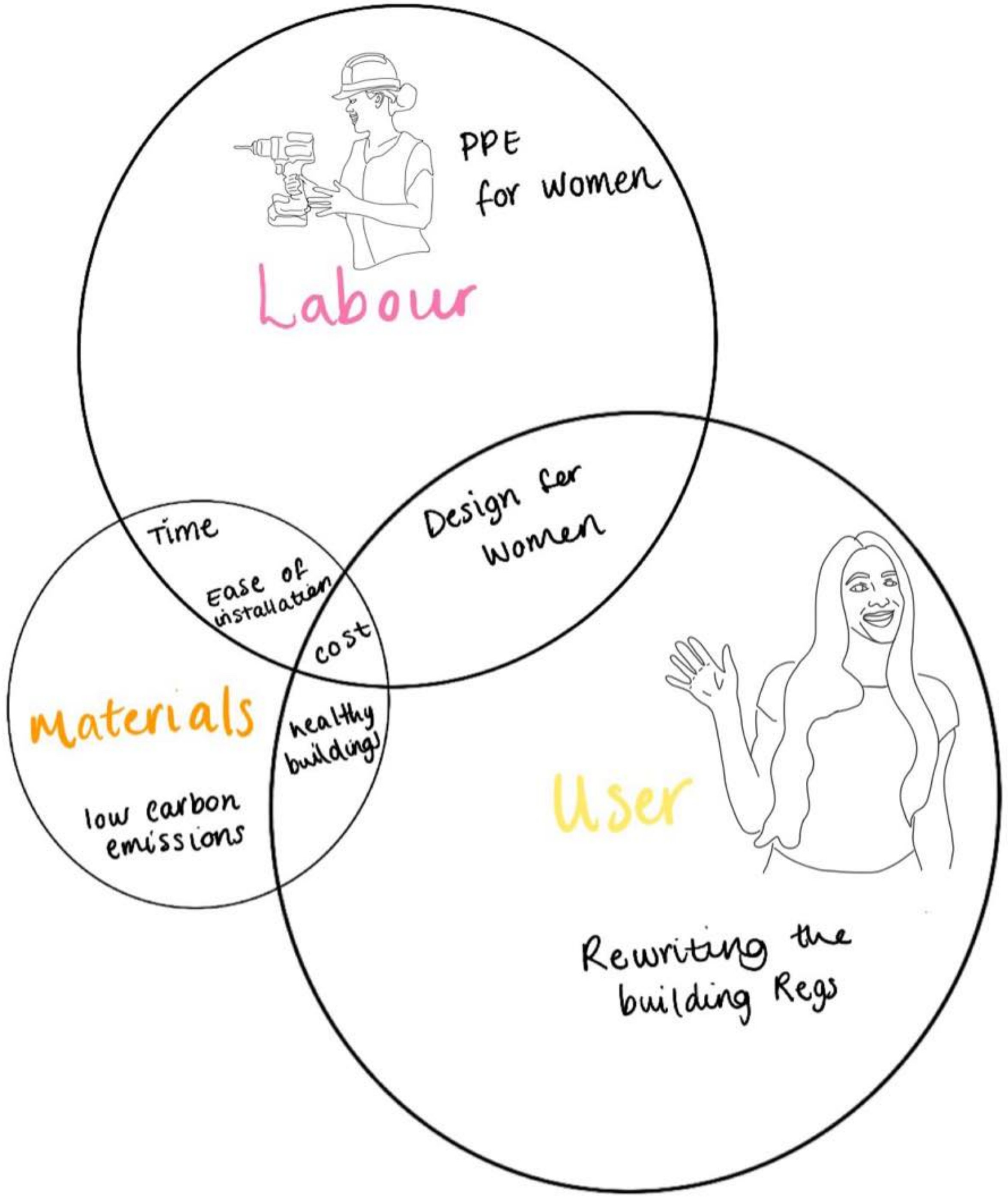
What are we doing in PS2?

Brief:
To analyse the critical approach to common materials and building techniques and explore alternative materials and techniques that can be used, as well as why they are not currently.

Critical Realism
The Situation Common

Critical Theorism
The Future Uncommon





The common uses:
- unsustainable construction techinques
- high embodied carbon materials
- outdated design rules meant for the healthy 30 yr old man

The uncommon explores:
- feminist construction techinques
- no plastic materials with low embodied carbon
- designing for women and inclusivity

What defines your common?
Critical opinion on plastic

Why is plastic used in common construction?


Flexible


Affordable


Durbable

Readily Available

Why is plastic as a common construction a bad thing?

1950's The plastic industry started to take shape

Common types of plastics in construction:

- **PVC** Polyvinyl chloride
- **PE** Polyethylene
- **PC** Polycarbonate
- **PP** Polypropylene
- **HDPE** High-density polyethylene


they are structurally weaker then other materials

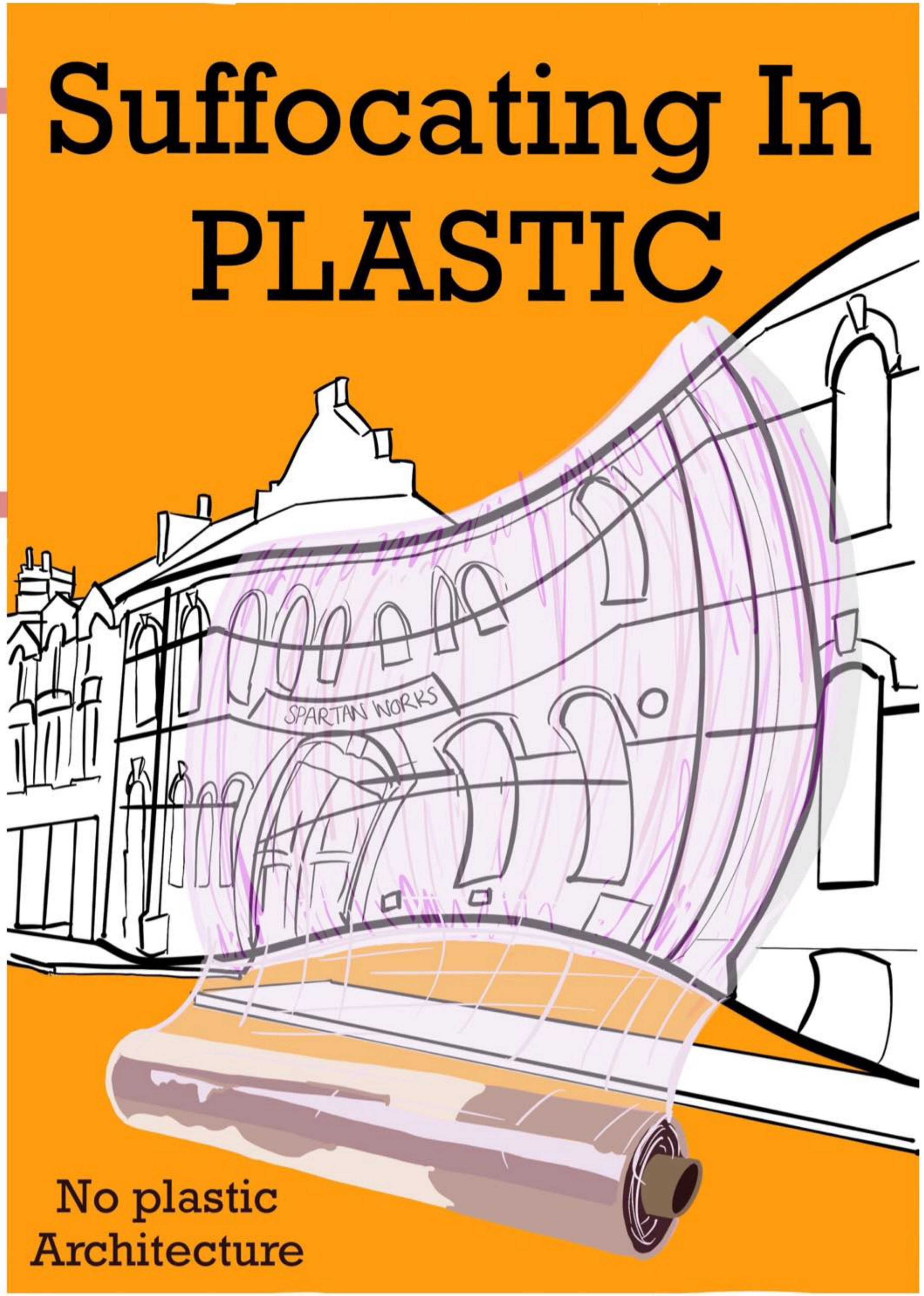

Petroleum based plastics are higly flammable

10,000
2400

Over 10,000 additives used in plastics, 2,400 of which are considered toxic

65 million metric tons of plastic being used by the industry every year.

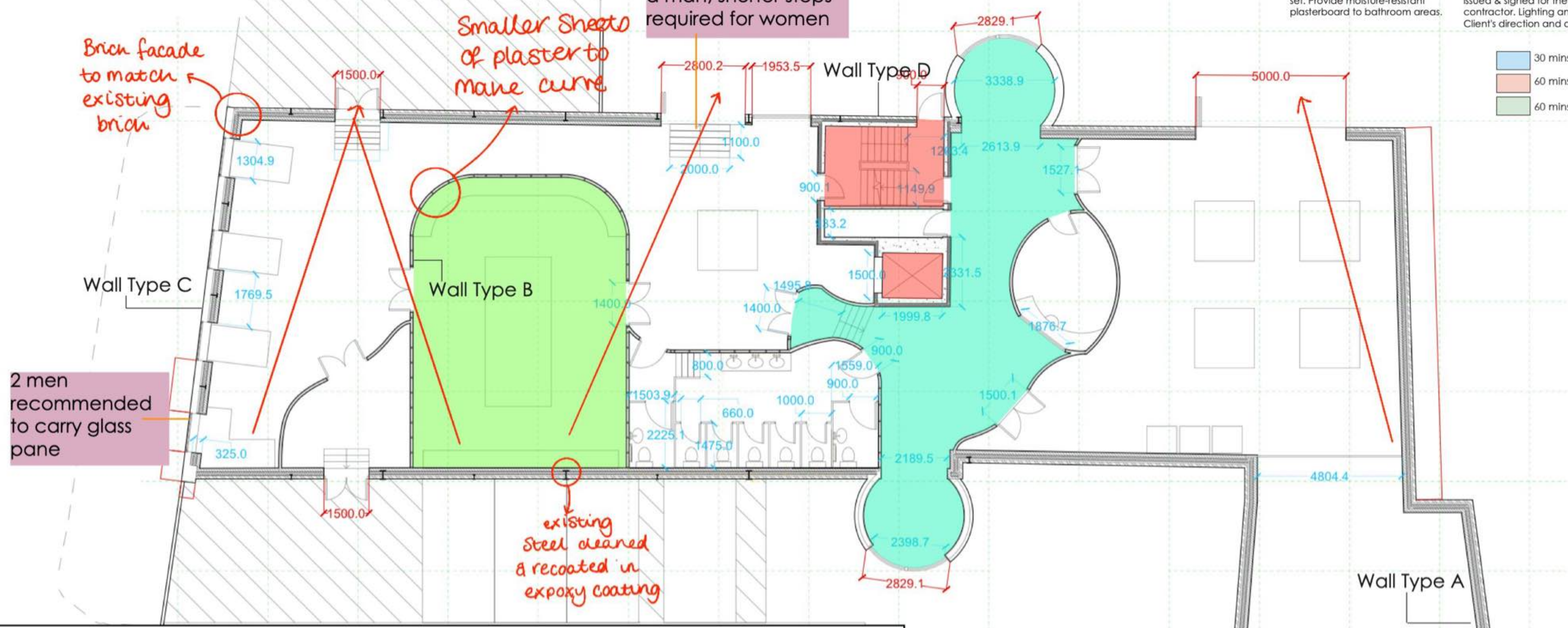
Over the next pages, I will analyse the use of plastic in my common construction, and note any points of change, in red pen,that can be altered in my design



Ground Floor Plan
Construction
Wall build ups on the Ground Floor

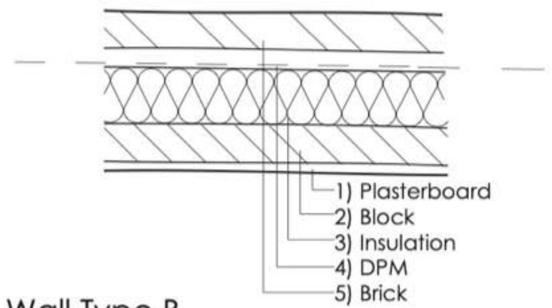
STUDWORK PARTITIONS
All new studwork partitioning to be 100mm timber studs with min. 25mm thick & 10kg/m3 density quilt infill, lined either side with 12.5mm plasterboard and 3mm set. Provide moisture-resistant plasterboard to bathroom areas.

ELECTRICS GENERALLY
All electrical work to comply with the requirements of Approved Document Part P (Electrical Safety) & to be designed, installed,inspected & tested by a competent contractor. If necessary an appropriate BS 7671 Electrical Installation Certificate should be issued & signed for the works by a competent contractor. Lighting and power layout to be to Client's direction and approval.

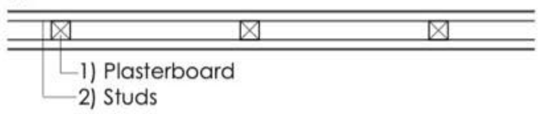


Wall Types
Scale 1:20 @A3

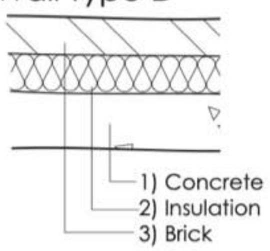
Wall Type A



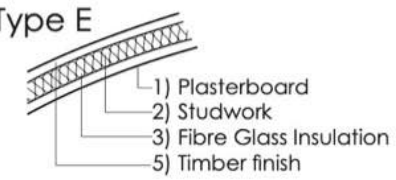
Wall Type B



Wall Type D



Wall Type E



GENERAL NOTES
1. This drawing is not to be scaled. Setting-out to be to figured dimensions. Read in conjunction with all accompanying specifications and Structural Engineer's drawings & details.

2. The Contractor shall take responsibility for maintaining & safeguarding the stability of the existing structures & earthworks on the site throughout the duration of the works.

3. All dimensions to be to structural elements (brickwork, studwork etc.) unless marked (*) which indicates a dimension to a non-structural element, finished surface or opening.

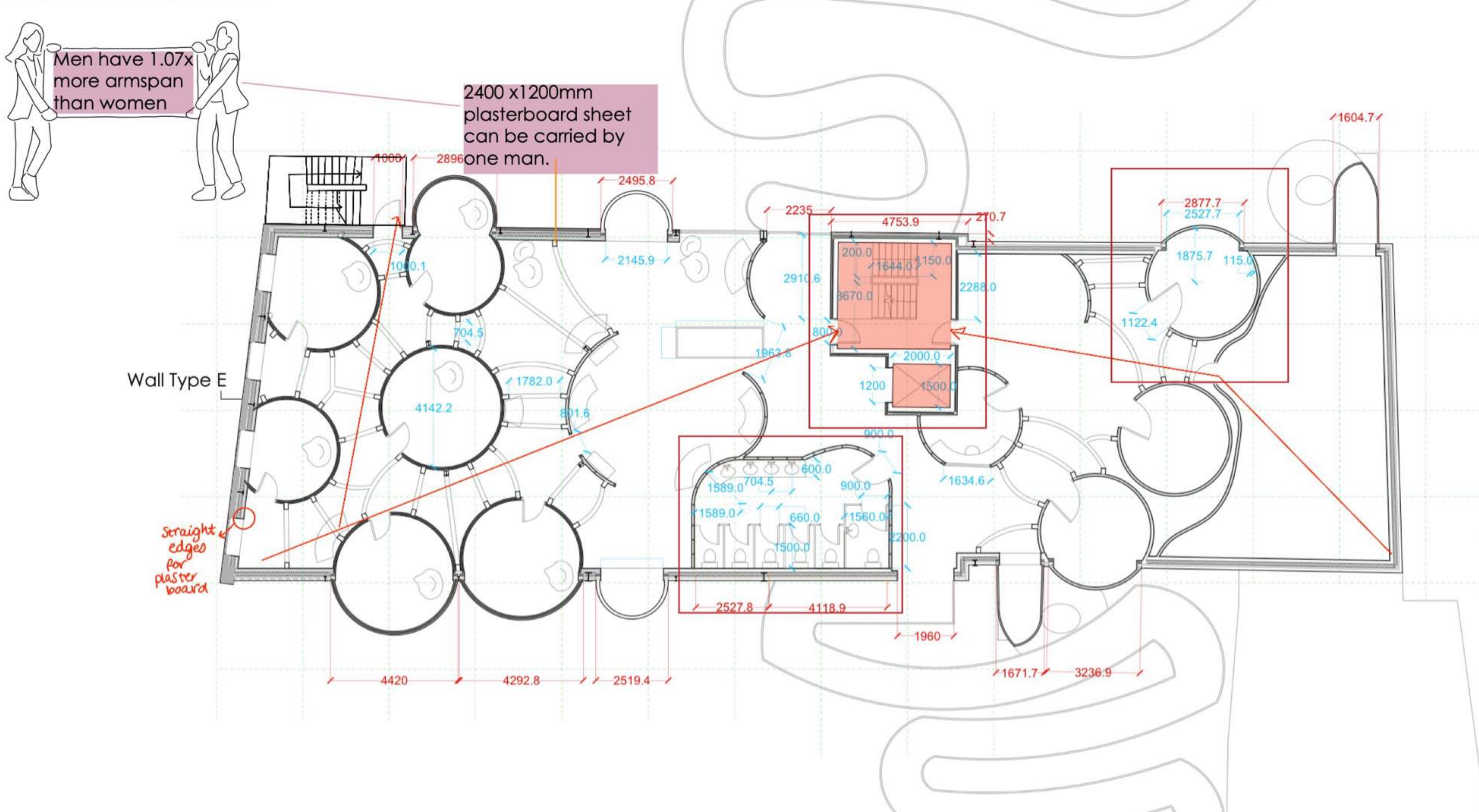
4. All new steelwork to be cleaned, de-scaled and de-greased & painted with 2 coats of red oxide. Provide 2 layers of 12.5mm Gyproc Fireline board and set to all new structural steelwork.

5. All carcassing timbers to be pressure impregnated with preservative with site-cut holes, notches etc. brushed with Hickson 'Ensele' or equal.

6. The Contractor is to carry out the duties and obligations of the Principal Contractor under the CDM 2015 Regulations.

First Floor Plan Construction

Wall build ups on the First Floor



60 mins fire protection Core

Disability Refuge

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Building Regulations

2C8: Cavity walls in coursed brickwork or blockwork:
All cavity walls should have leaves at least 90mm thick and cavities at least 50mm wide. The wall ties should have a horizontal spacing of 900mm and vertical spacing of 450mmm, or alternatively should be spaced such that he number of wall ties per square metre is not less than 2.5 ties/m2. Wall ties should also be provided, spaced not more than 300mm apart vertically, within a distance of 225mm from the vertical edges of all opening, movements joints and roof verges.

2C14 Maximum floor areas:
No floor enclosed by structural walls on all sides exceeds 70m2, and that not floor without structural wall on one side exceeds 36m2

2C23 Maximum span of floors:
The maximum span of any floor supported by a wall is 6m where the span is measured centre to centre of bearing

STUDWORK PARTITIONS
All new studwork partitioning to be 100mm timber studs with min. Studs lined with 100mm thick fibre glass insulation. 25mm thick & 10kg/m3 density quilt infill, lined either side with12.5mm plasterboard and 3mm

Cavity walls built off 600 wide concrete foundation min 1000 below GL 350 Plasmor Fibolite block cavity construction tied to existing walls with Furfix.

Approved Document M:
1.18 Car parking and setting down
"at least one parking bay designated for disabled people is provided on firm and level ground as close as feasible to the principal entrance of the building"

3.29: Passenger Lifts
"A larger lift size
(2000mm wide by 1400mm deep) will accommodate any type of wheelchair together with several other passengers."

5.10: Wheelchair Unisex Bathrooms:
Diagram 18 dimensions
a. one is located as close as possible to the entrance and/or waiting area of the building;
b. they are not located in a way that compromises the privacy of users;
c. they are located in a similar position on each floor of a multi-storey building, and allow for right- and left-hand transfer on alternate floors;
d. when more than one unisex toilet is available in other than multi-storey buildings, a choice of layouts suitable for left-hand and right-hand transfer is provided.

Approved Document B: Volume 2
C5
All fire doorsets, should be fitted with a self-closing device
In accordance with table
2.1:Limitations on travel distances:
Purpose group 4, 2 directions, 45m max escape distance.
2.18: Width of escape routes and exits
"The width of escape routes and exits should meet the provisions in Table 2.3, as well as the guidance in Approved Document M"
3.4: Refuges
"Refuges form part of the management plan and offer relatively safe areas for people to wait for a short period only."

First Floor Plan Construction Dimension Details

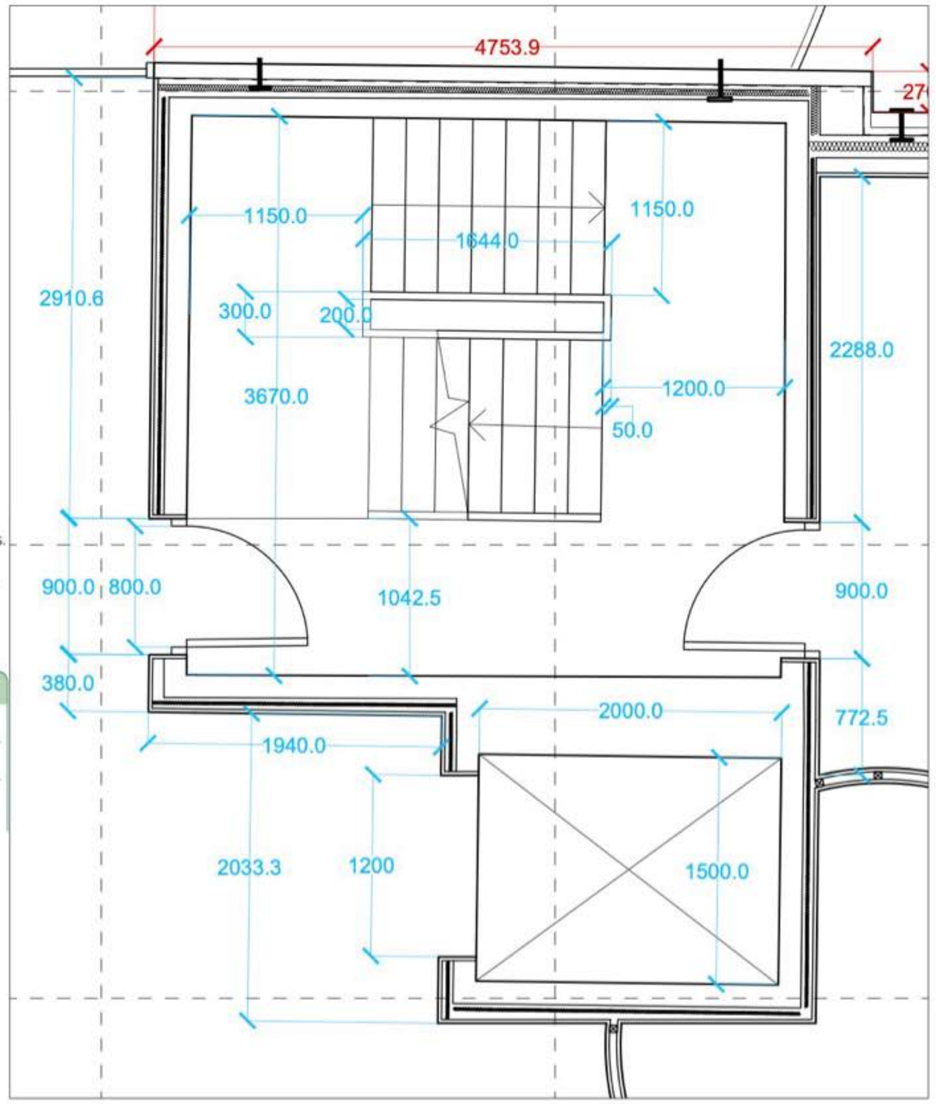
scale @ 1:50

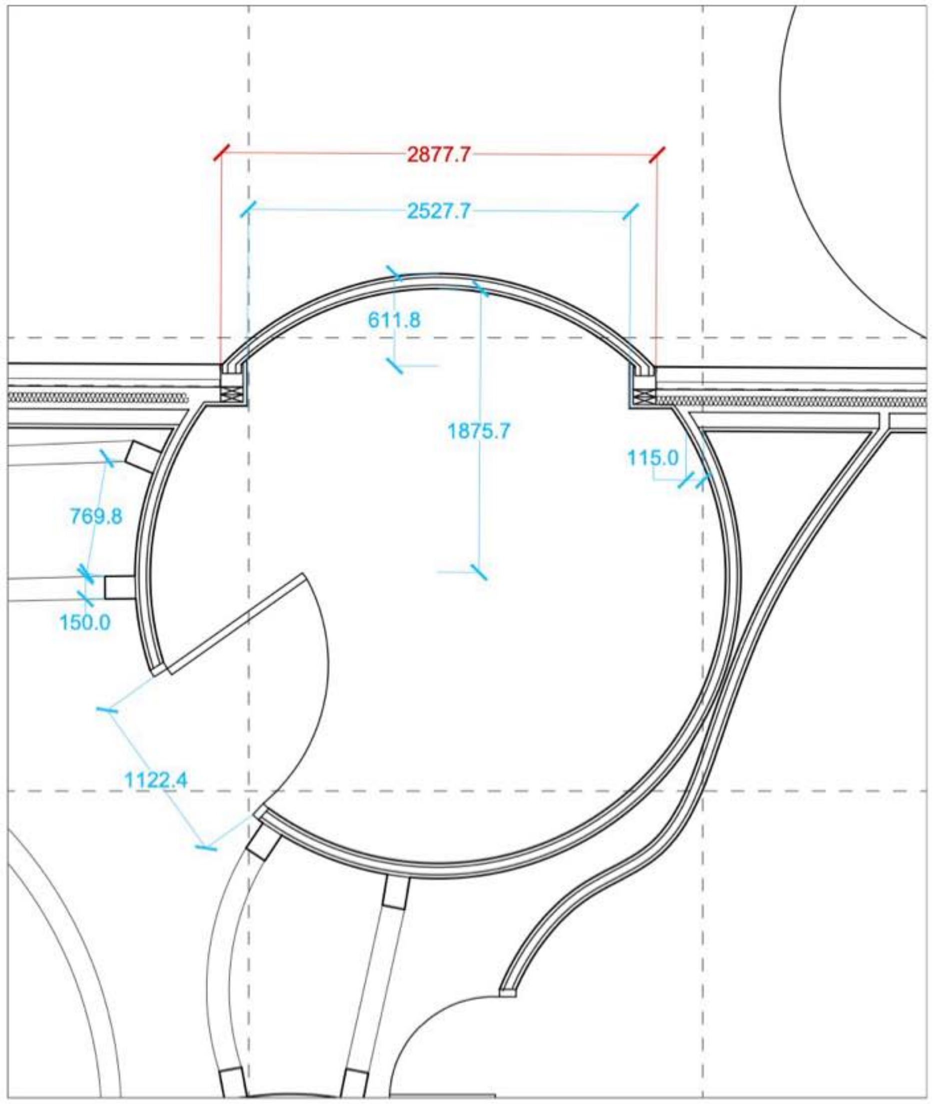
1m 2m 3m

All dimensions in mm

External dimensions

Internal dimensions





Approved Document B:

3.15 Paragraph 3.14 does not apply if either of the following applies.

a. Escape stairs are protected by a smoke control system designed in accordance with **BS EN 12101-6**.

b. Escape stairs are approached on each storey (except the top storey) through a protected lobby.

Despite these exceptions, at least one storey exit still needs to be discounted (paragraph 2.21).

3.63 A stair of acceptable width for everyday use will be sufficient for escape purposes. If it is also a firefighting stair or a common stair in a building with a storey 18m or more in height (see Diagram D6 in Appendix D), it should be at least 1100mm wide. The width is the clear width between the walls or balustrades. Any handrails and strings intruding into that width by a maximum of 100mm on each side may be ignored.

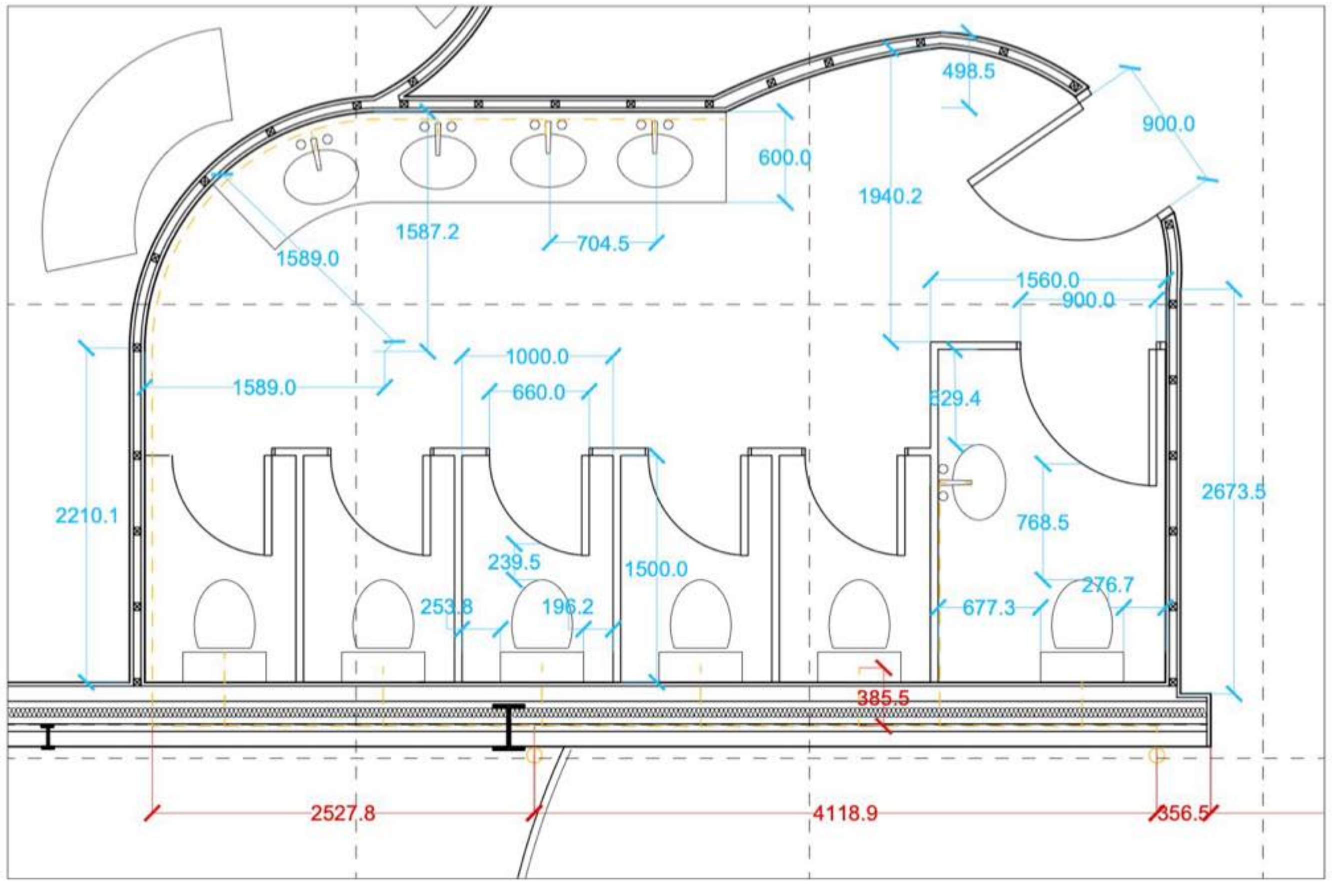
Table 3.1 Minimum widths of escape stairs

Situation of stair	Maximum number of people served[1]	Minimum stair width (mm)
1a. In a 'residential (institutional)' building (unless the stair will only be used by staff)	150	1000[2]
1b. In an 'assembly and recreation' building and serving an area used for assembly purposes (unless the area is less than $100m^2$)	220	1100

Approved Document T:

Table 3.1 Type A – Fully enclosed self-contained ambulant universal toilet

Minimum overall dimensions	985mm × 2125mm
Door arrangement	750mm minimum effective clear opening width
	Self-closer on door, if a fire door
	Horizontal closing bar, minimum 60mm from inside of bar to door face × 500mm minimum length of bar, 19–35mm diameter, used to open and close the door fixed to the inside face of the door at 900mm above finished floor level
	Outward opening are preferable but, where not practicable, inward opening doors should not obstruct activity spaces and column of clearance
Column of clearance/activity space	A 465mm minimum diameter column of clearance in front of the toilet pan between fixed sanitary ware and clear of the door swing
	The minimum activity space in front of a washbasin will depend upon the size and type of washbasin specified. The layout shown is for an activity space of 800mm wide × 600mm deep for use in front of a 250mm × 400mm washbasin, clear of the door swing
	The minimum activity space in front of a WC should be 600mm deep × 800mm wide



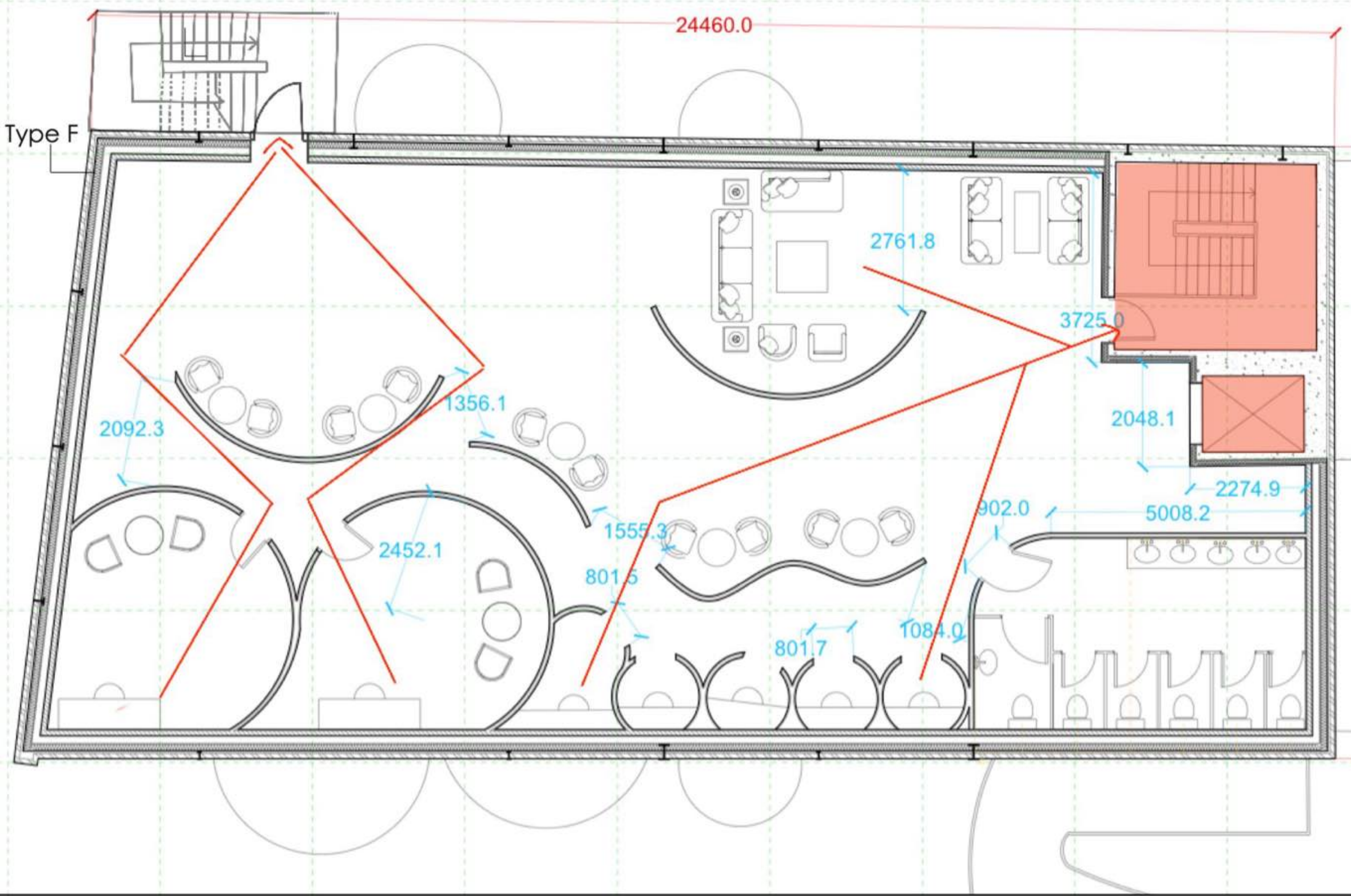
Second Floor Plan Construction

Wall build ups on the Second Floor

When considering fire evacuation times, sex can be a factor. Stength and physical endurance on men is often higher so this means they can escape quicker.

60 mins fire protection Core

Disability Refuge



Building Regulation Part L

Temperature of space:
-For a study space, a minimum of 16 degrees celsius is required, a recommended 21 degrees for max productivity... of men!

Table 4.1 Limiting U-values for new or replacement elements in new and existing buildings and air permeability in new buildings

Element type	Maximum U-value[1] W/(m²·K) or air permeability
Roof (flat roof)[2]	0.18
Roof (pitched roof)[2]	0.16
Wall[2][3]	0.26
Floor[4][5]	0.18

Increasing the temperature by 2 degrees for women, means increasing the insulation which would effect the U-Value of the building.
Room size: 541m3
Insulation: 100mm XPS
R-Value: 5
XPS insulation would need to be 150mm-200mm thick to increase the room by 2 degrees.
The U-value for 200mm of XPS insulation is 0.10 $W/m^2 \cdot K$

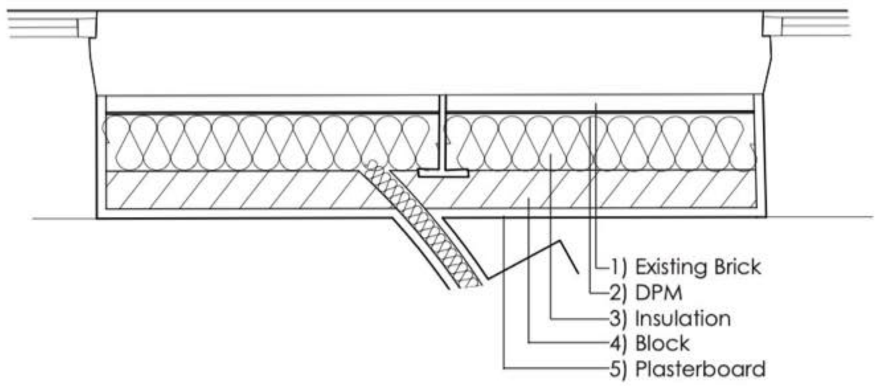
For the existing steel roofs and brick walls:

Table 4.2 Limiting U-values for existing elements in existing buildings

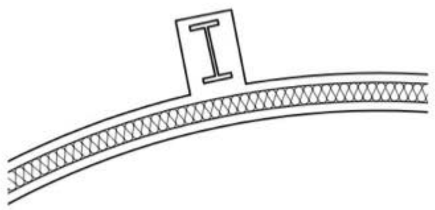
Element	U-value[1] W/(m²·K)	
	(a) Threshold	(b) Improved
Pitched roof – insulation at ceiling level[2]	0.35	0.16
Pitched roof – insulation at rafter level[2][3]	0.35	0.18
Flat roof or roof with integral insulation[2][4]	0.35	0.18
Wall – cavity insulation[2][5]	0.70	0.55
Wall – external or internal insulation[2][6]	0.70	0.30
Floors[7][8]	0.70	0.25

Wall Connections

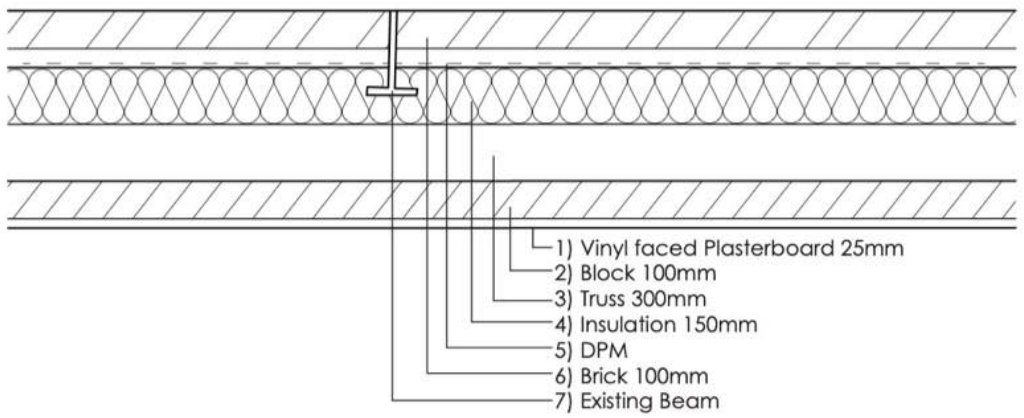
Wall Type C



Wall Type E



Wall Type F



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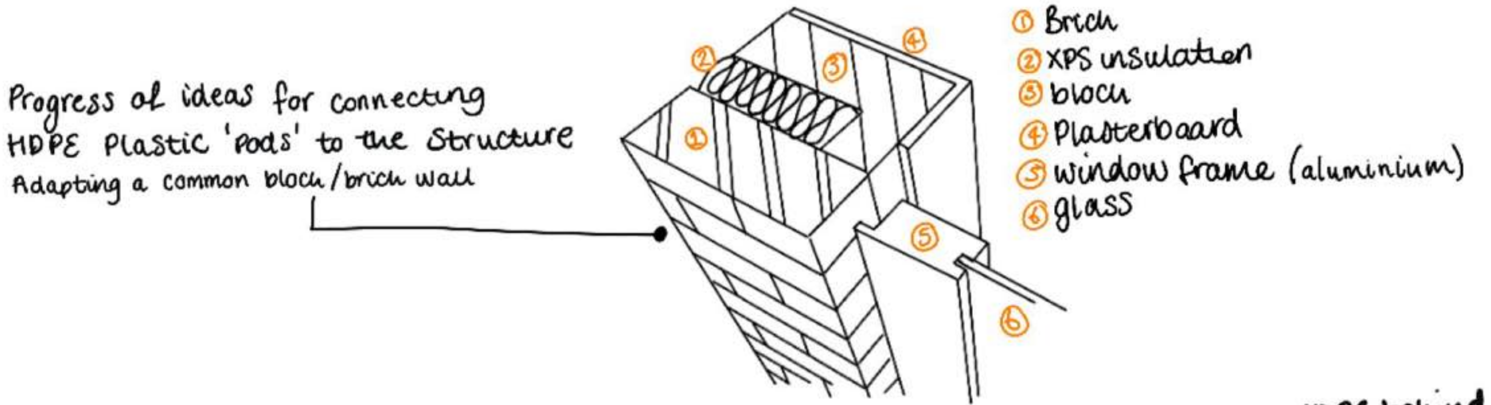
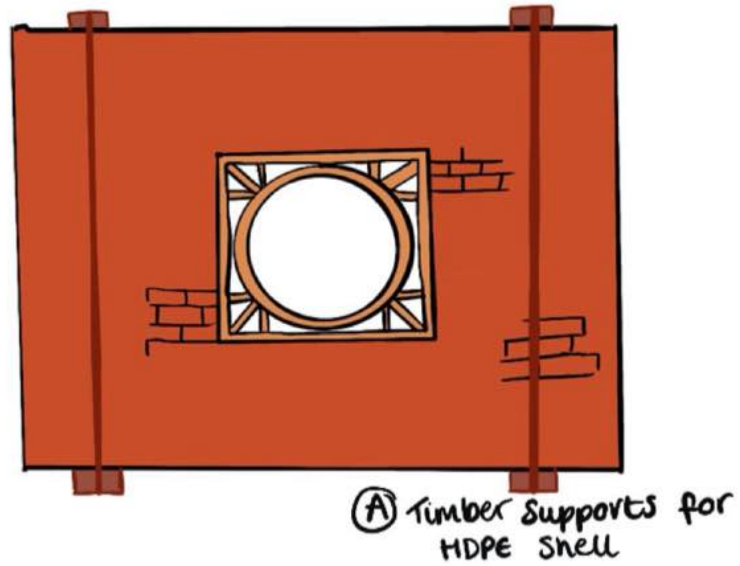
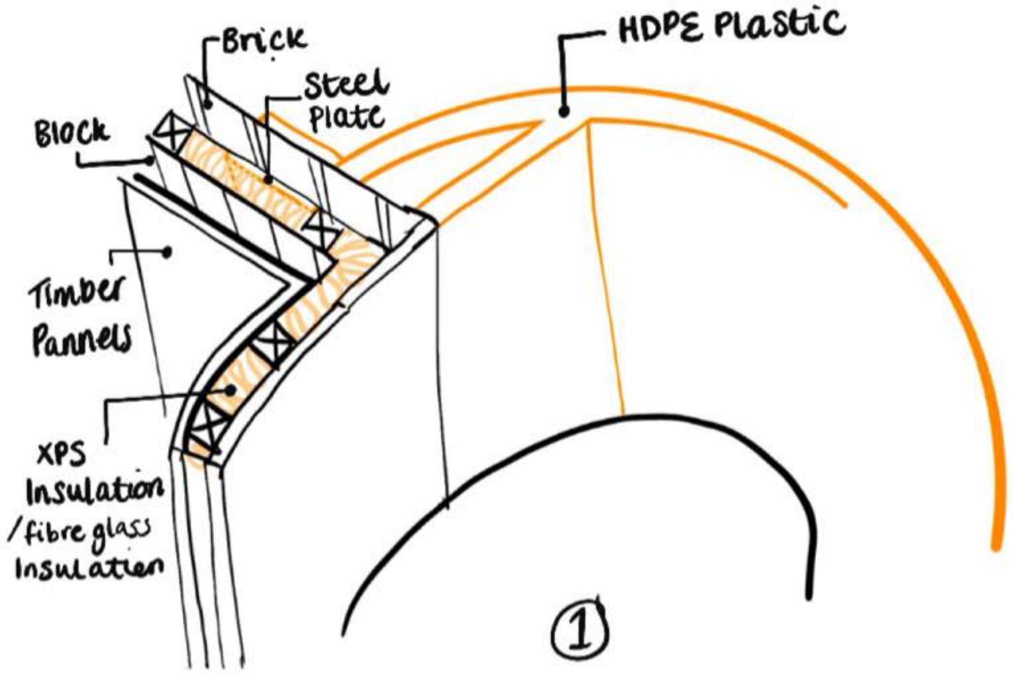
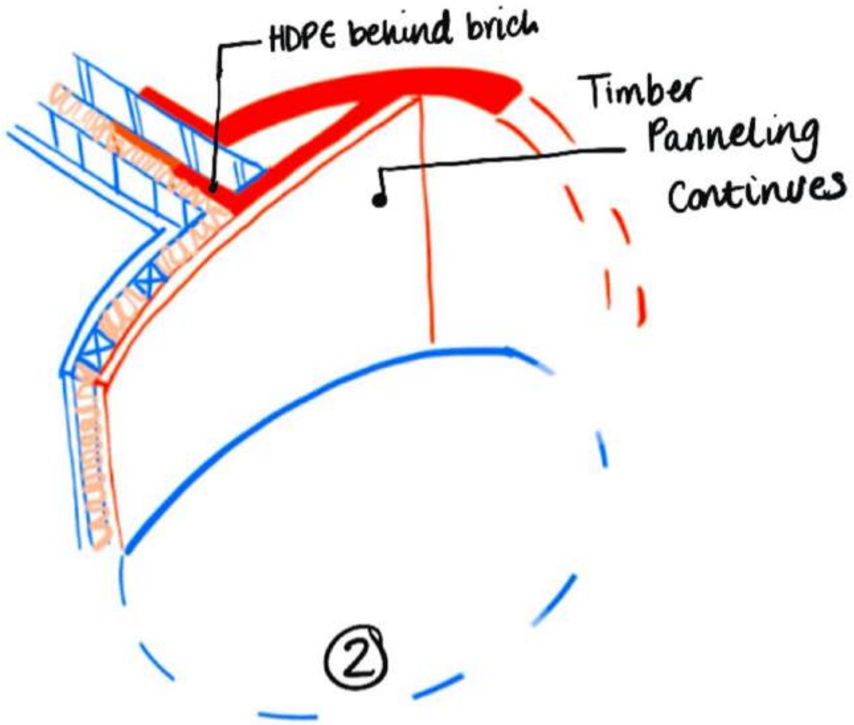
Sketch Ideas of HDPE Joint Detail

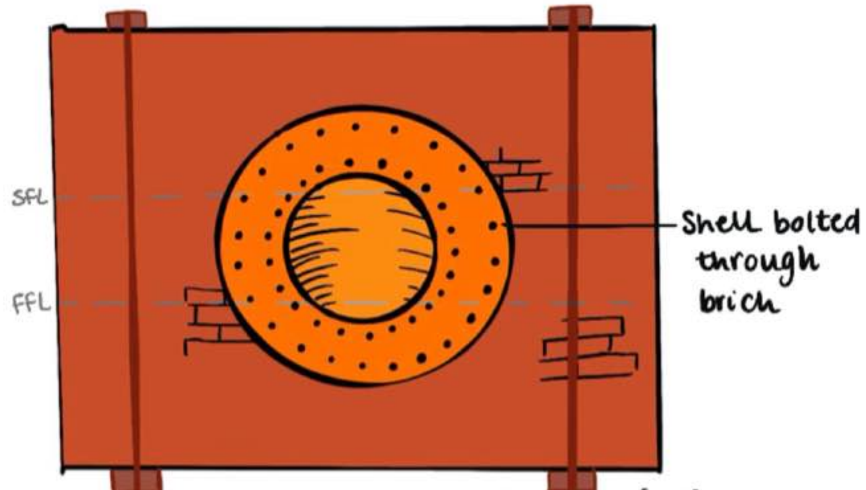
Case Study- Beach hut, Spark
Explored further on page 20

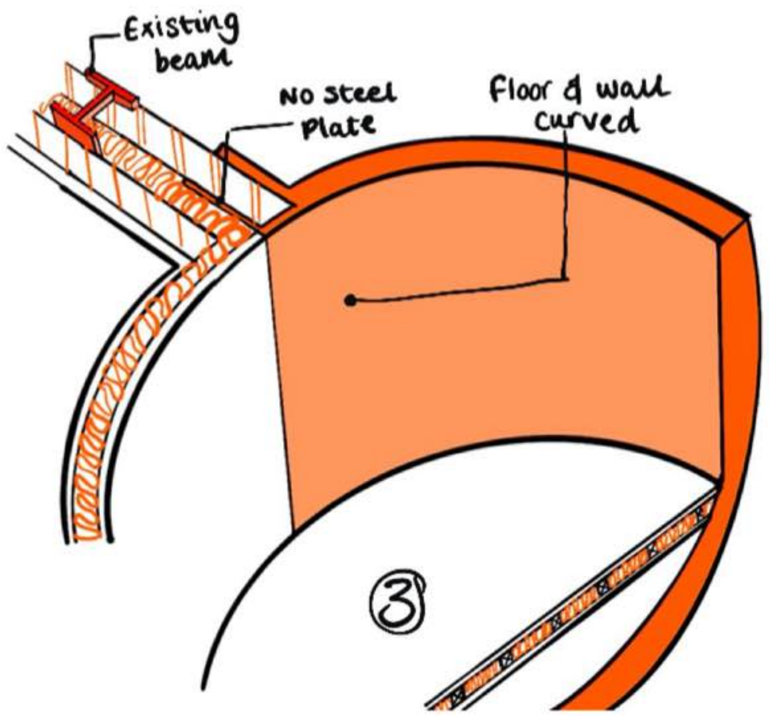


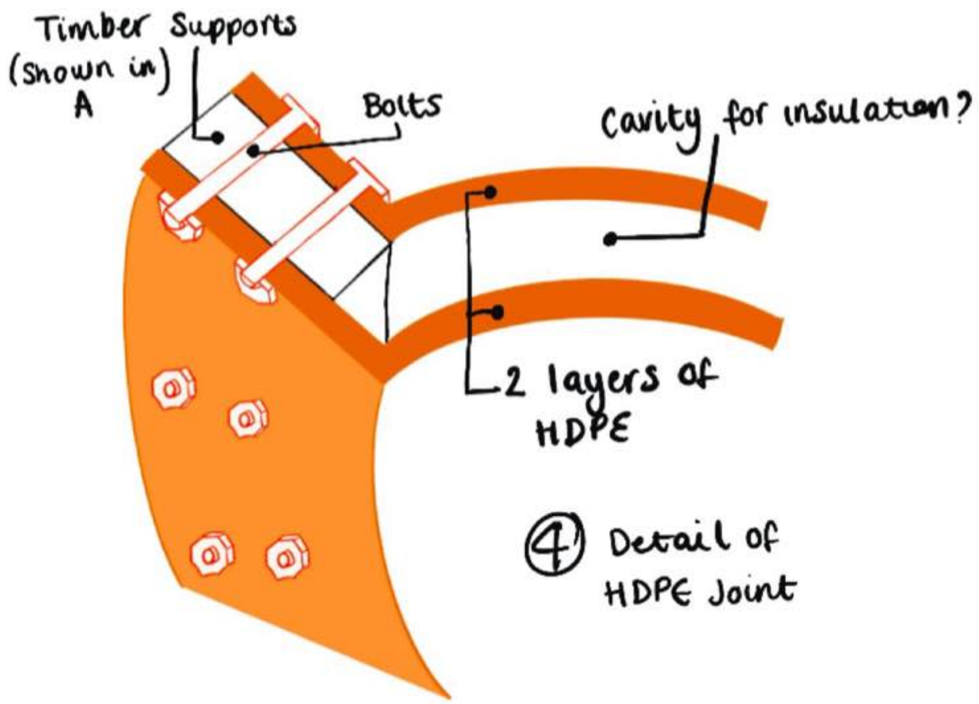


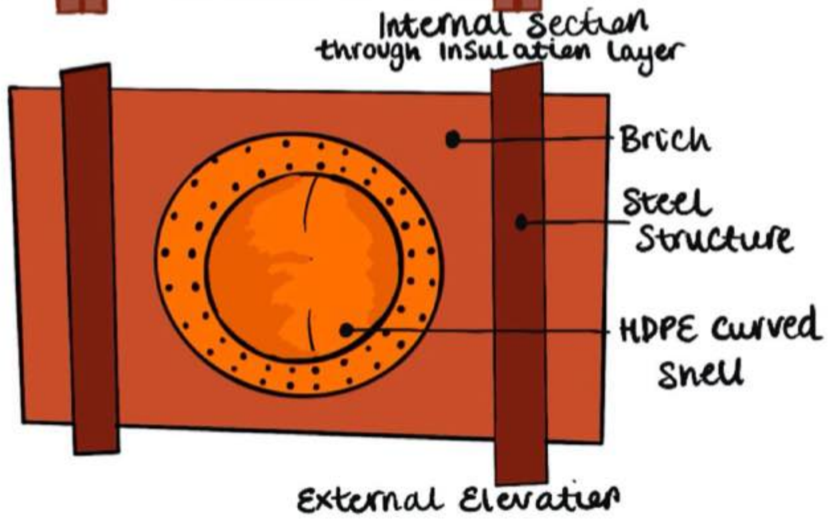












Section
Construction
Red penning on the Section

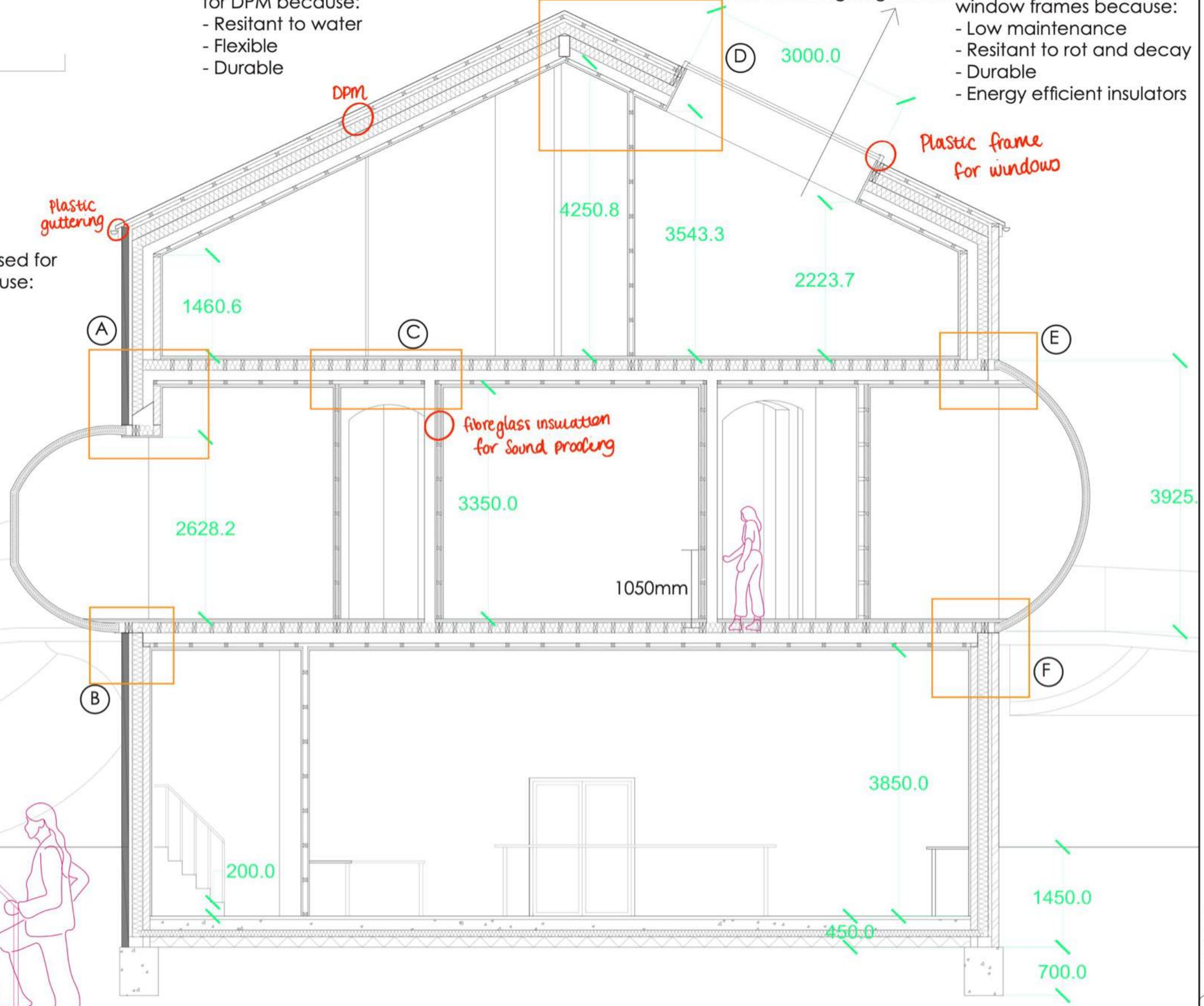
h. **Windows and doors:** to ensure continuity of the air barrier, window and door units should connect to the primary air barrier and window and door frames should be taped to surrounding structural openings, using air sealing tape. Compressible seals or gun sealant may be used to supplement taping.

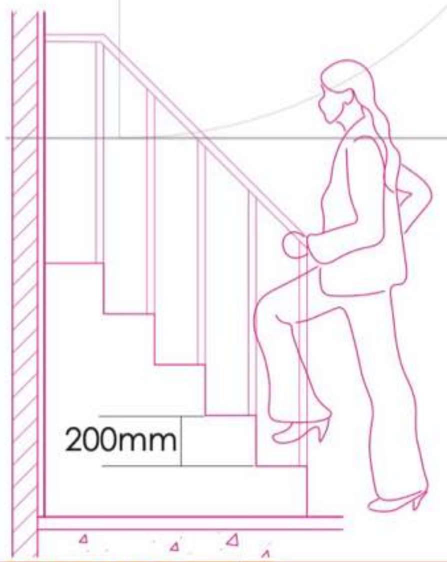
Part L Building Regulations

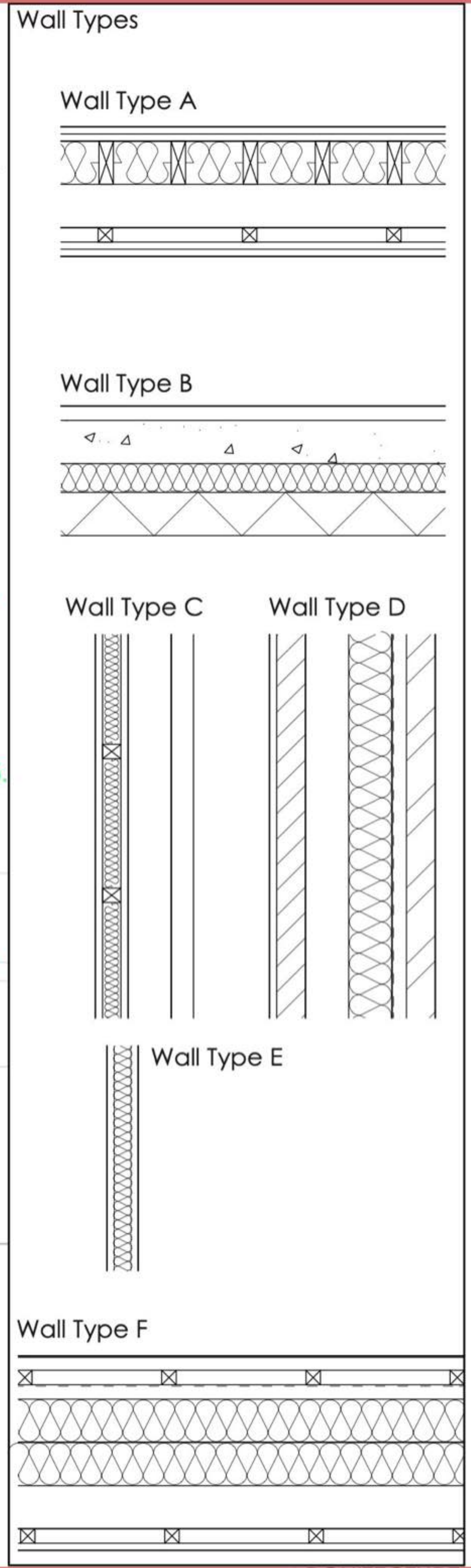
Polythene plastic is used for DPM because:
- Resitant to water
- Flexible
- Durable

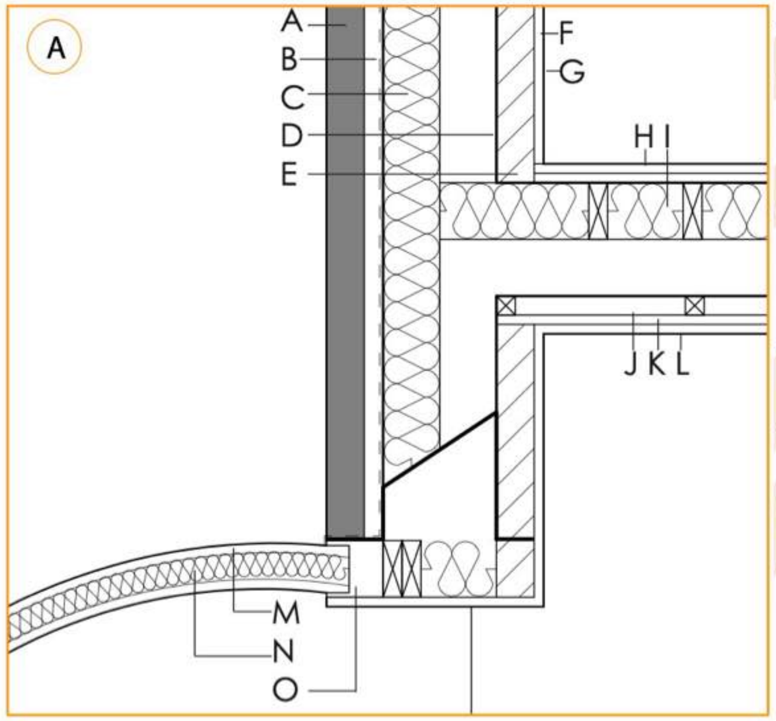
PVC plastic is used for window frames because:
- Low maintenance
- Resitant to rot and decay
- Durable
- Energy efficient insulators

PVC plastic is used for guttering because:
- lightweight
- easy to install
- cost effective
- durable





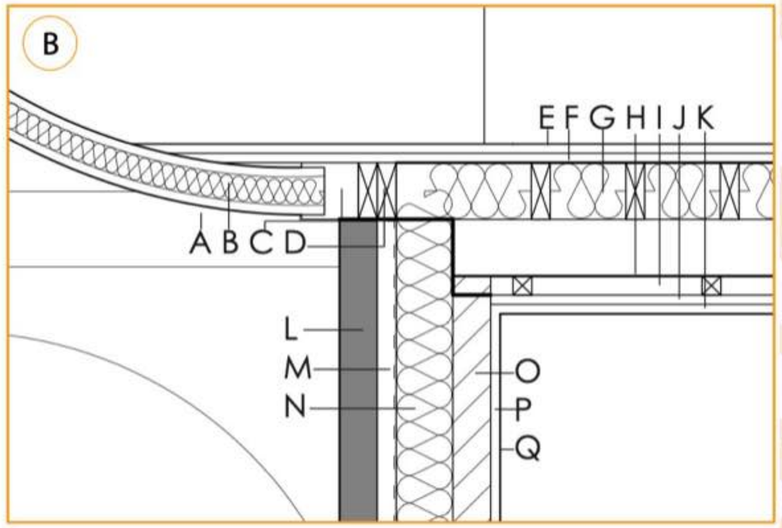




A) Existing Brick
B) DPM
C) XPS Insulation 150mm
D) Truss Structure 300mm
E) Block wall 100mm
F) Vinyl faced Plasterboard 25mm
G) Acrylic Wall Paint

H) Hardwood floor 25mm
I) Studwork 50mmx50mm
J) Plywood 25mm
K) Vinyl faced Plasterbaord 25mm
L) Steel Lintel coated in Epoxy based intumescent coating

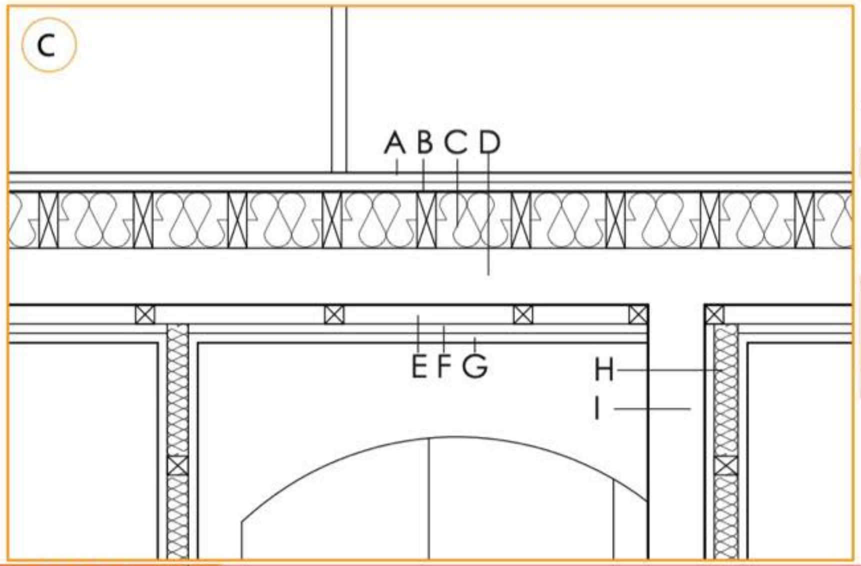
M) HDPE plastic 25mm
N) XPS insulation 50mm
O) Plastic frame
P) Studs



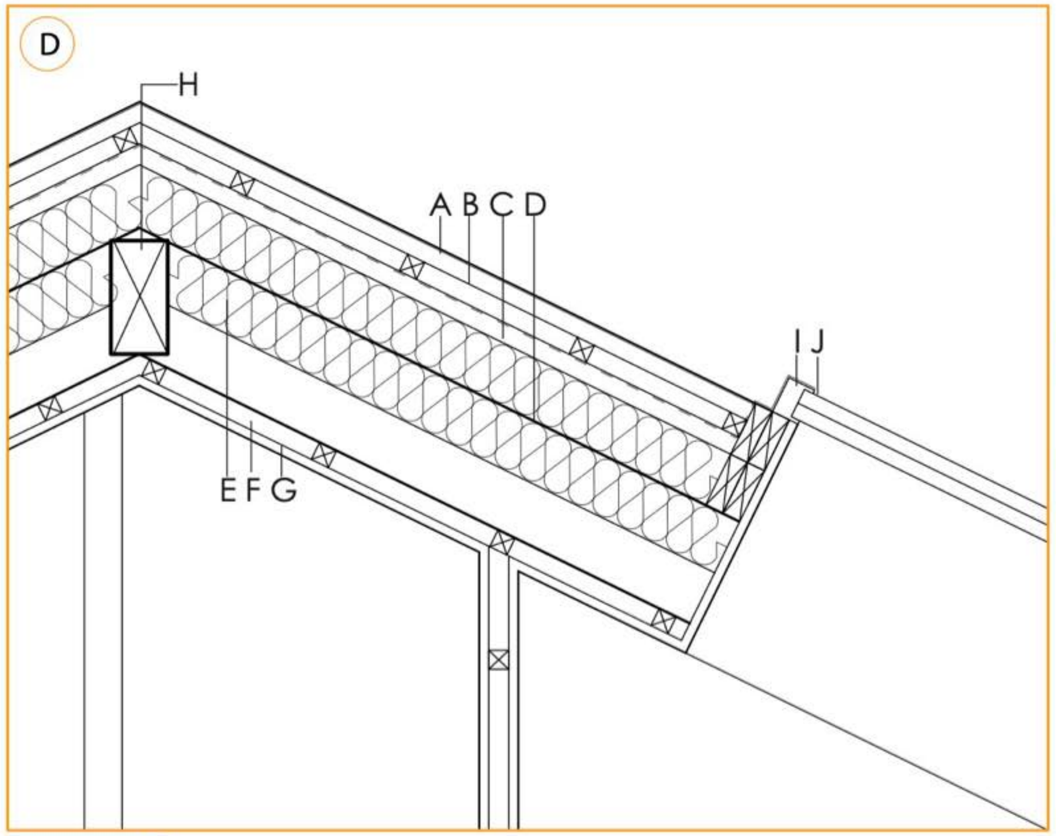
A) HDPE plastic 25mm
B) XPS insulation 50mm
C) Plastic frame
D) Studs

E) Hardwood floor 25mm
F) Plywood 25mm
G) 150mm XPS Insulation
H) Steel Beam 300mm coated in Epoxy based intumescent coating
I) Studwork 50mmx50mm
J) Plywood 25mm
K) Vinyl faced Plasterboard 25mm

L) Existing Brick
M) DPM
N) XPS Insulation 150mm
O) Block wall 100mm
P) Vinyl faced Plasterboard 25mm
Q) Acrylic Wall Paint



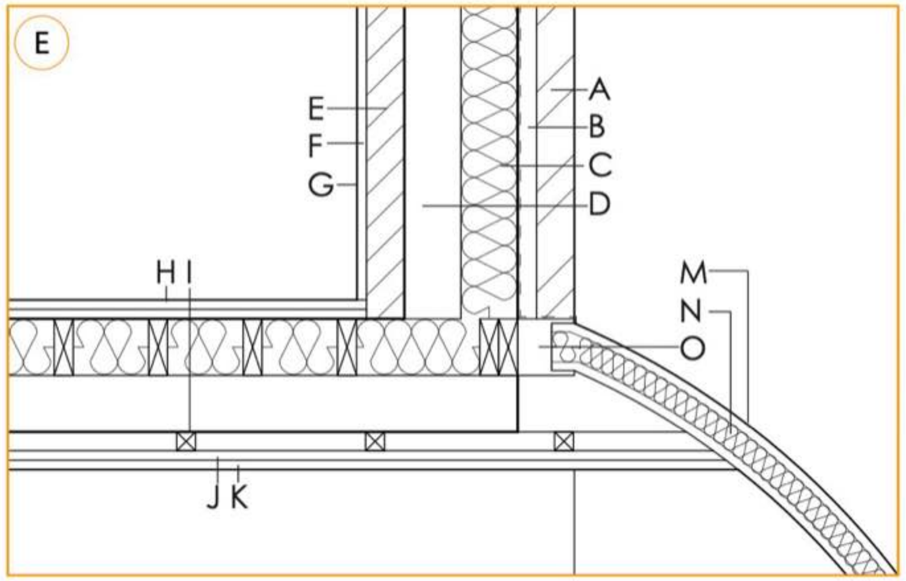
A) Hardwood Floor 25mm
B) Plywood 25mm
C) XPS insulation 150mm
D) Beam
E) Studs 50x50mm
F) Plywood 25mm
G) Vinyl faced Plasterbaord 25mm
H)XPS insulation 100mm
I) Steel Beams coated in Epoxy based intumescent coating



A) Corrugated Steel roof
B) Studs 50x50mm
C) DPM
D) 300mm Truss
E) 150mm XPS Insulation
F) Studs 50x50mm
G) Vinyl faced Plasterbaord 25mm

H) Beam

I) Plastic Frame
J) Glass



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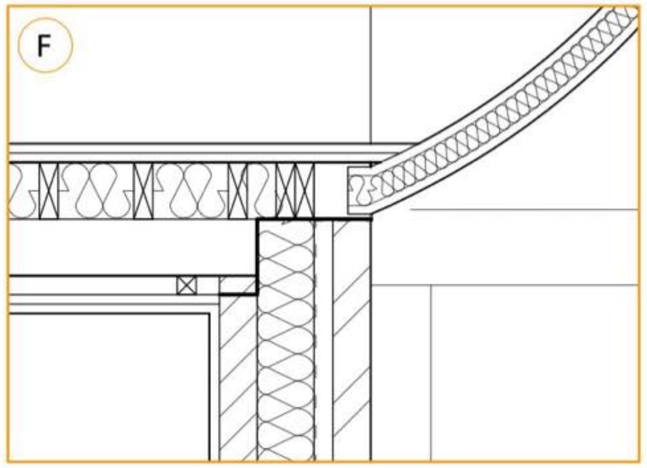


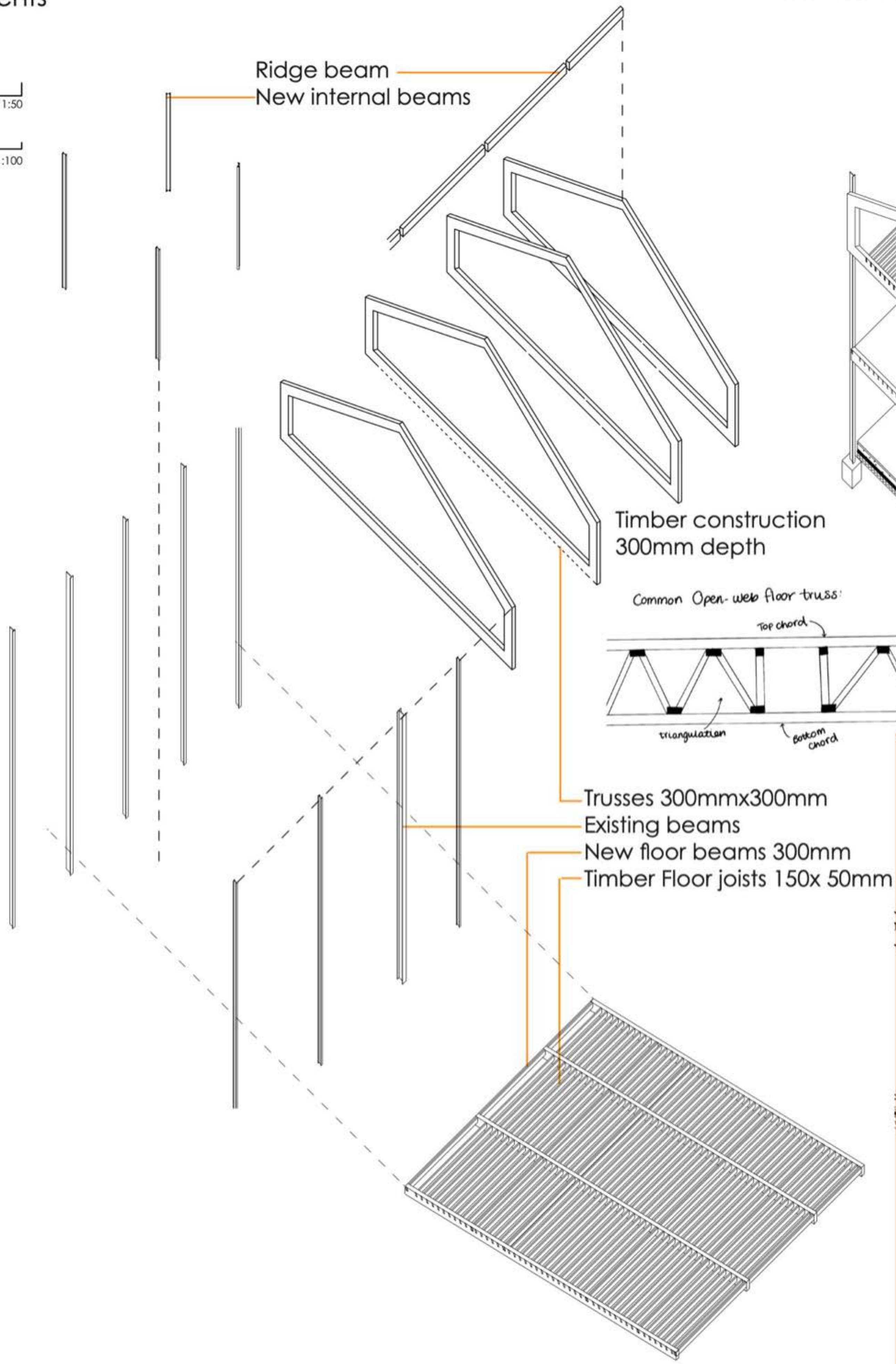
Plastic content

Isometric of structural elements

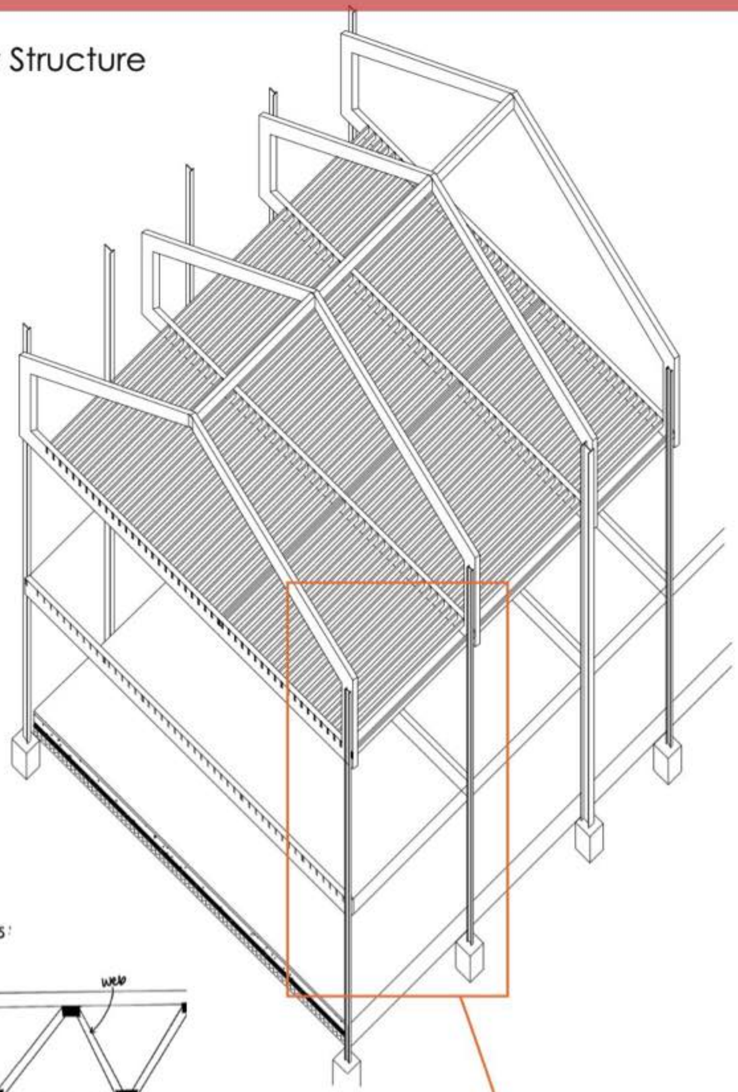
1:50

1m

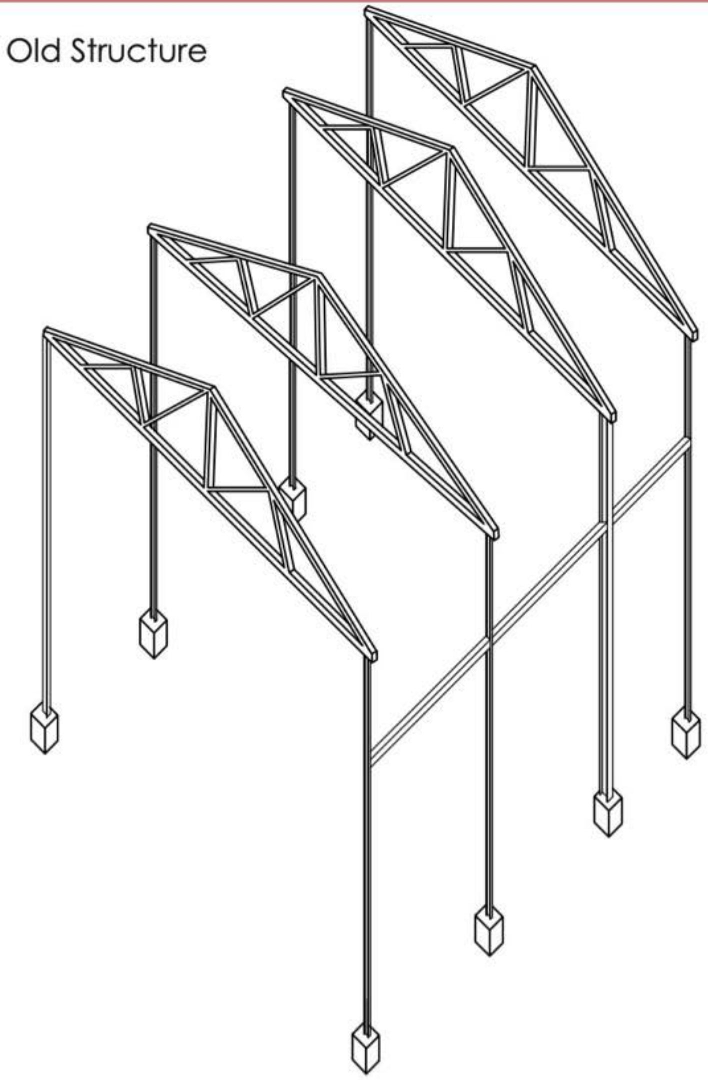
1:100

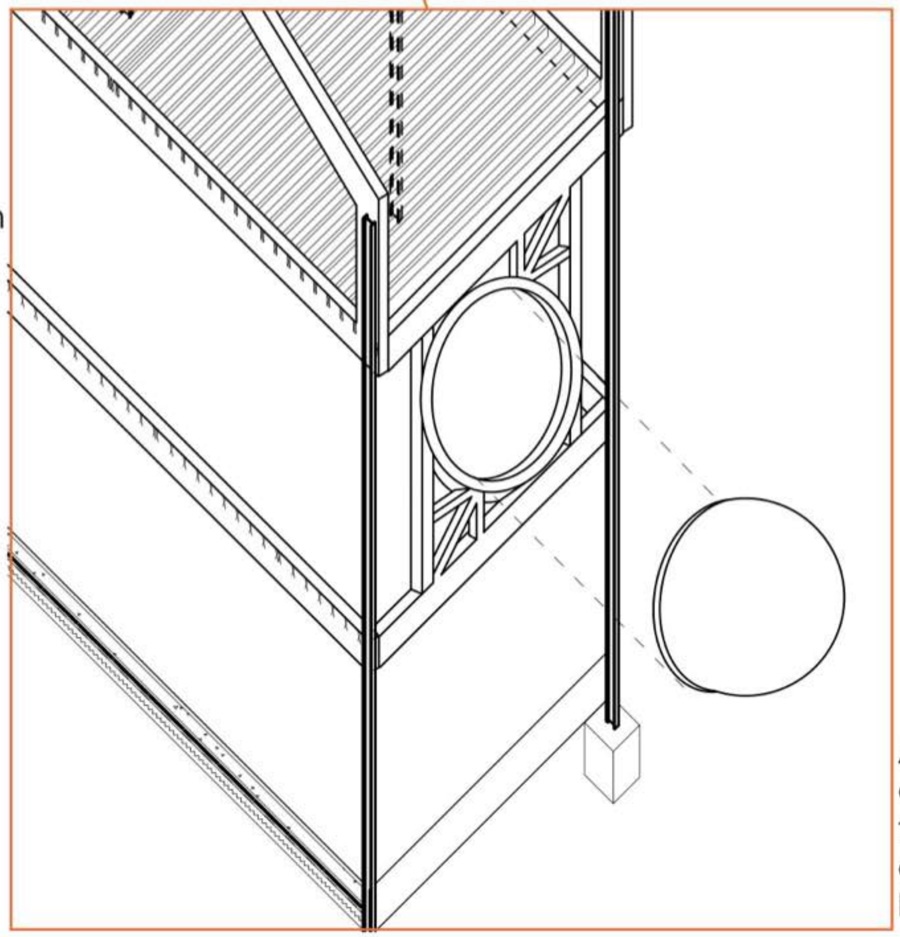


New Structure



Old Structure





Additional steels
added to support
the HDPE pod frame
and the weight of the
Plastic dome

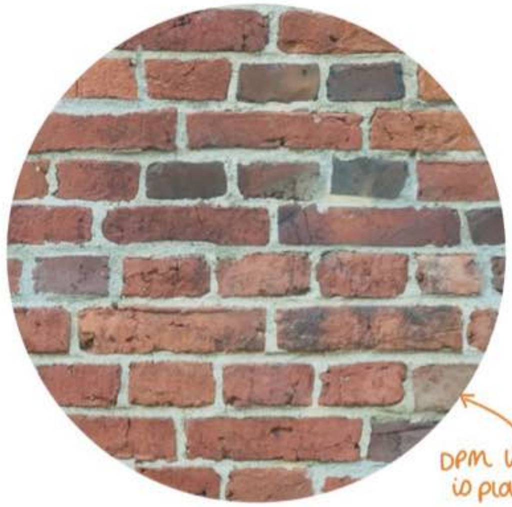
Existing Site with Beams
1.038m³ of Steel in the beams

Material analysis

Looking into the common materials used in the building as well as annotating their plastic usage

	material	group	impact / m3	volume [m3]		area [m2]		thickness [mm]		result
1	Brick, red	mineralsk	297.0 kg CO2eq/m3	60.59	m3	591.15	m2	102.5	mm	17,996.1 kg $CO_{2\,eq}$
2	Concrete C20/25	mineralsk	215.0 kg CO2eq/m3	40	m3		m2		mm	8,600.0 kg $CO_{2\,eq}$
3	Glass pane, double-glazed	komponenter	4580.0 kg CO2eq/m3	2.30	m3	82	m2	28	mm	10,515.7 kg $CO_{2\,eq}$
4	Plywood	trae	-649.0 kg CO2eq/m3	55.35	m3	1107	m2	50	mm	-35,922.1 kg $CO_{2\,eq}$
5	Roof panel (steel)	metal	21509.0 kg CO2eq/m3	0.50	m3	719	m2	0.7	mm	10,825.5 kg $CO_{2\,eq}$
6	Galvanised steel	metal	23482.5 kg CO2eq/m3	0	m3	0	m2	0	mm	0 kg $CO_{2\,eq}$
7	XPS insulation	kunststof	94.0 kg CO2eq/m3	176.49	m3	784.39	m2	225	mm	16,589.8 kg $CO_{2\,eq}$
8	Reused brick	mineralsk	13.7 kg CO2eq/m3	19.81	m3	193.24	m2	102.5	mm	271.4 kg $CO_{2\,eq}$

Recycling steel: (Euric, 2022)
- Reduces CO2 emssions by 58%
- Saves 72% of energy required in primary production
- Saves 1.5 tonnes of Carbon emissions for every tonne of steel
- Reduces air pollution by 86%
- Reduces water use by 40 %
- Reduces water pollution by 76%



DPM lining is plastic

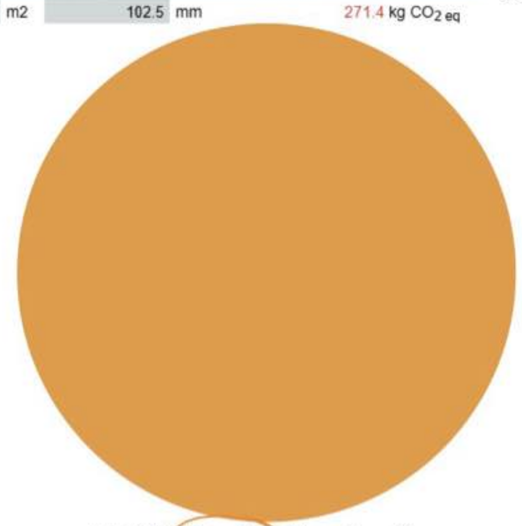
Brick- Aesthetics

Durability	●●●●●
Cost	●●●●●
Sustainability	●●●●○
Carbon	●●●○○
Fire resistance	●●●●●
Breathability	●●●●○

more dots means better

Concrete- Structural

Durability	●●●●●
Cost	●●●○○
Sustainability	●●○○○
Carbon	●●●○○
Fire resistance	●●●●●
Breathability	●○○○○



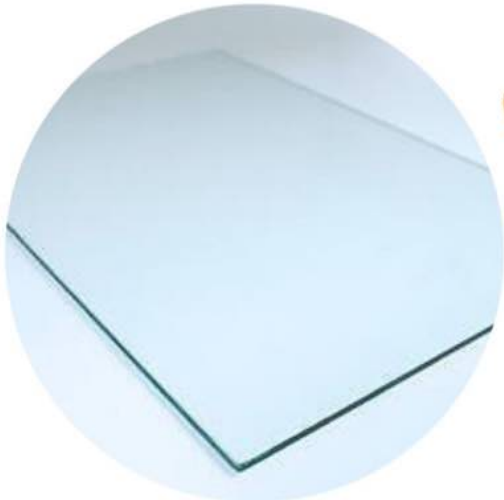
HDPE Plastic- Aesthetic

Durability	●●●●○
Cost	●●●○○
Sustainability	●●○○○
Carbon	●●●○○
Fire resistance	●○○○○
Breathability	●○○○○

Adhesive is considered a form of plastic

Glulam Timber- Aesthetic

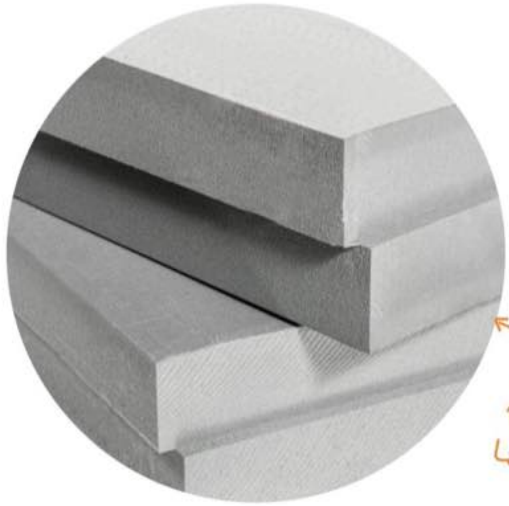
Durability	●●●●○
Cost	●●●○○
Sustainability	●●●●○
Carbon	●●●●●
Fire resistance	●○○○○
Breathability	●●●●○



Plastic frame to hold glass

Glass- Aesthetic

Durability	●●●○○
Cost	●●●○○
Sustainability	●●●○○
Carbon	●●○○○
Fire resistance	●●●●○
Breathability	●○○○○



made from Polystyrene ↳ a Synthetic Plastic

XPS Insulation- Thermal

Durability	●●●●○
Cost	●●●○○
Sustainability	●●○○○
Carbon	●●●●○
Fire resistance	●○○○○
Breathability	●○○○○

Vinyl Coating is plastic

Vinyl Faced Plasterboard- Aesthetics

Durability	●●●○○
Cost	●●●○○
Sustainability	●○○○○
Carbon	●●○○○
Fire resistance	●●●○○
Breathability	●○○○○

Epoxy based intumescent coating used

Exsiting beams- Structural

Durability	●●●●●
Cost	●●●○○
Sustainability	●●●○○
Carbon	●●○○○
Fire resistance	●●●●●
Breathability	●○○○○

Summary of common:

-Plastic is used throughout construction in most elements

-Construction is designed for men

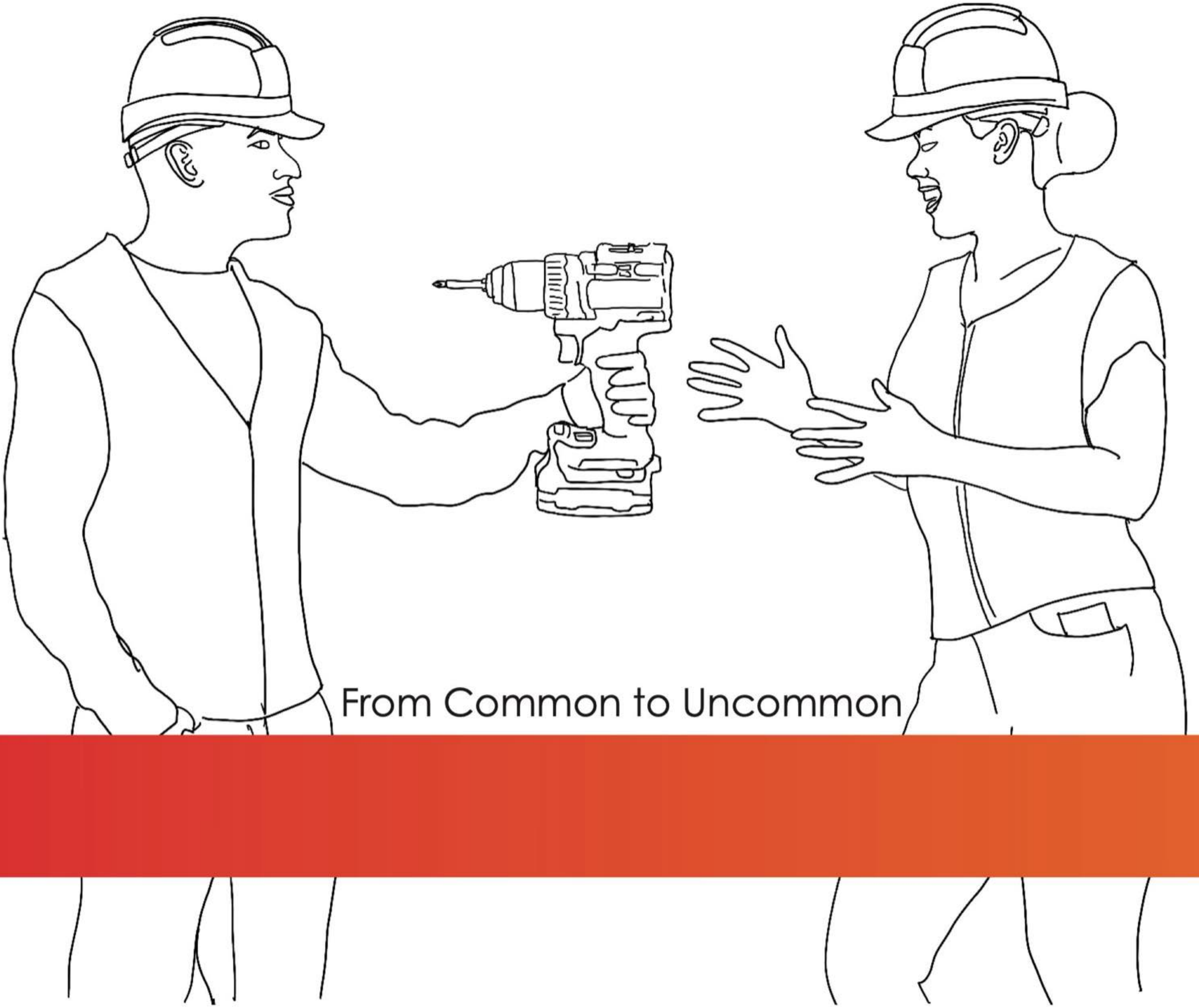
- Our building regulations design for the healthy 30yr old man

What to explore in the uncommon:

-Plastic free Architecture

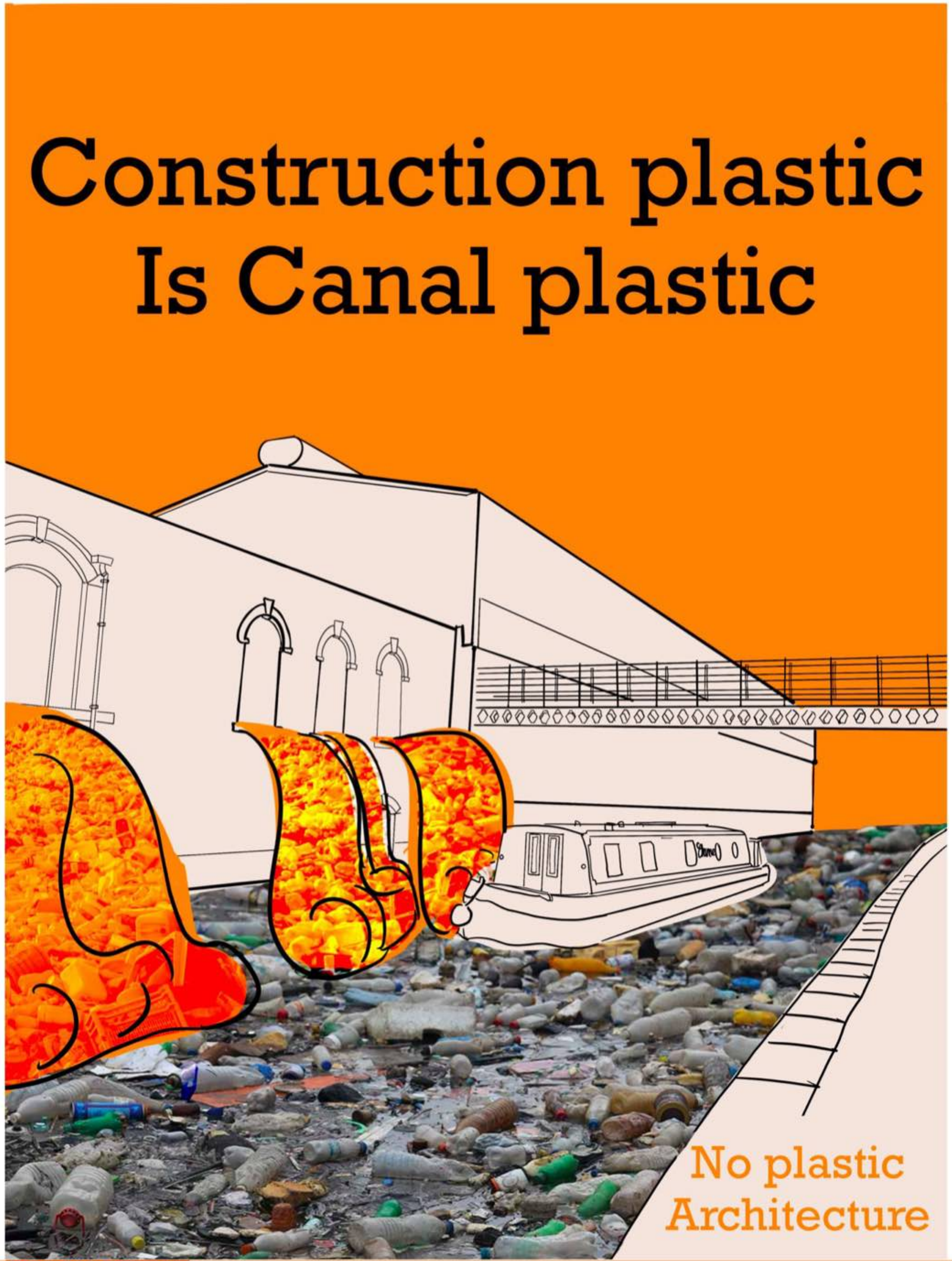
-How to introduce women to construction

- How we can change the building regulations to accomodate women



From Common to Uncommon

Exploration into materials I would like to explore in my PPS



Why NO PLASTIC?

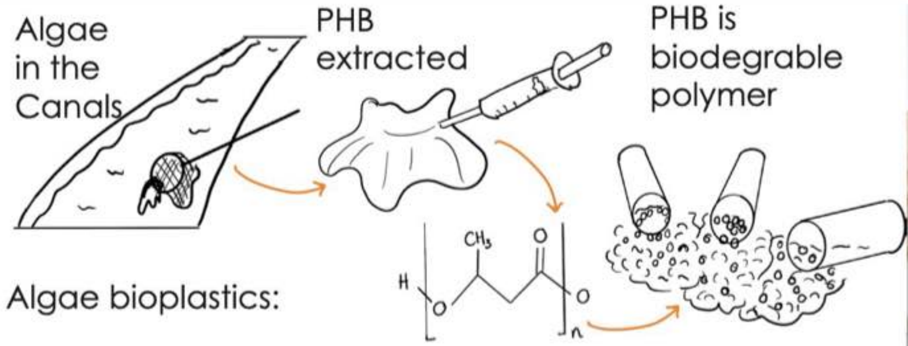
Plastic you put in the bin ends up in landfill. When rubbish is being transported to landfill, plastic is often blown away because it's so lightweight. From there, it can eventually clutter around drains and enter rivers and the sea this way.

1/3 fish caught for human consumption now contains plastic.

8 million pieces of plastic pollution make their way into the ocean every day. (OSPAR, 2009)

100,000 marine mammals and turtles and 1 million sea birds are killed by marine plastic pollution every year. (UK Government, 2018)

Algae Bio-Plastic



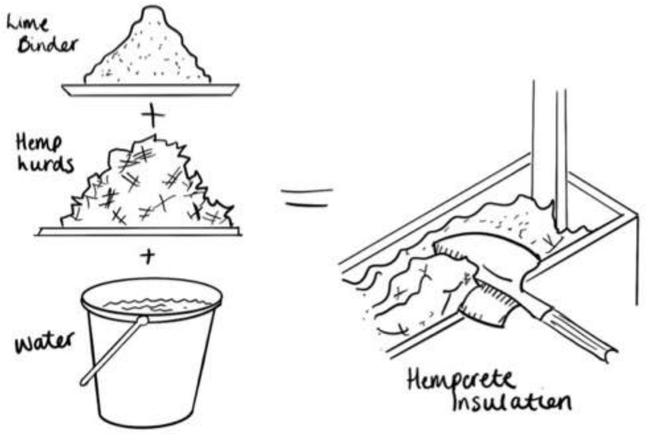
Algae bioplastics:

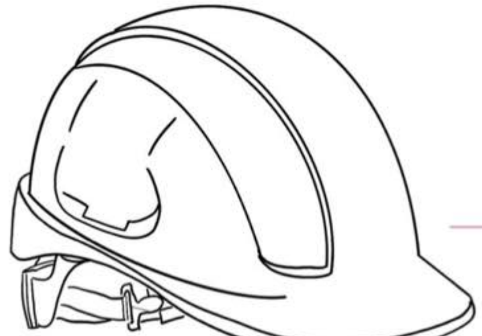
- Reduce Carbon footprint
- Less Energy Consumption
- Biodegradable

Bioplastics can be made using protein- and carbohydrate-based polymers from algae, and enhanced through genetic enginering.

Hemp

Hempcrete, a bio-composite material made from hemp hurds and lime, is non-toxic, breathable, and has excellent insulation properties.





15%

of professionals in the UK construction industry are Women

1%

of those Women in construction are in the manual labour sector

60%

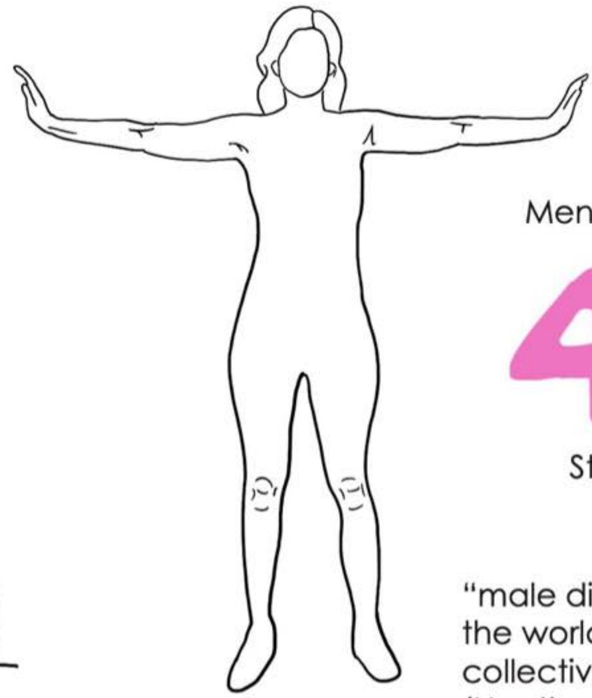
of employers aren't providing women's PPE

1.07x

Average Arm Span 1550mm

Average Arm Span 1660mm

Average Height 1616mm

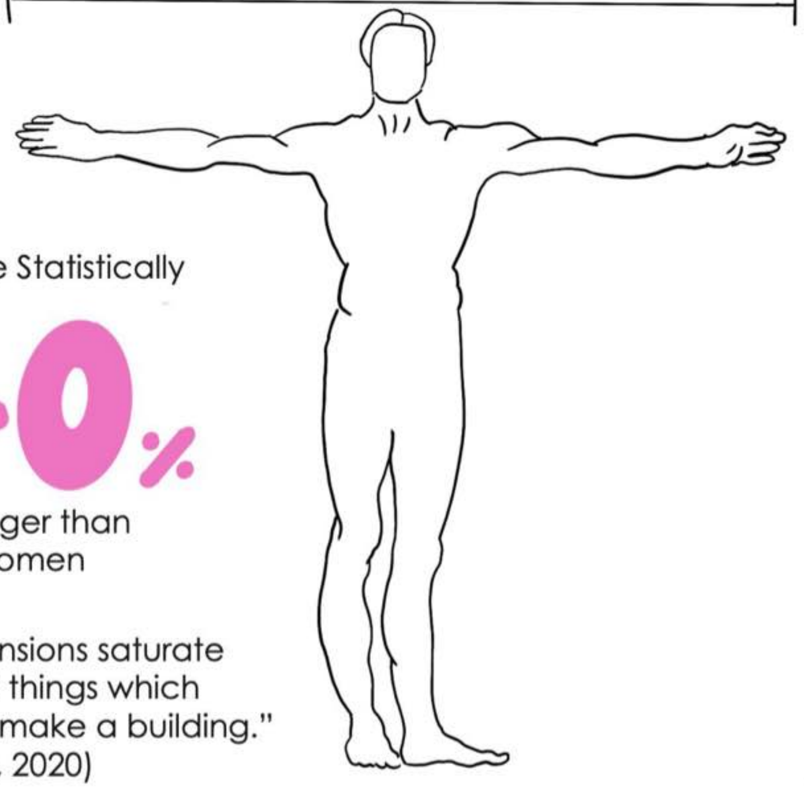


Men are Statistically

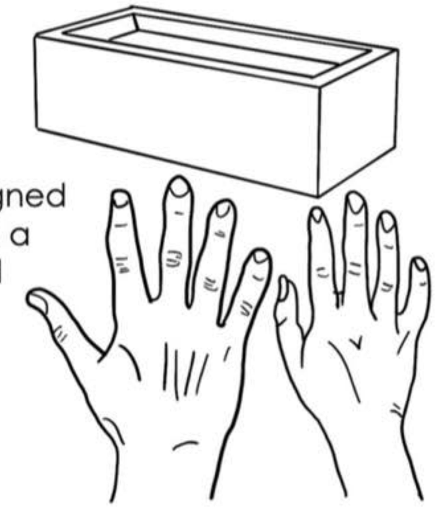
40%

Stronger than women

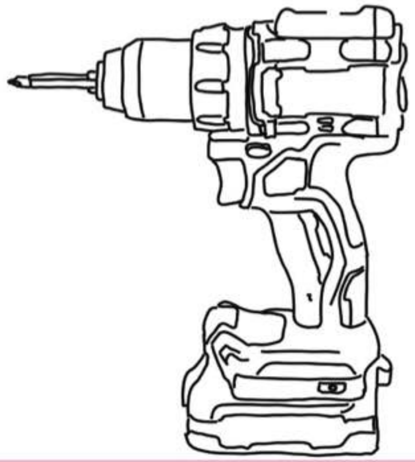
"male dimensions saturate the world of things which collectively make a building." (Heathcote, 2020)



Average Height 1750mm

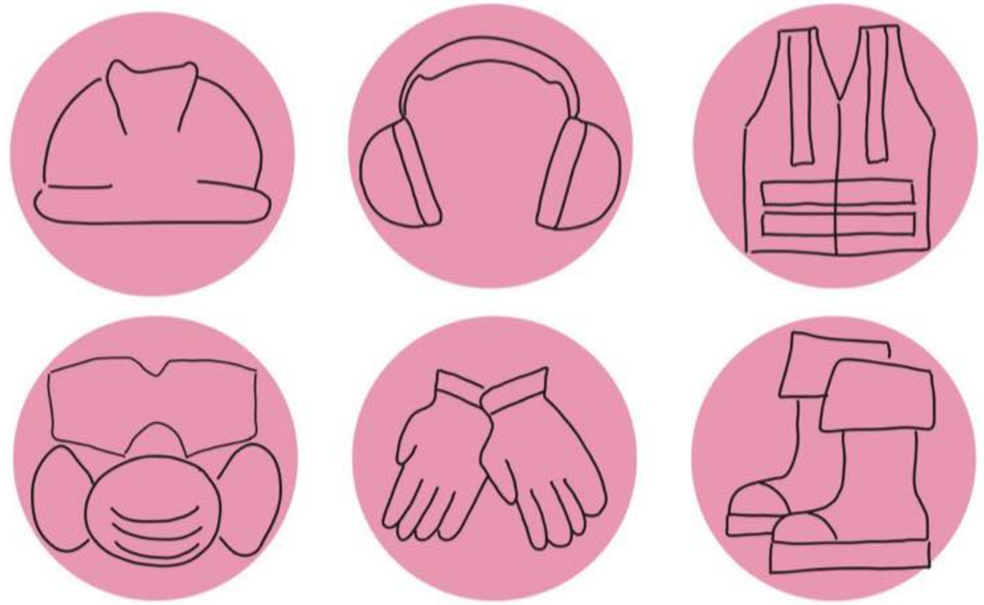


Bricks are designed to be held in a male hand



Tools are designed for larger hands and stronger grips

-Size of tools
-Weight
-Grip/handles
-Button placement
-Power



PPE is designed primarily for men, with some companies now designing for "female fitting" PPE.

The construction industry is unsustainable through the lense of feminism. As the world progresses, the construction industry is one of those still to progress.

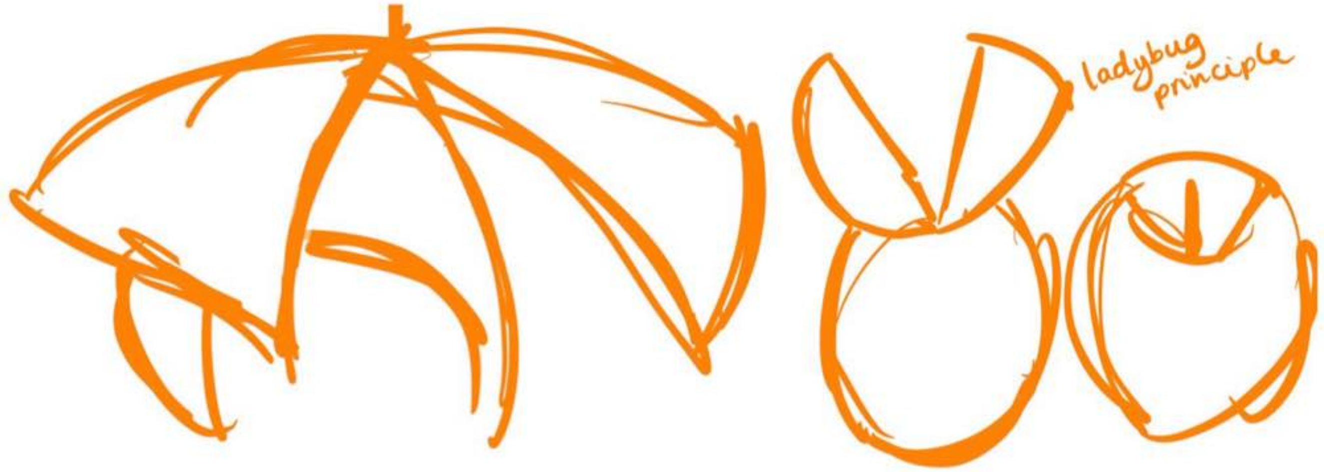
Un-Common Prototype (UCP) Mini Brief

Breaking Free from Constraints
Unrestricted exploration into materials and construction techniques.

"It should be a contraption, adapting to its surroundings, responding to environmental forces, and challenging conventional construction."

Inital sketches for a space to explore the no plastic materials, using nature/ ocean life as the main influence.

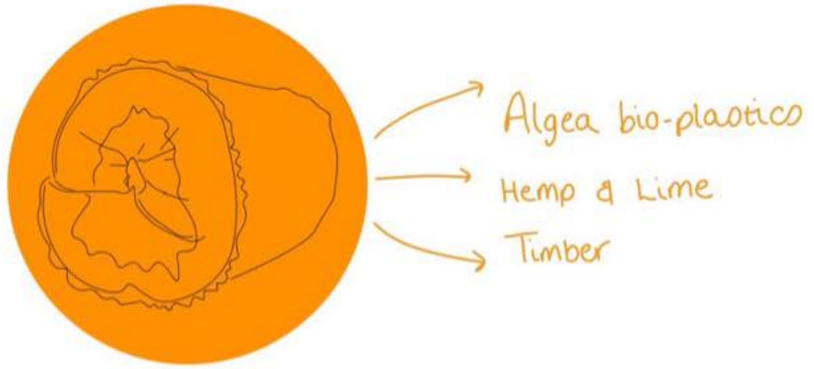
This was a response to the brief.



I want to explore:

Materials

Natural no plastic model

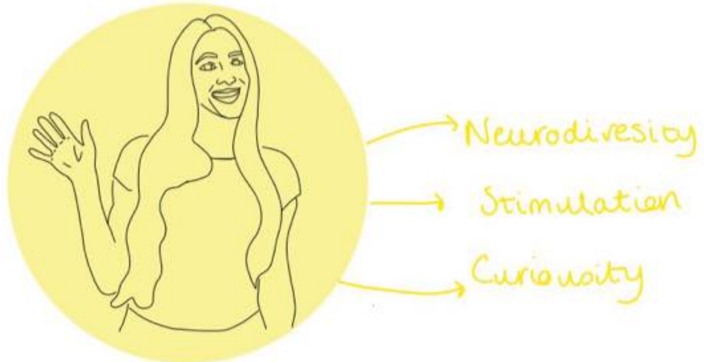


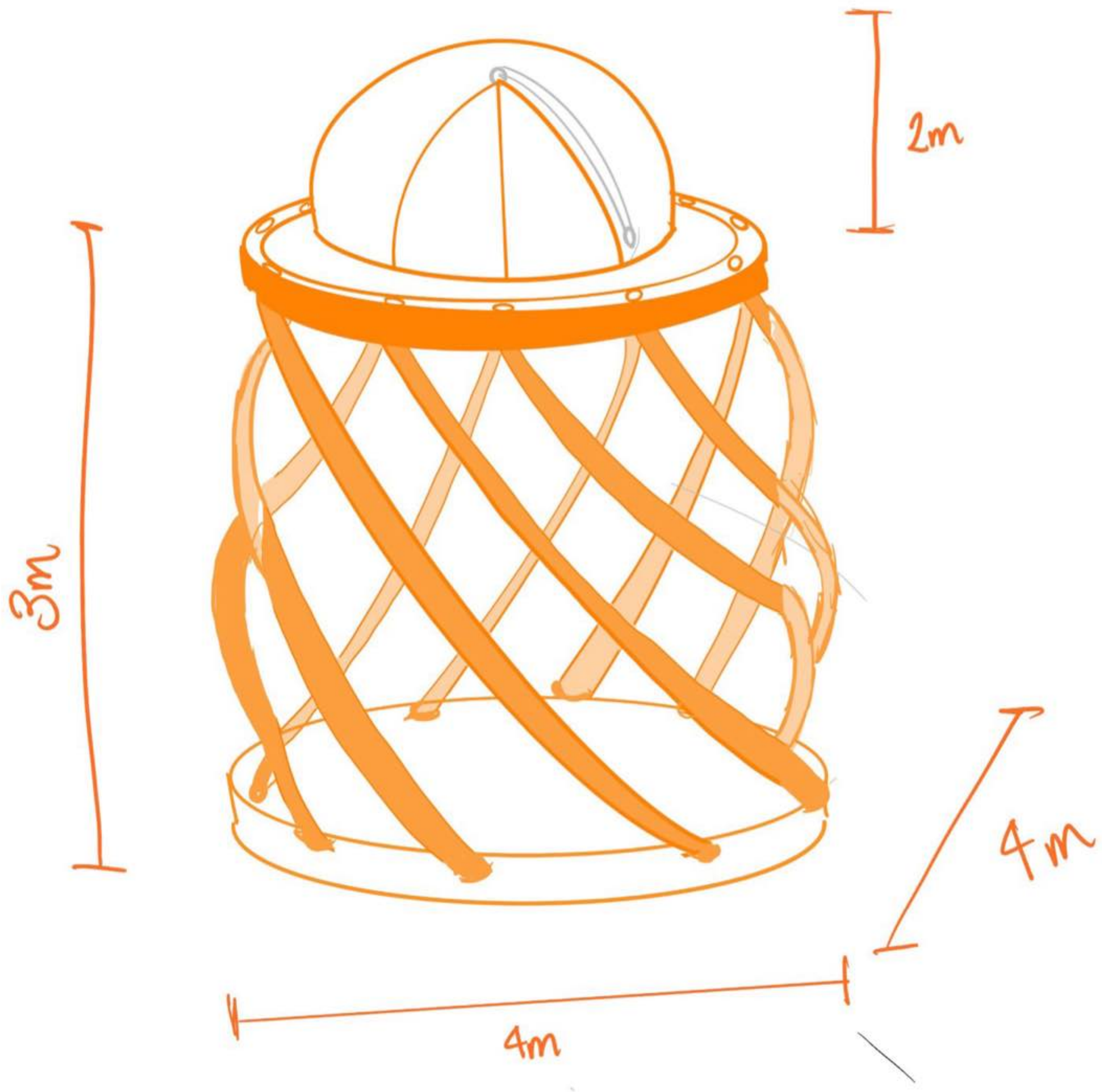
Women in construction

designing for a women to be able to build with ease

User

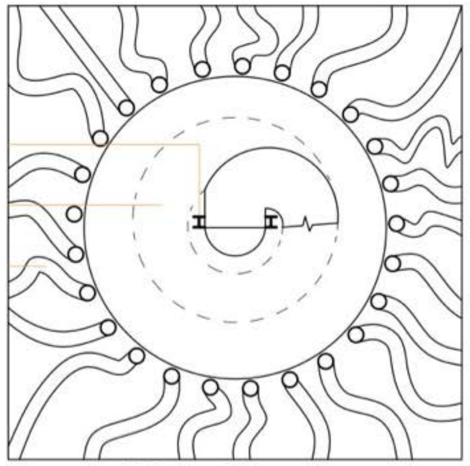
throwing away the handbook designing the space for women and non-binary people



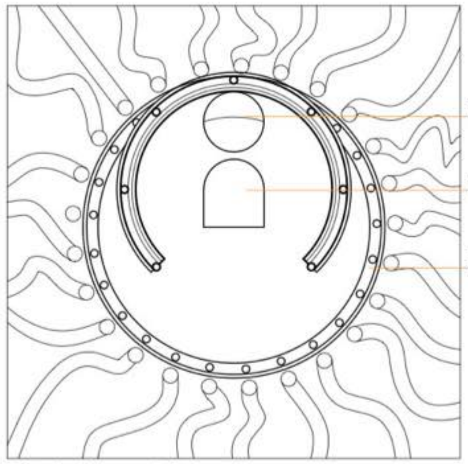


PPS Design

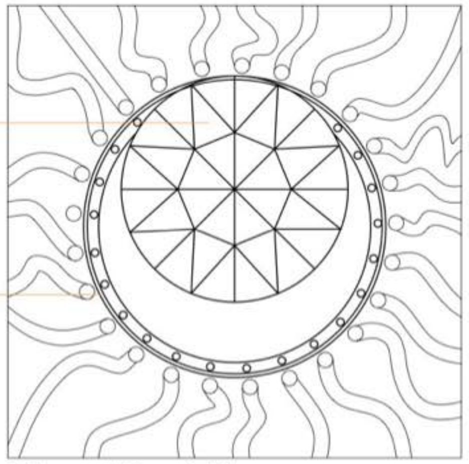
Exploring the use of no plastic materials to form a space to promote awareness of the damage plastic has on the waterways.



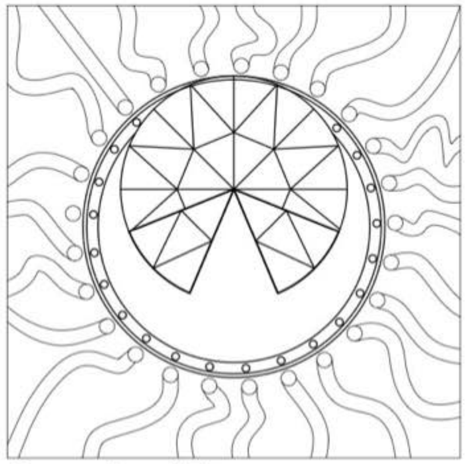
Ground Floor Plan



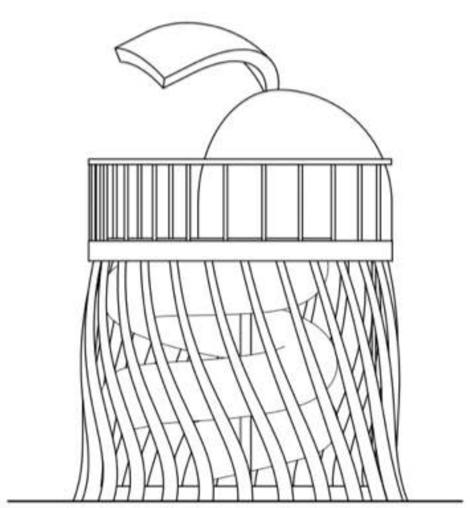
First Floor Plan



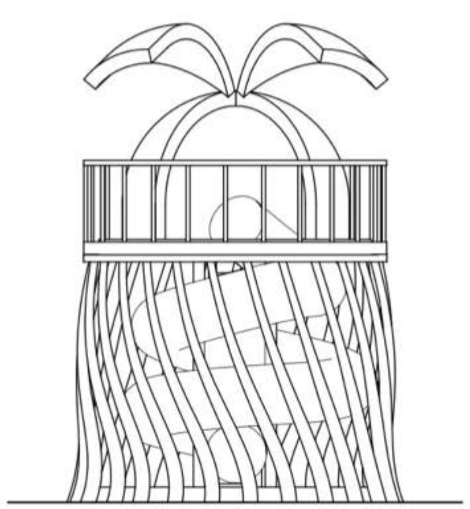
Closed Roof Plan



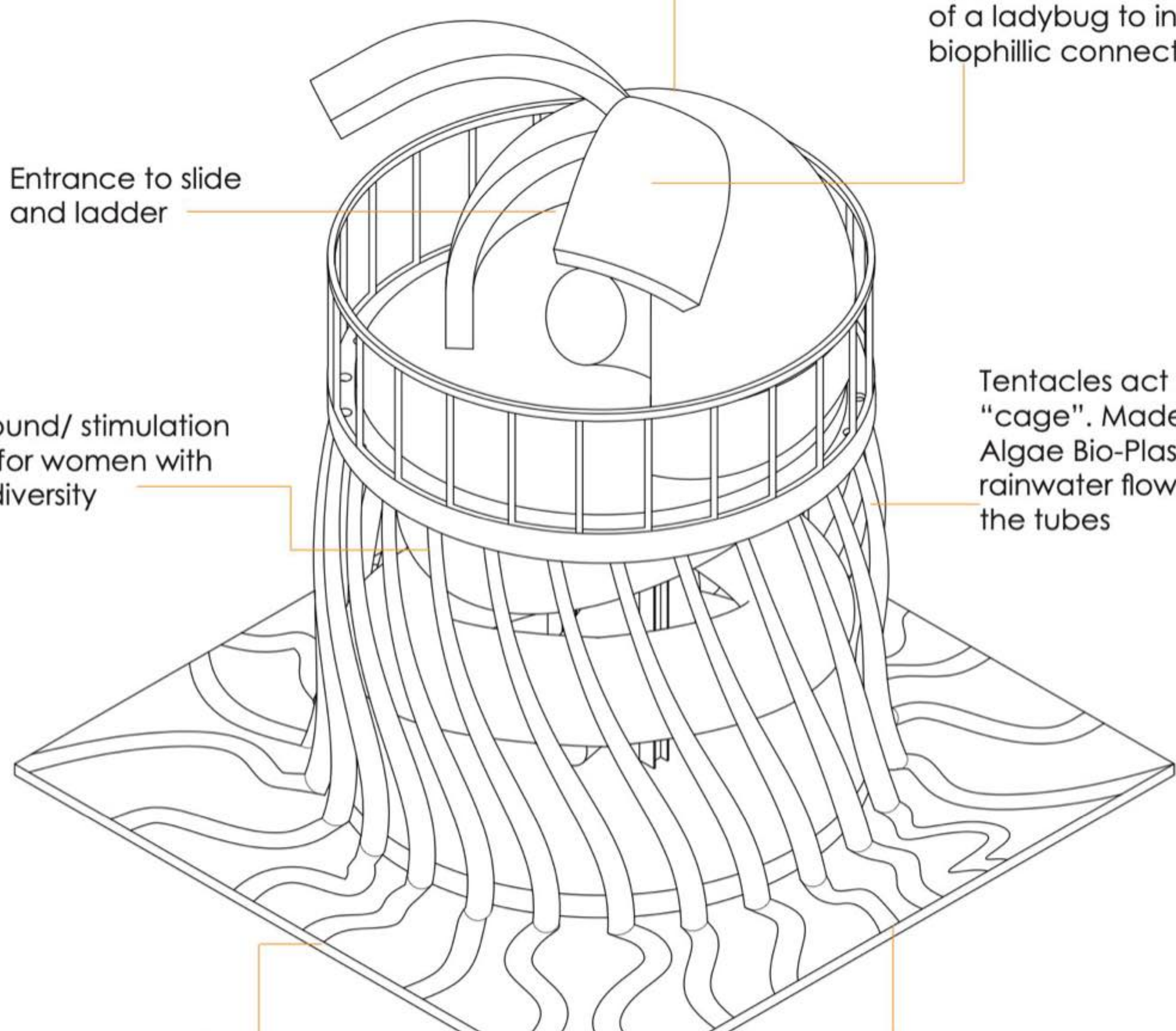
Open Roof Plan



Side Elevation



Front Elevation



Precedent Inspiration for PPS Model

Beach Huts, Spark

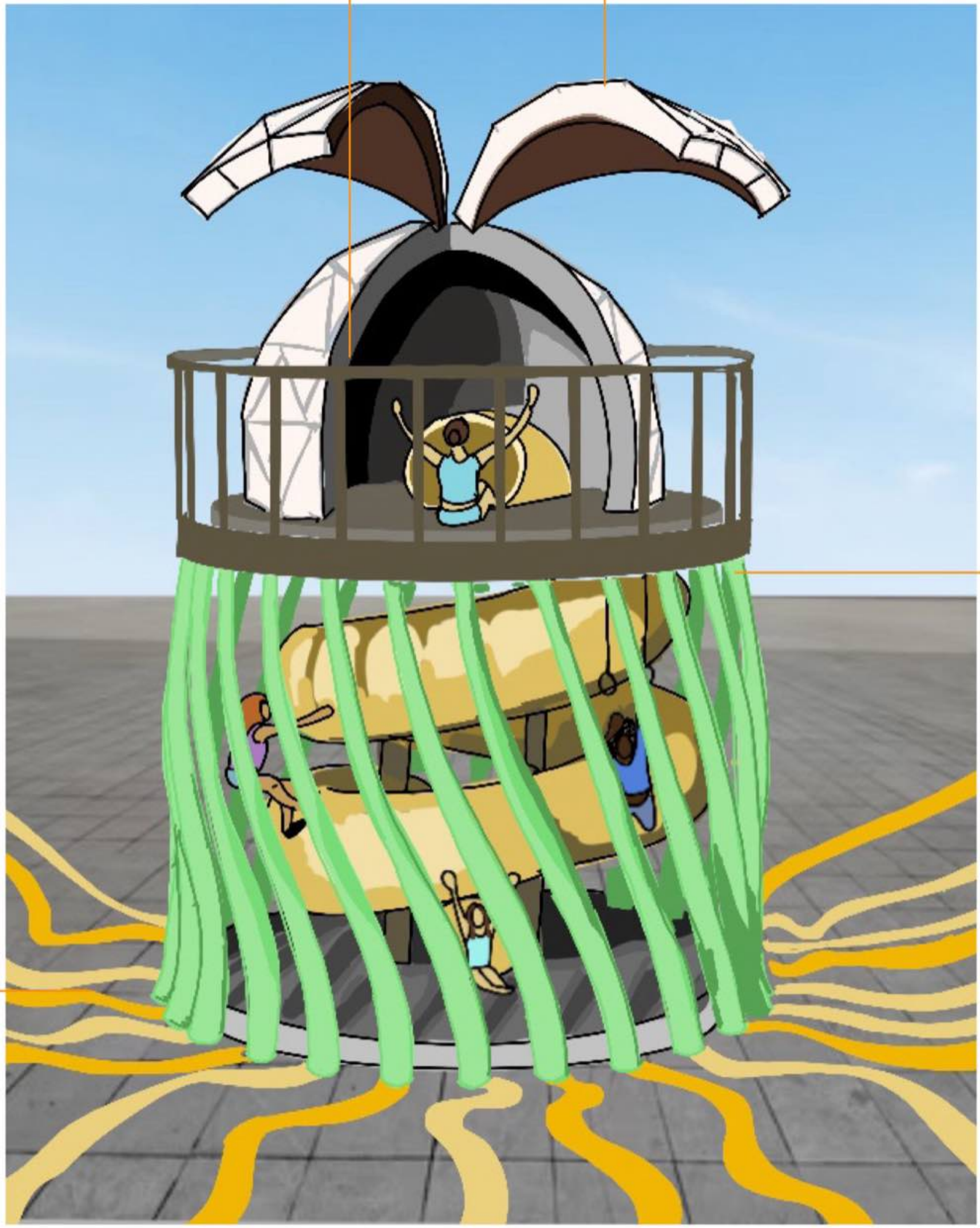
Re-using the plastic that is dumped in the ocean to form recycled HDPE beach huts. The beach huts are raised off the ground with the structural support running up the middle, attached to a Pre-Cast stems below.

The pod structure is made from steal beams, which the sheets are attached to. It acts as a shell for the reused material to sit on. The huts are naturally ventilated and self sustainable, with a film of PV film on the top of the scale, generating sufficient power.

Claremont Park, HTA Design

The park design, supports the Brent Cross Town vision for supporting health and wellbeing. A place to be active, play and socialise. The vibrancy improves connectivity and inclusivity.

Using the stripes and ribbons in my design to add vibrancy to my design and tie together the algae tubes and nearby water sources.



ArboSkin pavilion, ITKE

Stuggart university students built this structure to demonstrate the structural properties of newer bio-plastics. Bioplastic granules are extruded into sheets before being thermoformed and excess material was trimmed off.

Bracing rings and joists are used to create load bearing walls. Waste material was re-granulated and put back into the production process and the bioplastic sheets can be composted as the end of their life.

Algae Dome, Aleksander Wadas Studio

The idea behind this design was to show how algae could be farmed within an architectural space in order to feed the occupants of the space. Algae is used in food supplements as it is high in protein, vitamins, minerals and essential amino acids.
Algae uses photosythesis to turn CO_2 to Oxygen, meaning architectural uses could reduce green house gases.

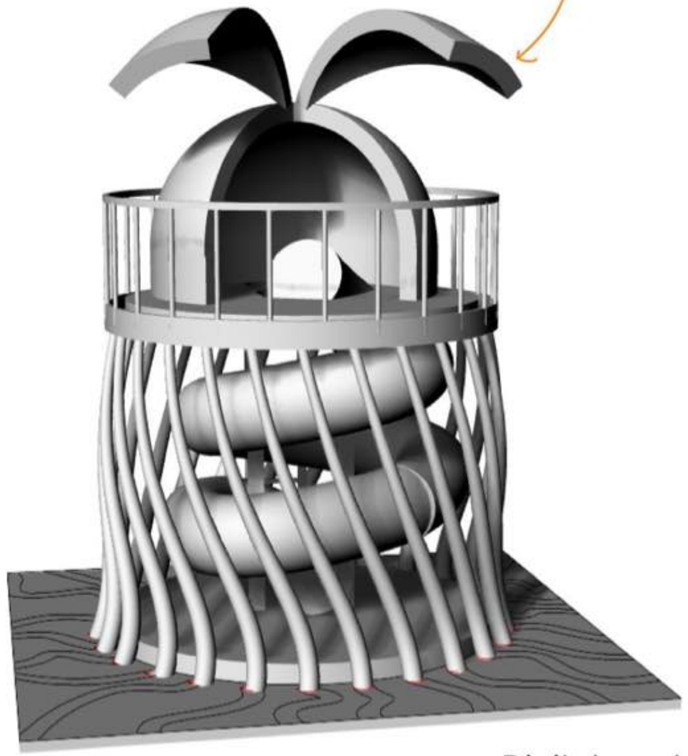
In this structure, timber supports were used to support the tubes as they were intended for farming and not for structure. Extra support is used in my PPS design to allow for the structural element, this will be hemp I-beams.

The 1:50 model made from recycled MDF and orange card, shows the base construction of the beams that are use to structurally support the model. The digital model shows how the added algae bioplastic tubes, which act as a guttering system to carry water to nearby water sources, are decorative and have little structural function. The orange card allows the exciting water patterns to show.

model could bounce and twist

Prototype paper model

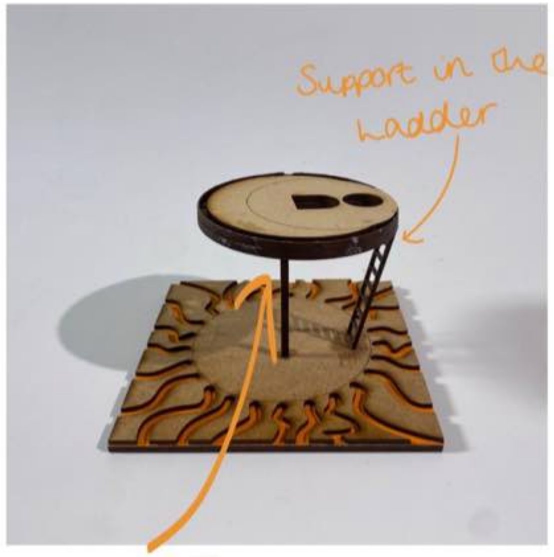
must be a lightweight Structure



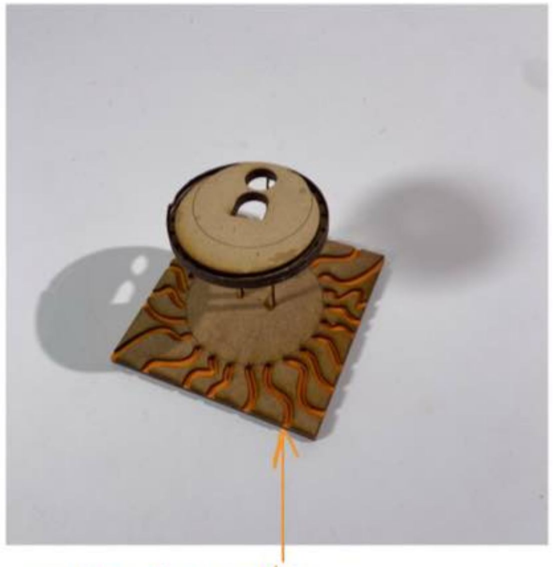
Digital model

Drawing over physical model

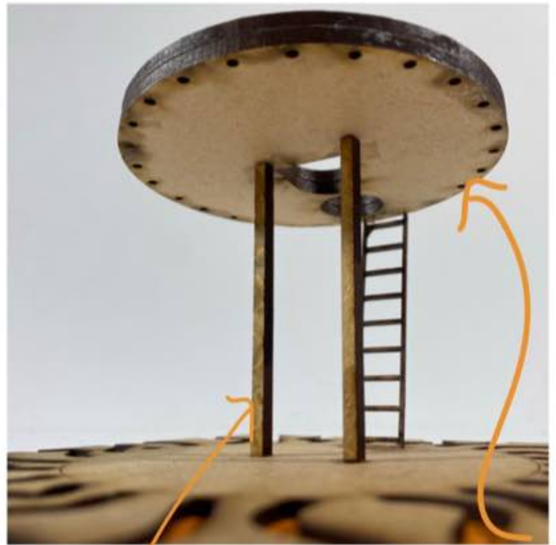
Support in the ladder



catilever



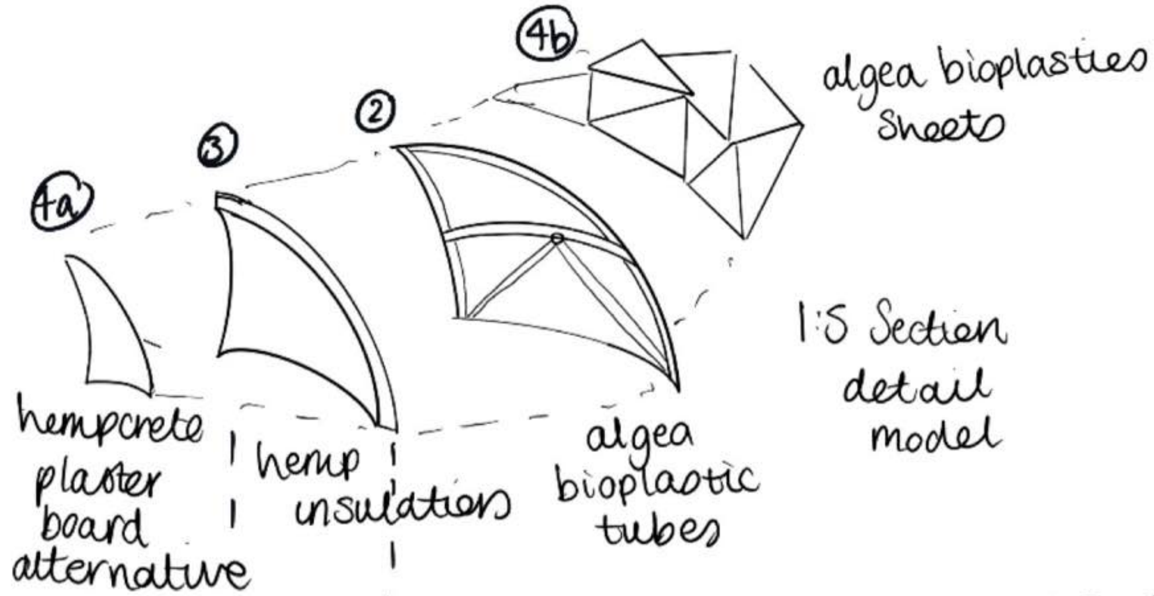
Water channels



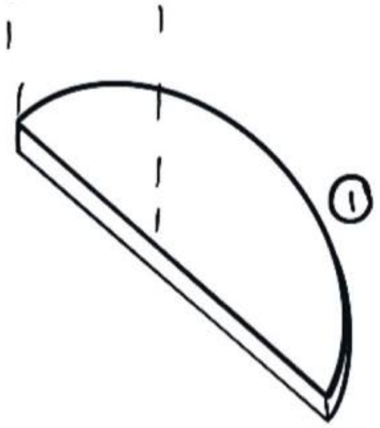
main structure

Gutter for water to flow into tubes

PPS Model
Sectional Material Detail
1:10

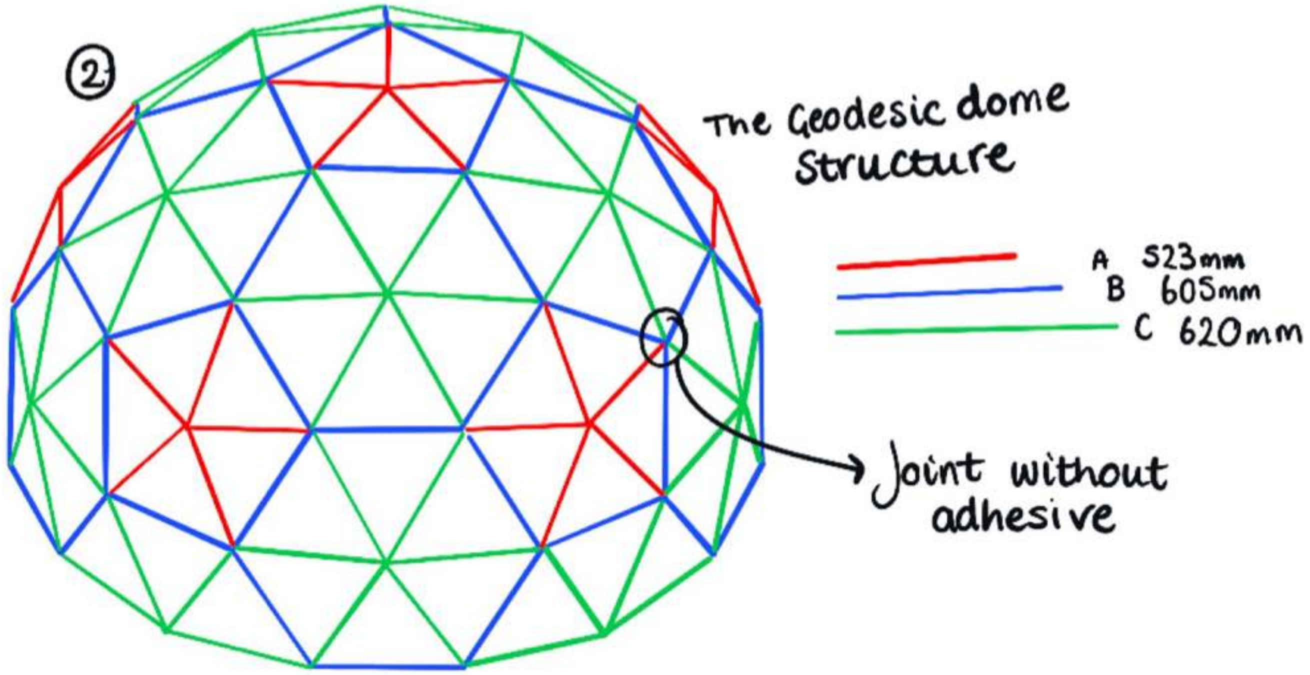


The layers of the 1:10 material model i'd like to explore and how they go together



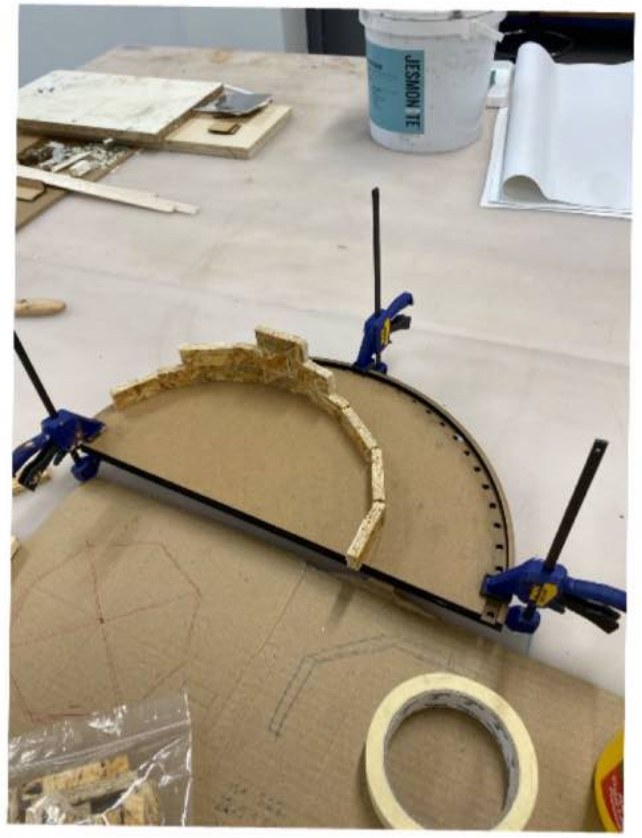
1 Recycled MDF - floor
2 Chipboard - Structure
3 Chipboard - hemp blochs
4 a) Seaweed - hempcrete
b) Ricepaper - bio-plastic

Using a geodesic dome for the structure



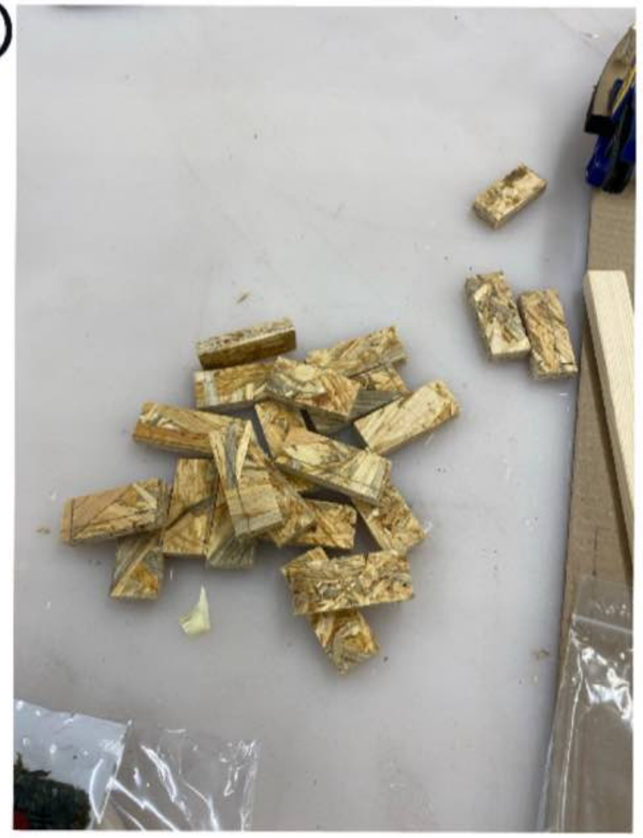
Kit of Parts

1



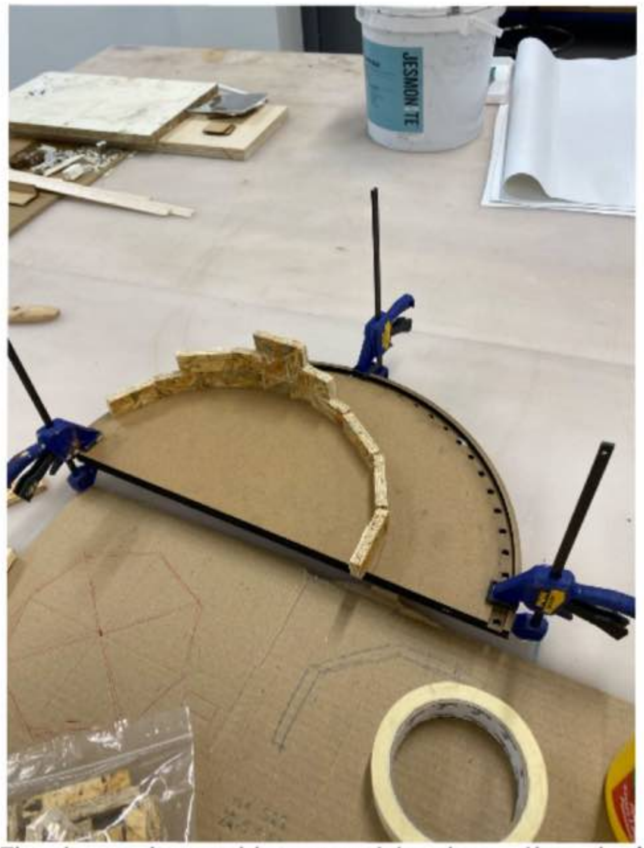
2

3



4

PPS Model
Sectional Material Detail
1:10
The process



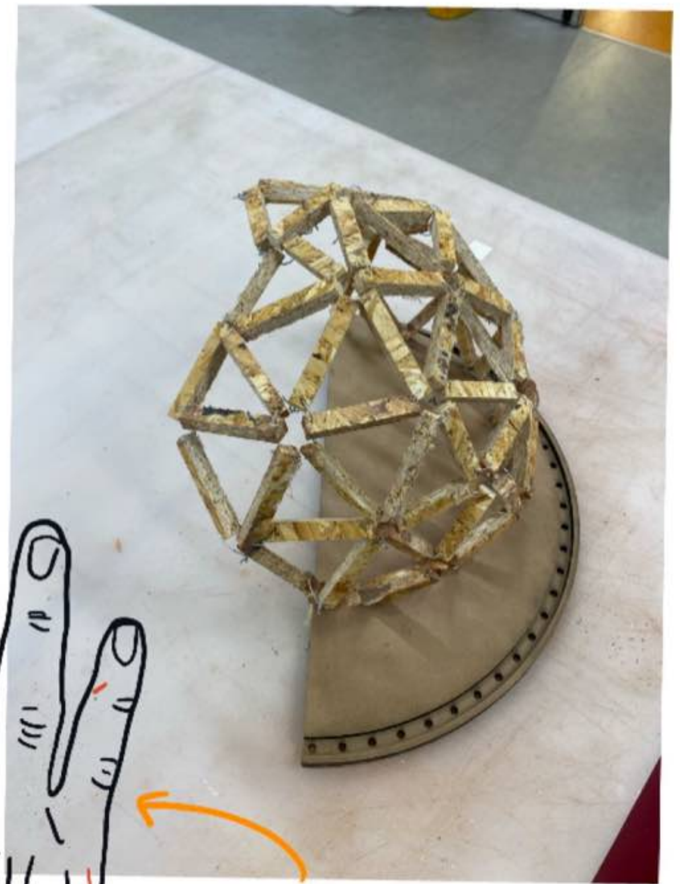
The base board laser cut to show the drain holes and the ground for the dome

Starting by creating the structure of the dome with chipboard to represnt hemp-crete i-beams

Using clay instead of adhesive to join the structure and smooth the connection

The clay was too brittle to hold the structure so the dome collasped and a new strategy was thought of

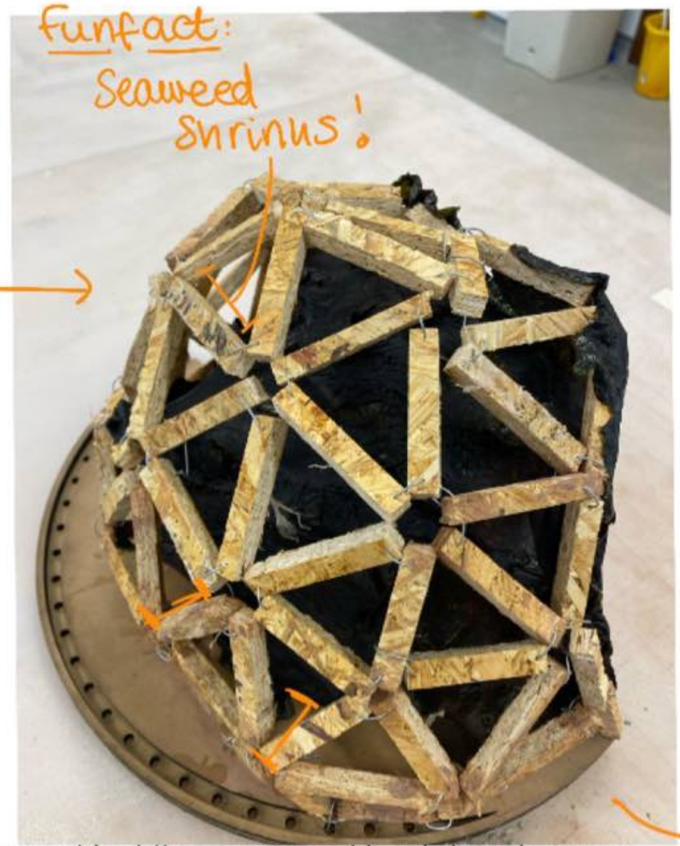
Starting to use wire to make the connections



once the dome structure was made, I attempted to papermache the seaweed internal to represent the hempcrete plaster

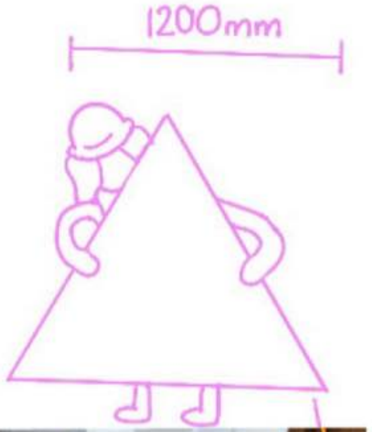
PPS Model
Sectional Material Detail
1:10
The process

Drying seaweed on its side so the wet seaweed weight wouldn't cause the structure to collapse

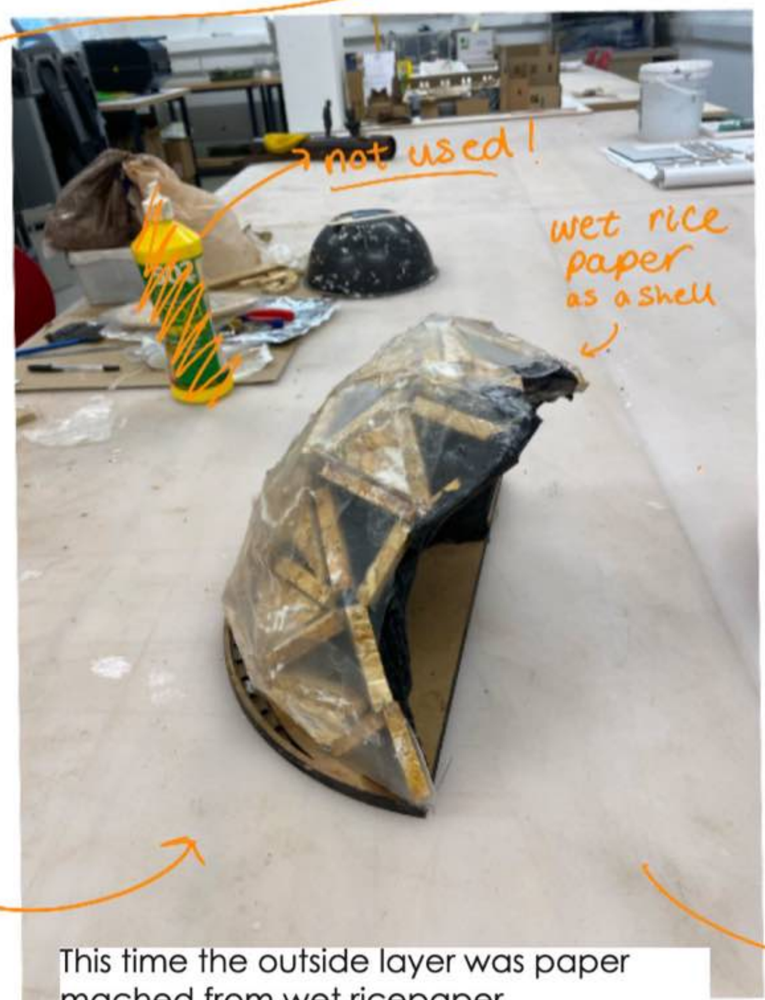


Once dried the seaweed had shrunk away from the structure forming its own dome

This seaweed layer was very satisfying to tap as it had dried, holding its shape



Starting to fill the structural gaps with the hempcrete insulation (also chipboard)



This time the outside layer was paper mached from wet ricepaper

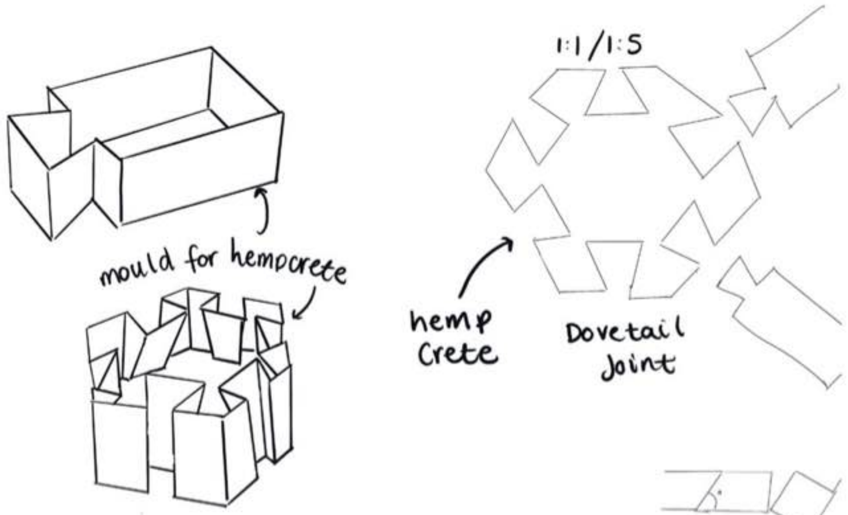
The triangular panels of ricepaper were designed to be carriable by women constructing the dome

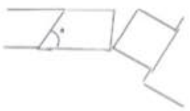
PPS Model
Sectional Material Detail
1:10
Final Model

The final model for my 1:10 material exploration. This was an interesting process in using no adhesives or plastics in my model making process, which as rewarding as that feels to know the environmental damage reduced, it opened my eyes to how complex these materials are to work with and the research that is needed to require the certain skills to apply them to a building.

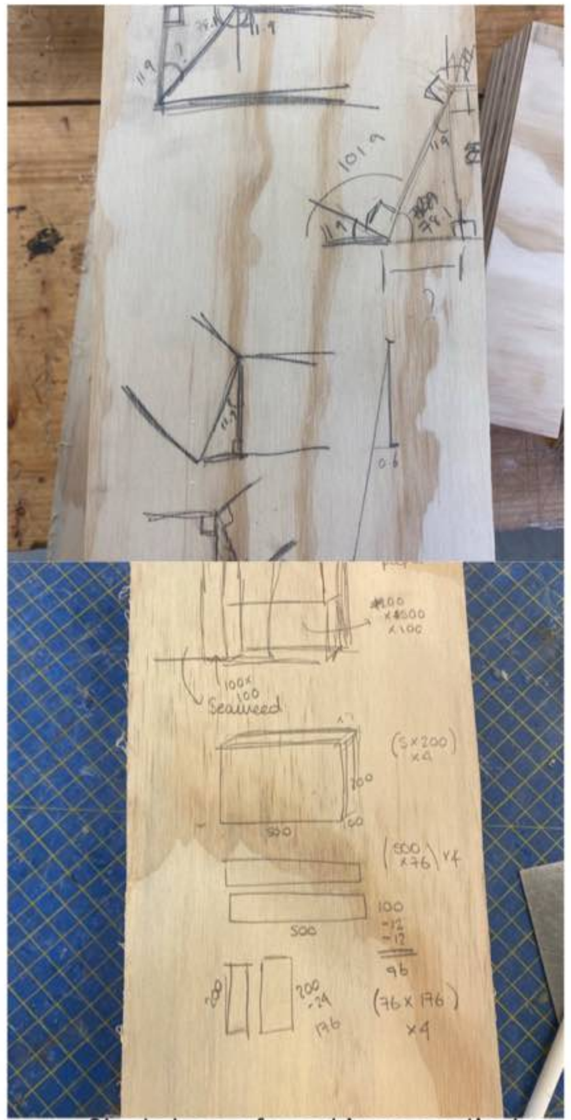
PPS Model
Sectional Joint Detail
1:1

The joints in my 1:10 model, showed I needed to look further at how I was going to attach the structure together. Domes like this often use steel, however a dome made from natural materials, I wanted to use a material that furthered this. I decided to look into hemp-crete joints, which could be pour casted like the beams and blocks. To do this I wanted to make a 1:1 wooden joint to work out the complexities of the angles and sizes.





Initial drawings of the idea of a cast joint



Sketches of workings on timber

1 Marking out

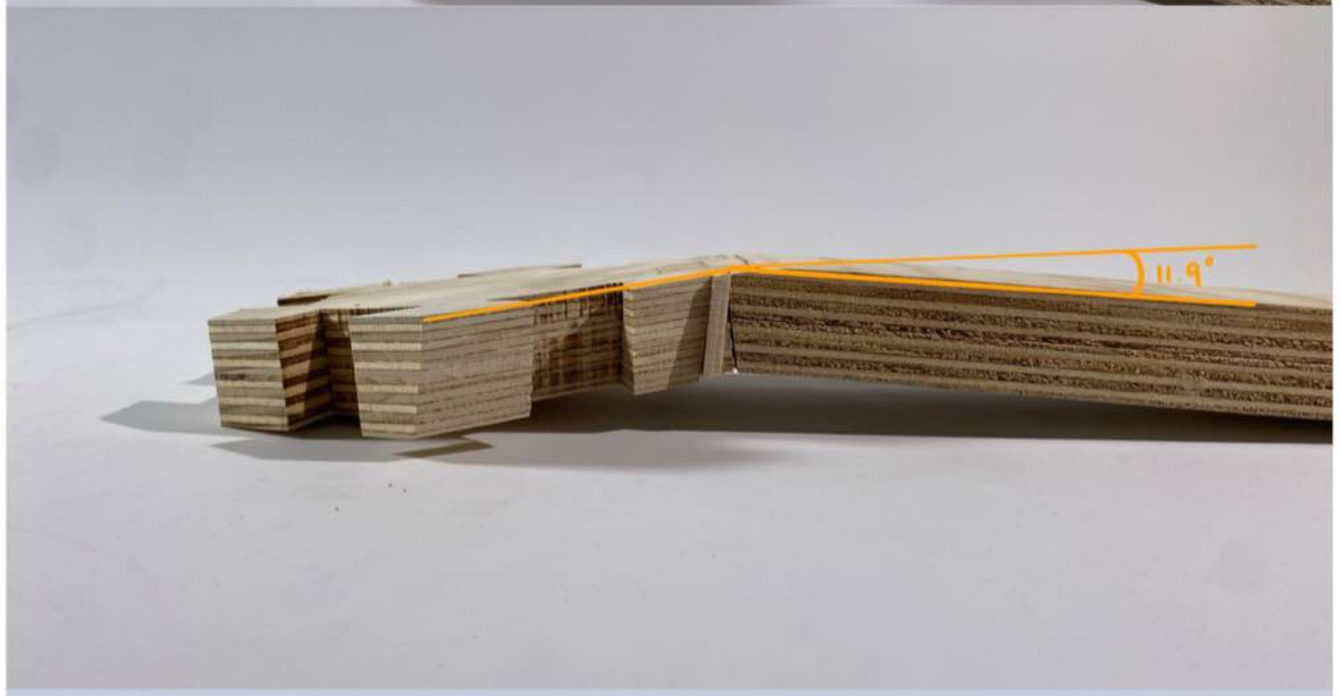
2 After cutting out

3 The gap after the angle

4 Filling the gap

5 Wood filler for small gaps

6 Sanding out



Velindre Cancer Center
White Arkitektur

On 11th February 2025, I attended the Riba: Architecture for healing talk in London. Among the speakers was Micheal Woodford from White Arkitektur, who introduced the Velindre Cancer Center in Wales. This project concentrated on the materials used to create a Biophillic design- “fighting the system”

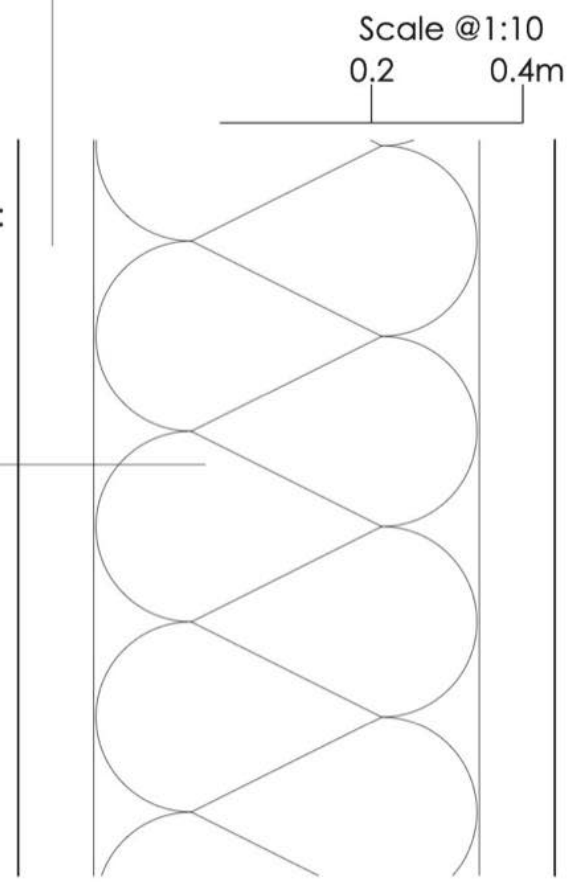
Renovations of a pre 1945 hospital, with the aims to promote green travel and better transport systems to the hospital.

Materials:
-9% solid timber and CLT
-Local solution
- Stone and slate
Material pyramid was used to determine the least embodied carbon materials to use.

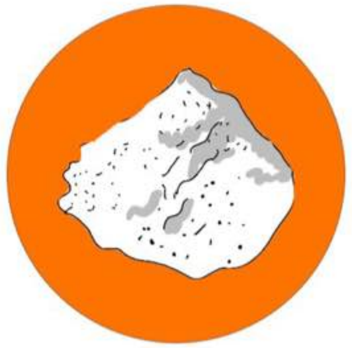
Local mapping showed the following materials could be sourced:
- Gabion
- Limestone (waste quarrys)
- Timber
- Lime

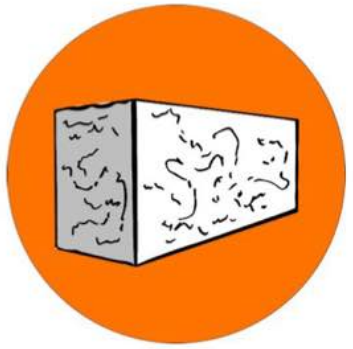
Hempcrete used the local lime.
510mm hempblock wall was used.

Postitives of hempcrete:
- Non combustible
- antibacterial
- no biocide
- not a radiation material



I like the exposed timber





My opinion:
Hempcrete was a good choice for hospitals for breathability, I liked the use of it in this design as it promoted health and wellbeing. Breathability improves air quality which improves overall health. The timber is a biophillic element, which is benificial for the connection to nature, another factor that improves health in a hospital environment.

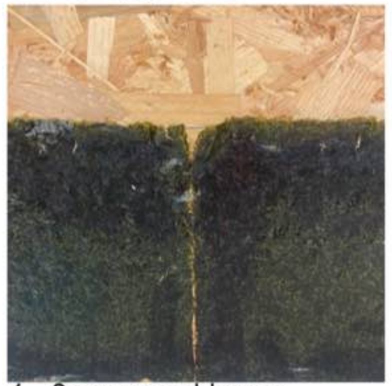

1 Making hempcrete blocks

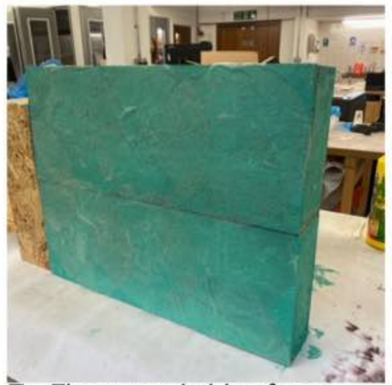

2 Making hempcrete structure


3 Hempcrete blocks green


4 Seaweed layer for hempplaster

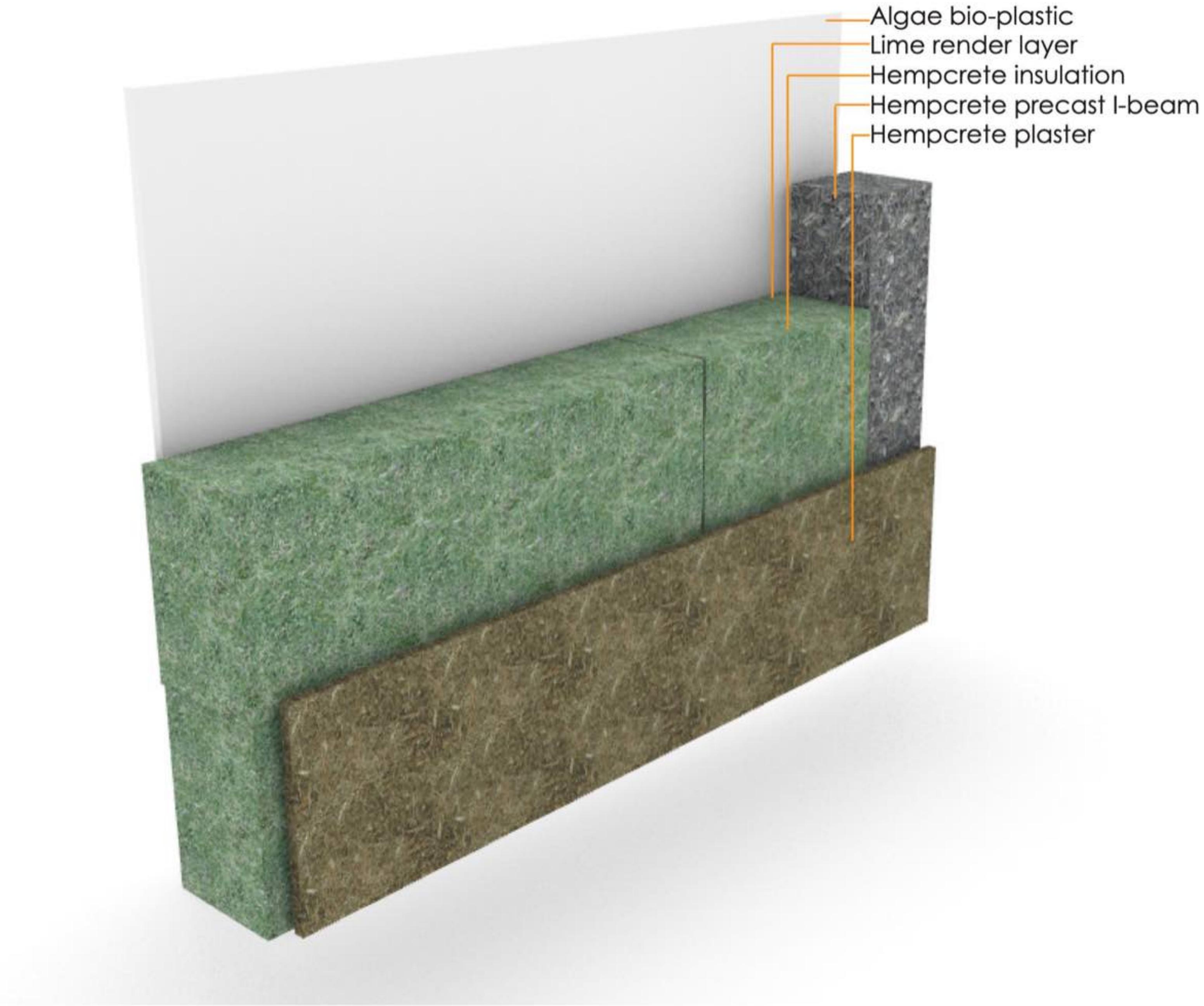

5 Ricepaper on hempcrete insulation


6 Seaweed layer


7 The model before drying


8 After drying the model cracked

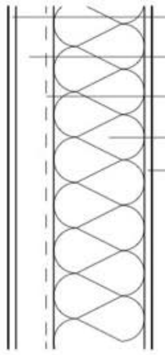
This 1:1 detail of the wall build up shown in the dome, uses the materials as before. I started by making a physical model, however the natural materials I used previously (seaweed and ricepaper) were too thin to be accurate and didn't show the section I wanted to. I therefore modelled the 1:1 detail on rhino which showed clearly the section. I will use this sectional detail to make changes to my plan and section.



Applying material to the building

The wall build up and how this effects the building

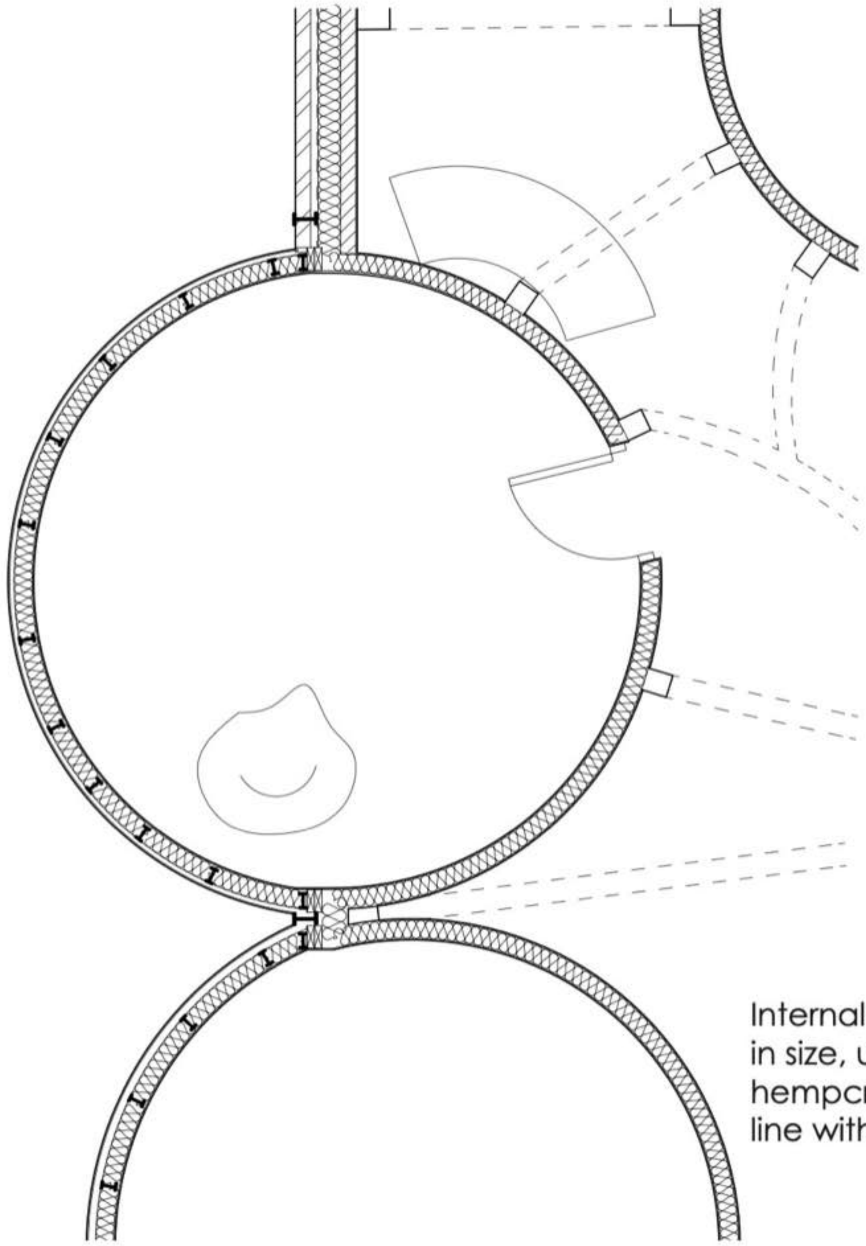
My PPS model explored the use of hempcrete and algae bioplastic which can be applied to the domes and structural wall in the building



The Wall Build up:
1) Algae Bioplastic 10mm
2) 50mm ventilation gap
3) Non- Plastic DPM
4) Hemp Crete Insulation
5) Hemp Crete Plaster

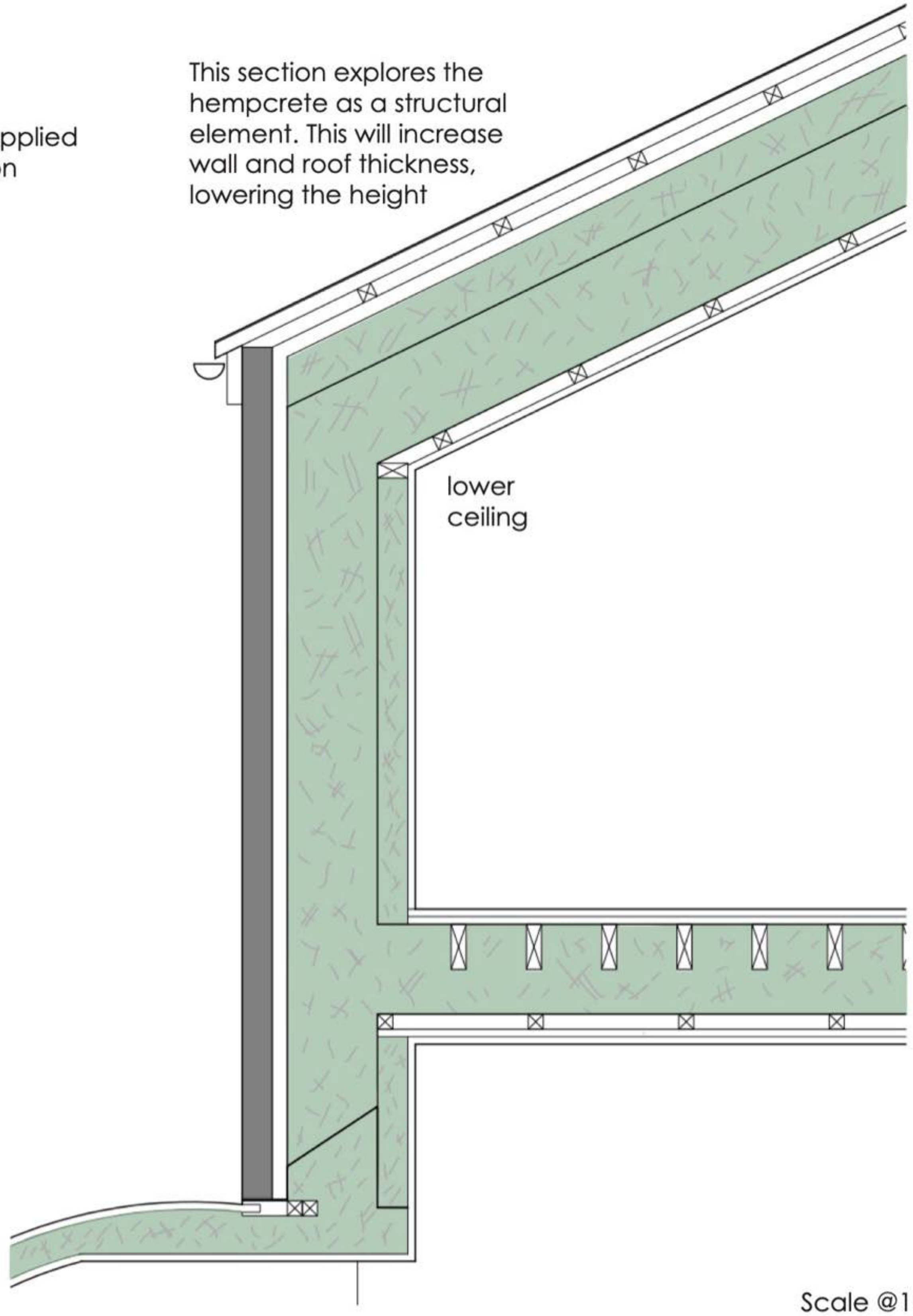
Scale @1:10
0.2 0.4m

This build up can be applied to the plan and section



Adding the wall build up to the existing plan

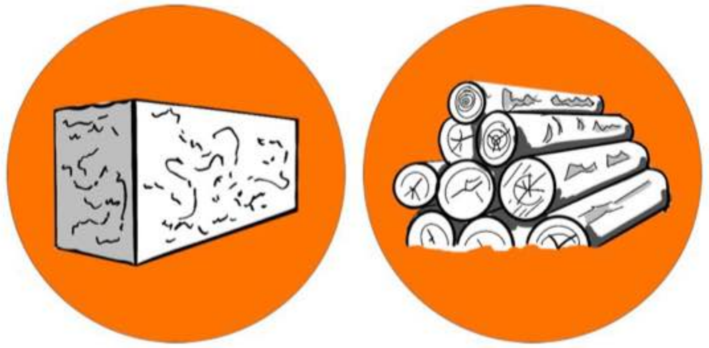
This section explores the hempcrete as a structural element. This will increase wall and roof thickness, lowering the height

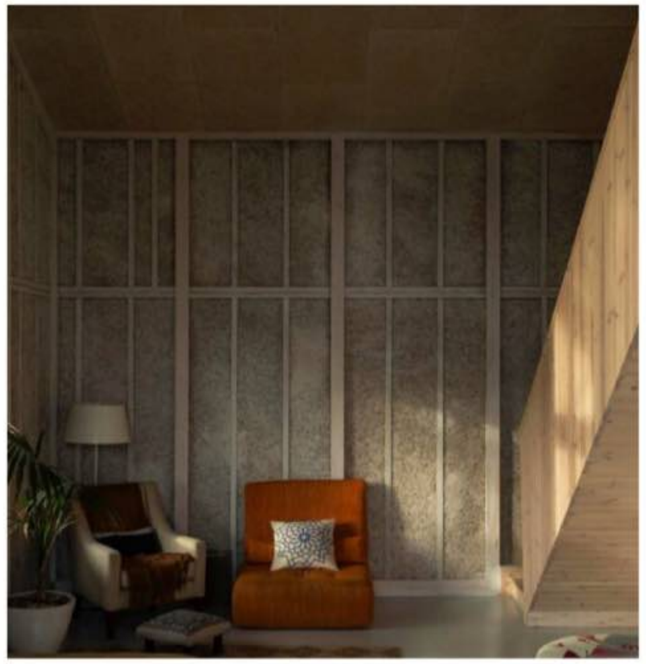


Adding the wall build up to the existing section

For Client Steve Barren, owner of Hempden, a hemp farm in Oxfordshire. Steve established Margent Farm as a business and began researching and developing bio-based alternatives to plastics, integrating the materials grown at the farm.

The end result aim was a house and a materials research facility. The body of the house is made by entirely grown materials, making it low in embodied carbon.

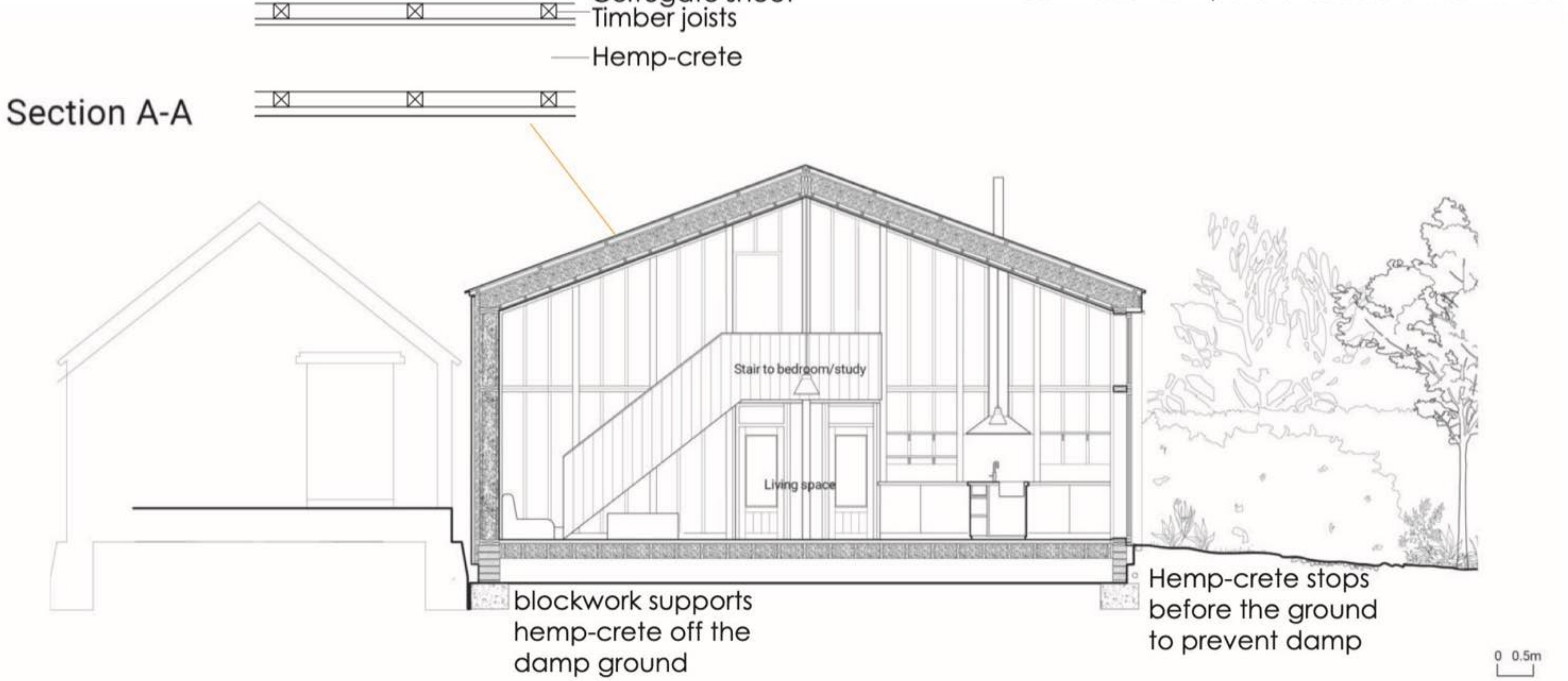


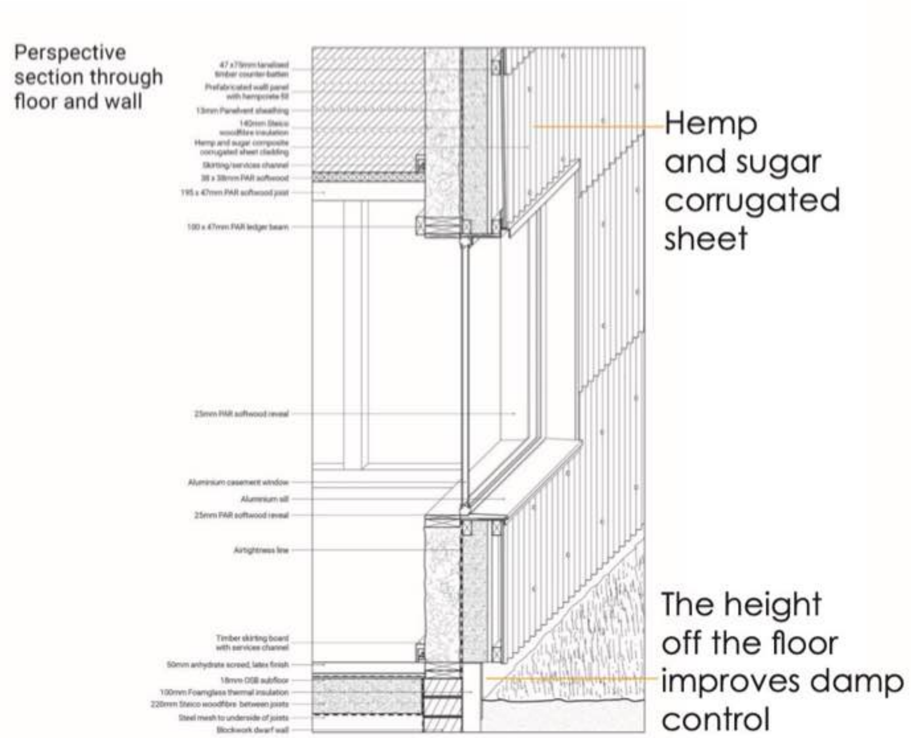


Exposed structure internally and hempcrete, allows the user to connect with the primal nature of biophillic design.

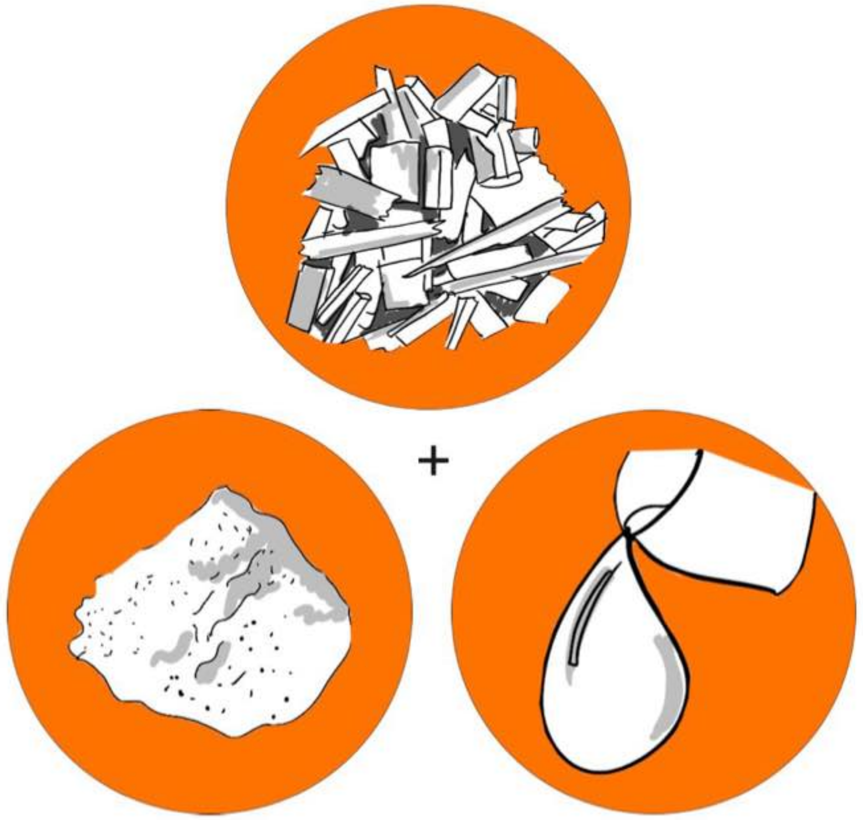
Built in a panel system, the structure uses timber I- joists with the precast hempcrete dried in a factory. Steico Woodfibre insulation is used and no membranes are needed as the building allows moisture to move freely. Rough texture to the walls makes them highly absorbent acoustically.

Can't cast hempcrete outside in the winter!





How its made:



Positives:
- Lightweight design
- High load bearing strength
- Sustainbale
- High thermal and Acoustic performance
- Versatility
- Durable
- Low Carbon emissions

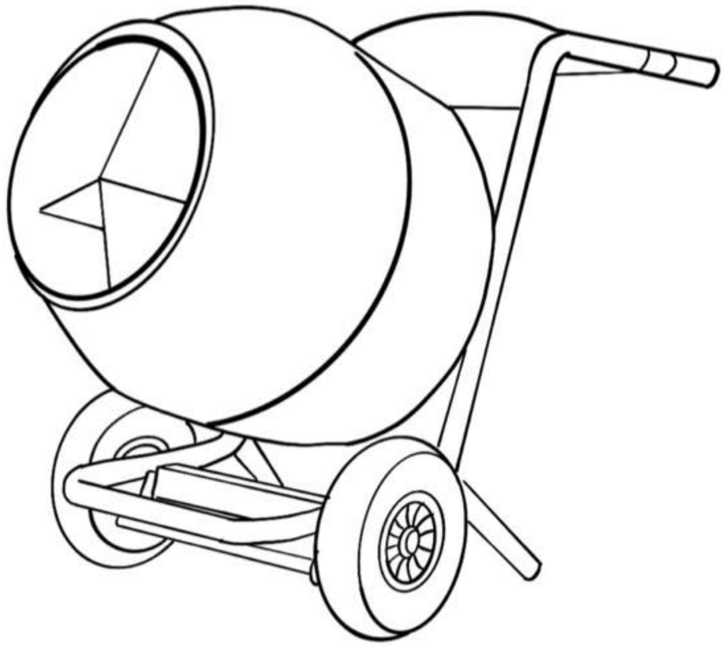
Hempcrete I-Beams:

Carbon emisions: -55.1 kg CO2eq/m3
U-Value: 0.2 W/m²K
Cost: £40 per meter
Hempcrete I-beams are non combustible

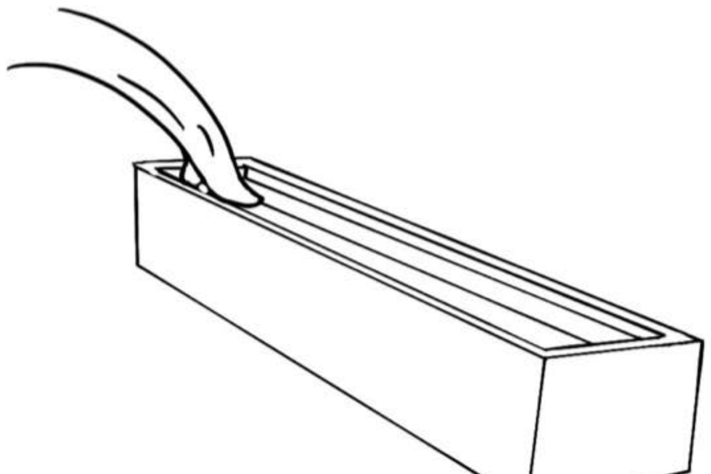
Comparison to Steel I-Beams:

Carbon emisions: 5403.2 kg CO2eq/m3
U-Value: 5.0 W/m²K.
Cost: £75 per meter
Steel I-beams require an epoxy coating to make them fire proof

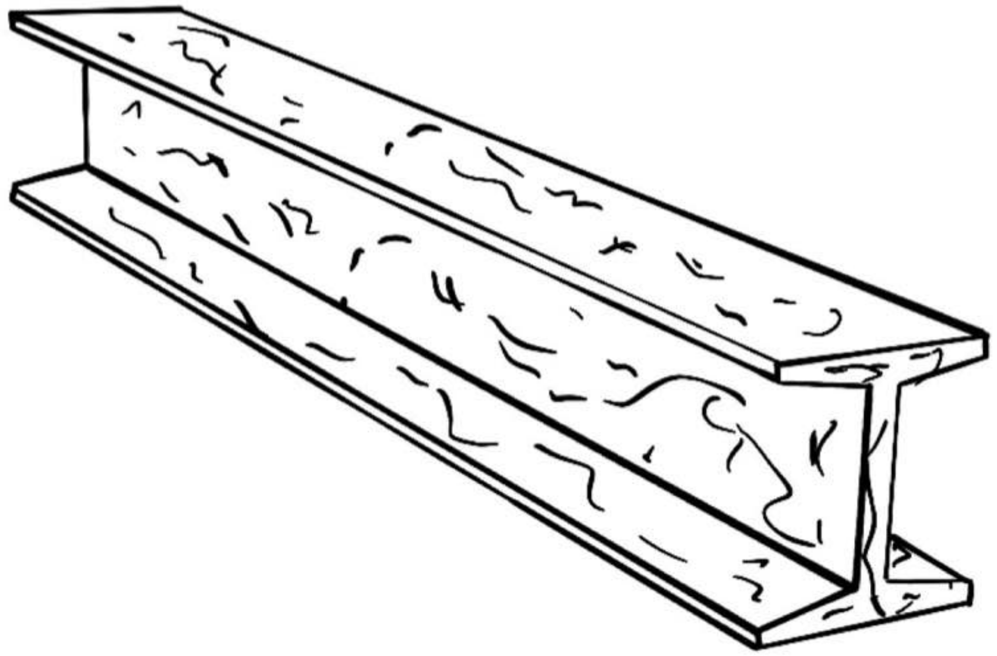
Structural comparison:
Hempcrete, while strong in compression, is not as strong in tension or bending as steel. Steel beams are highly resistant to bending, shear forces, and other stresses, and their tensile strength allows them to bear significant weight without failure. Hempcrete can be used in low-rise buildings for structural purposes, such as my site.



Added to a mixer

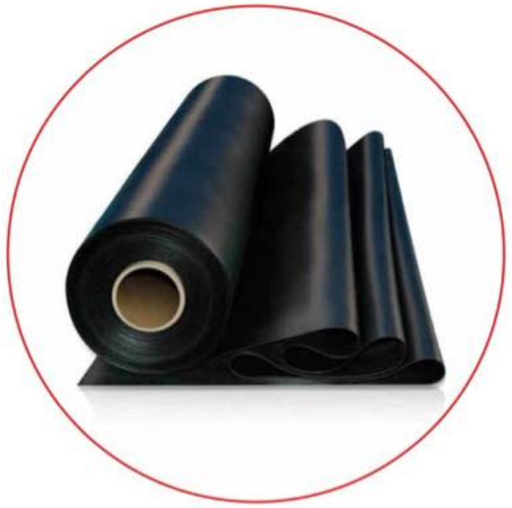


Poured into I-Beam moulds



Once cast has set, I-Beam is ready to use

Lime render
Material anaylsis



As a replacement for plastic waterproof mebranes and vapour barriers, I am looking into lime render as an alternative. Plastic membrane is long lasting and convenient however it is unsustainable and uses plastic.

Traditionally applied in 3 layers, 25mm thick in total

Positives:
- Breathable
- Sustainbale
- Low Carbon emissions
- Flexibility
- Damp prevention

Negatives:
- Slower drying time
- skills required for application
- increased costs

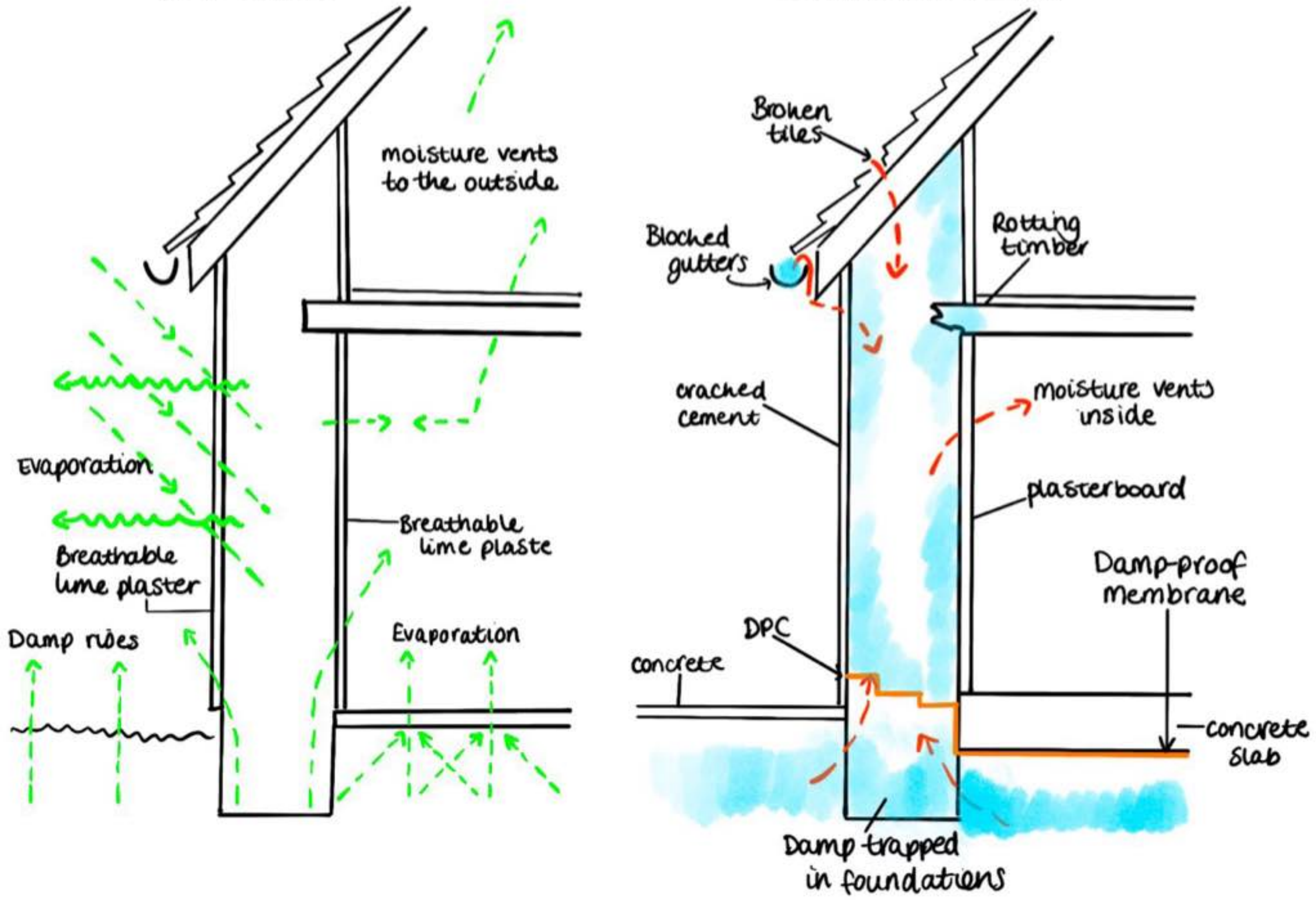
The Science Part

non-hydraulic lime (air lime) is used. Lime render sets through Carbonation:

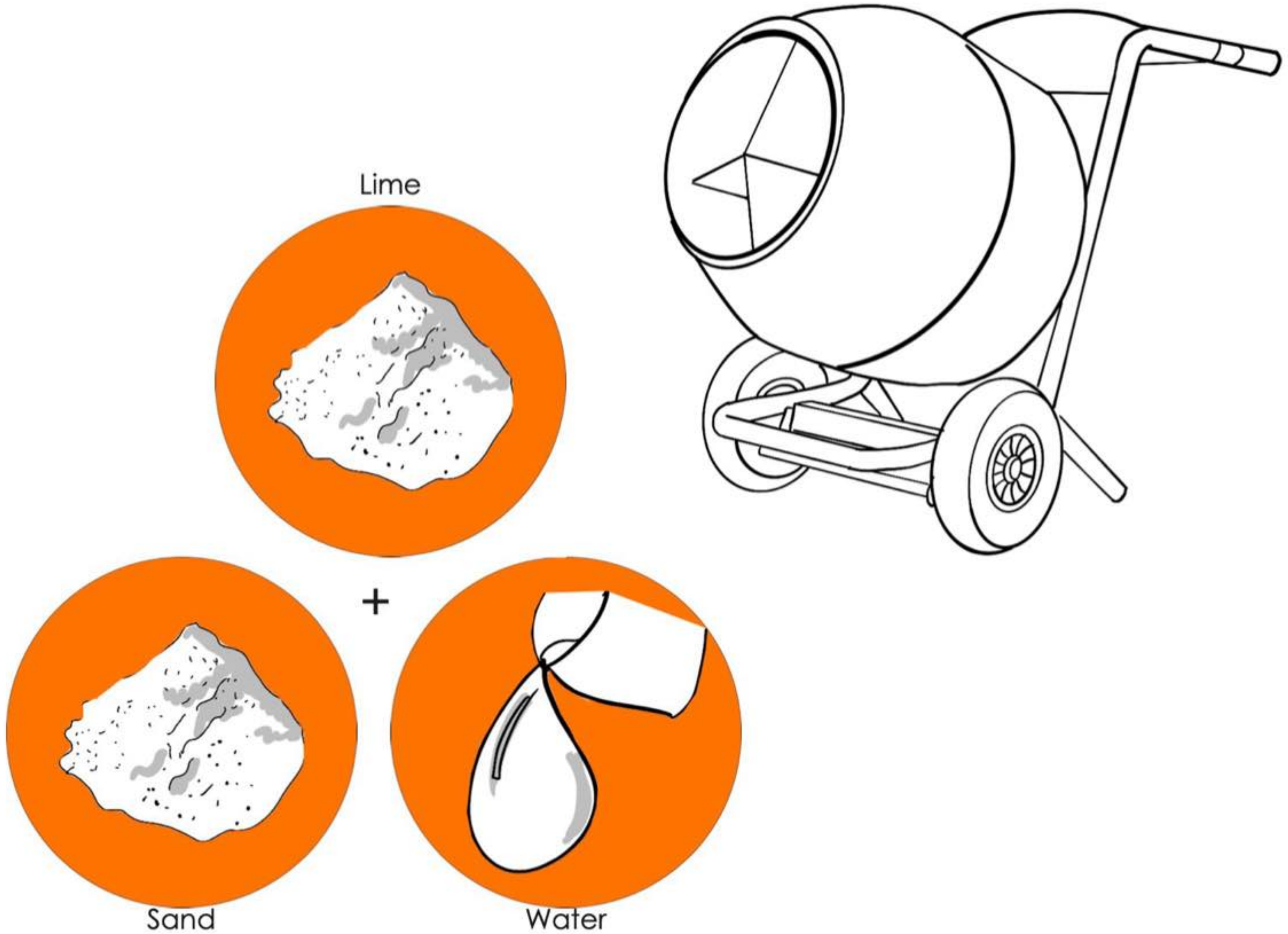
$CO_2 + H_2O \rightarrow H_2CO_3$

Air and water effects

Lime render | Common material

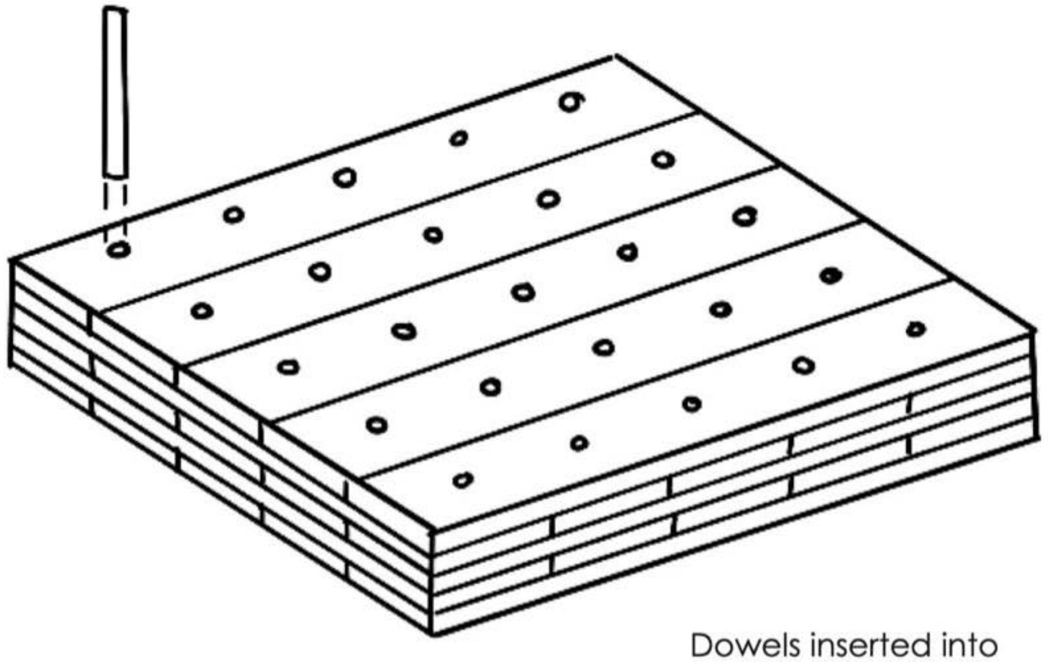


How its made:

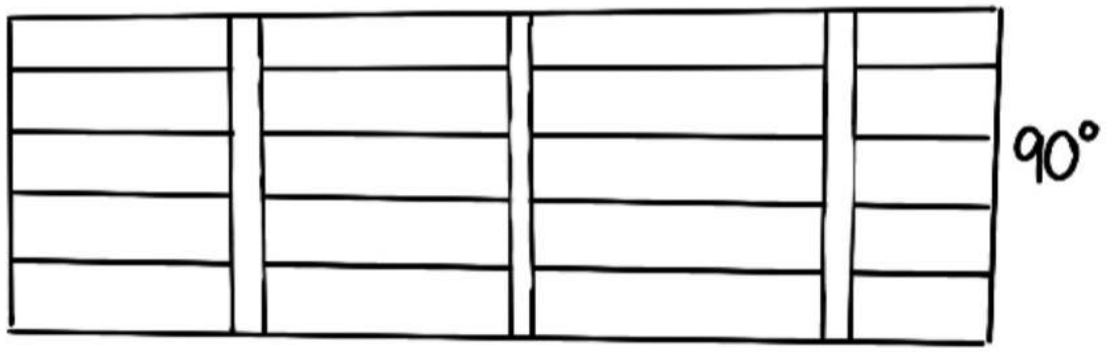


Non-adhesive Glulam
Timber
AFLT
Material Exploration

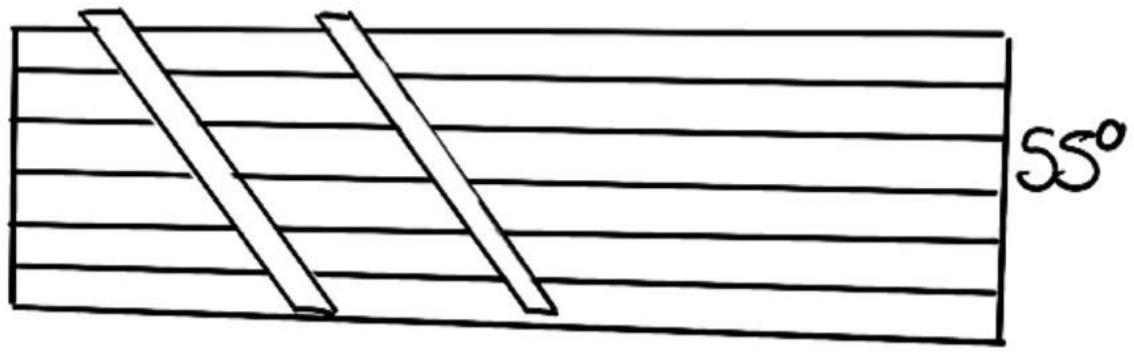
How its made:



Dowels inserted into timber to hold them together



either 90 or 55 degrees



How much adhesive is used in glulam beams?
0.3mm of adhesive layer per beam
1% of glulam is adhesives

$55.3m^3$- 1% $0.5m^3$ of adhesive in my building

What is Adhesive:

Adhesive is anything that forms a bond:
-glue
-paste
-cement

Adhesive used in glulam beams is polycondensation. They harden through the separation of water

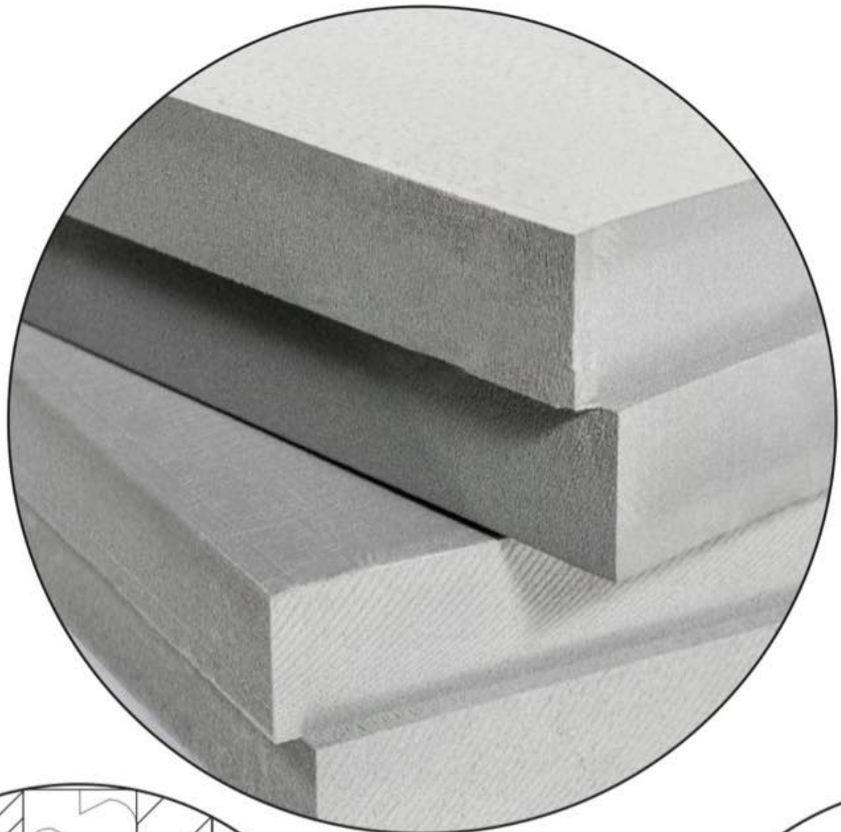
Timber as a biophillic element:

The use of timber in architecture and design not only brings an aesthetic appeal but also has proven psychological benefits, reducing stress and improving focus. Wood's tactile qualities, varying grains, and ability to age gracefully create a dynamic, ever-changing atmosphere that aligns with biophilic principles of natural complexity and sensory engagement. Incorporating timber into interior spaces, from walls to flooring and furniture, establishes a sense of harmony between the human-made and natural worlds, promoting a more balanced and restorative environment. This is benifical for helping women with neurodiversity.

Insulation Comparison

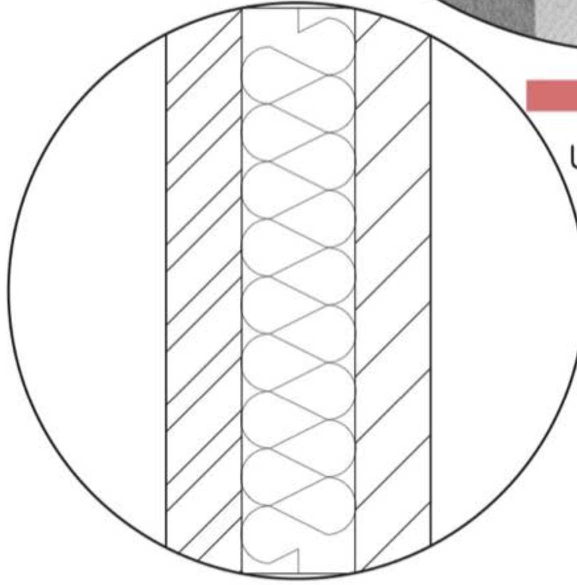
Comparing common plastic containing insulation vs uncommon hemp-crete insulation

Common Material



Common Material

Uncommon Material



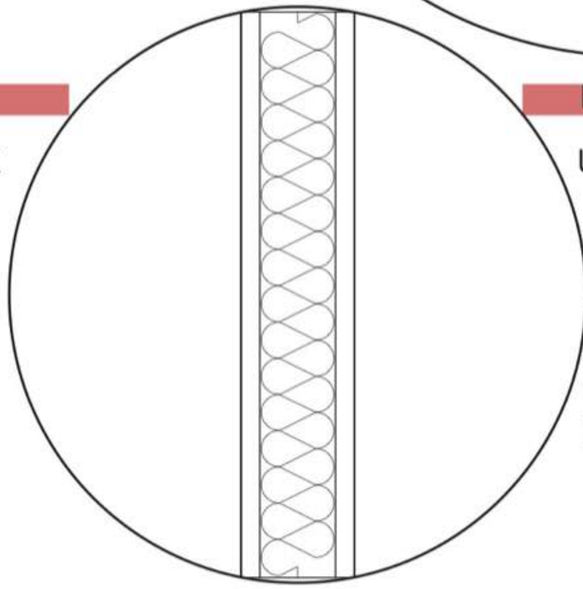
150mm

XPS Insulation

U-Value 0.15W/m²K

This is commonly used for tempurature insulation. It is readily available and 200mm will sufficiently heat a room for a woman.

Cost : £15 per sqm
Weight: 9kg per sqm
Embodied Carbon: 94.0 kg CO2eq/m3



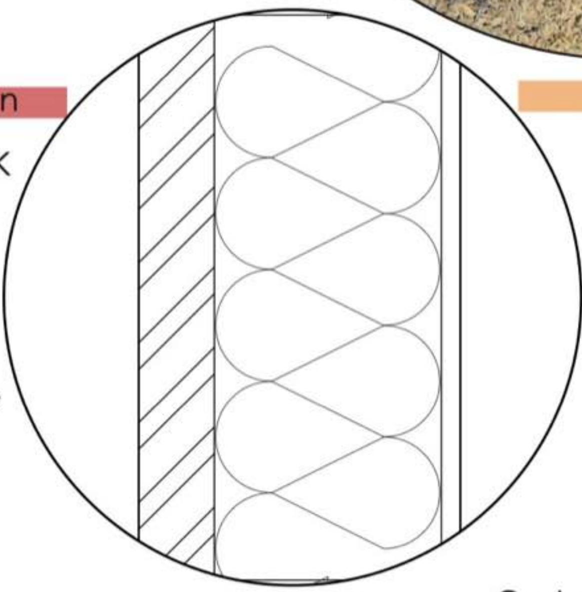
100mm

Fibreglass Insulation

U-Value 0.28W/m²K

This is commonly used for Acoustic insulation. It traps the sound in air pockets and is fire resistant.

Cost : £10 per sqm
Weight: 2.2kg per sqm
Embodied Carbon: 12.8 kg CO2eq/m3



300mm

Hempcrete Insulation

U-Value 0.20W/m²K

I want to use this as it reduces the use of plastic in my design and improves the carbon emission of my building. Although the thickness of the walls will increase, my building has the space to accomodate this and it will improve the heating on site. It can also be used for acoustic reasons which reduces the number of materials needed.

Cost : £100 per sqm
Weight: 90kg per sqm
Embodied Carbon: -55.1 kg CO2eq/m3

	material	group	impact / m3	volume [m3]		area [m2]		thickness [mm]		result
1	XPS insulation	kunststof	94.0 kg CO2eq/m3	654312	m3		m2		mm	61,505,328.0 kg CO_2 eq
2	Glass wool	mineralsk	12.8 kg CO2eq/m3	4786.5	m3		m2		mm	61,267.2 kg CO_2 eq
3	Hemp lime	biobaseret	-55.1 kg CO2eq/m3	659098.5	m3		m2		mm	-36,316,327.3 kg CO_2 eq

61,566,595.2 kg CO2 eq total of common materials

Rethinking the materials
Material Analysis

1	Brick, red	mineral	297.0 kg CO2eq/m3	50.59	m3		m2		etc.	15,025.2 kg	CO2eq
2	Hemp lime	biobased	-55.1 kg CO2eq/m3	6590	m3		m2		etc.	-363,109.0 kg	CO2eq
3	Glulam and cross-laminated timber CLT	wood	-664.0 kg CO2eq/m3	55.35	m3		m2		etc.	-36,752.4 kg	CO2eq
4	Glass pane, double-glazed	components	4580.0 kg CO2eq/m3	2.3	m3		m2		etc.	10,534.0 kg	CO2eq

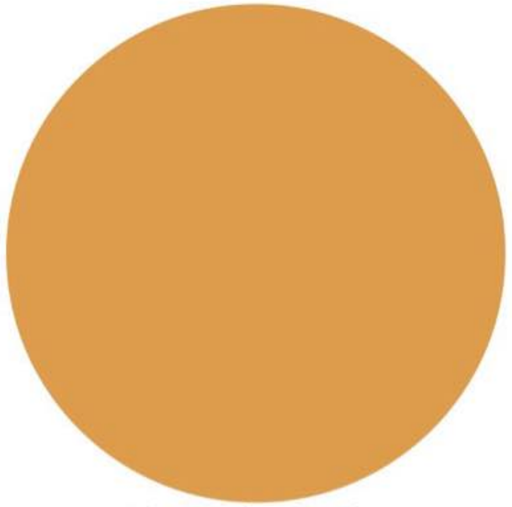
This analysis shows that in comparison to the common materials, the overall results are better, carbon emmisons for the materials are lower, and a higher sustainability rating. No plastic architecture is better for the environment.

Brick- Aesthetics

Durability ●●●●●
Cost ●●●●●
Sustainability ●●●●○
Carbon ●●●○○
Fire resistance ●●●●●
Breathability ●●●●○

Lime render DPM

Durability ●●●○○
Cost ●●●●○
Sustainability ●●●●●
Carbon ●●●●●
Fire resistance ●●●●○
Breathability ●●●●●

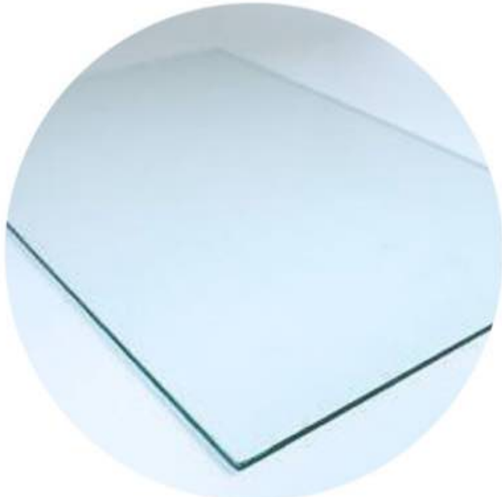


Algae Bio-plastic

Durability ●●●○○
Cost ●●○○○
Sustainability ●●●●○
Carbon ●●●●●
Fire resistance ●●○○○
Breathability ●●●●○

Non adhesive glulam Timber- Aesthetic

Durability ●●●●○
Cost ●●●○○
Sustainability ●●●●●
Carbon ●●●●●
Fire resistance ●●●○○
Breathability ●●●●○



Glass- Aesthetic

Durability ●●●○○
Cost ●●●○○
Sustainability ●●●○○
Carbon ●●○○○
Fire resistance ●●●●○
Breathability ●○○○○

Hempcrete Insulation- Thermal

Durability ●●●○○
Cost ●●●○○
Sustainability ●●●●●
Carbon ●●●●●
Fire resistance ●●●●○
Breathability ●●●●●

Hempcrete Plaster- Aesthetics

Durability ●●●○○
Cost ●●●○○
Sustainability ●●●●●
Carbon ●●●●●
Fire resistance ●●●●○
Breathability ●●●●●

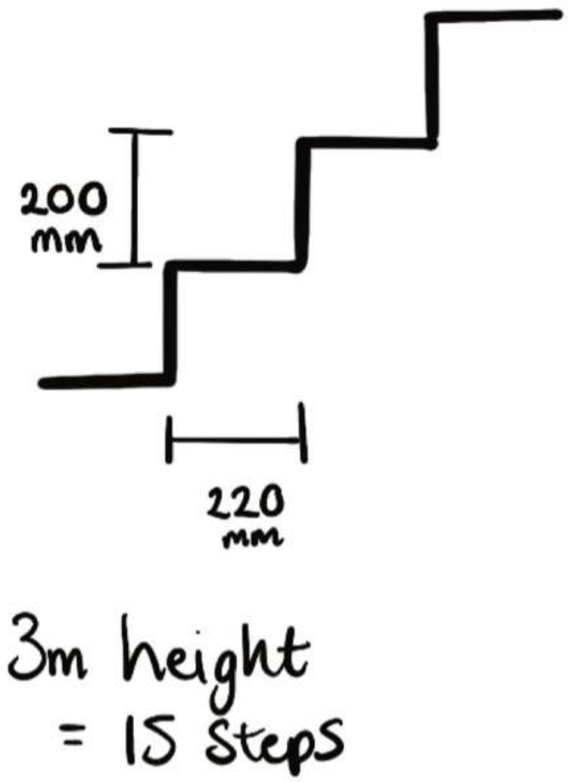
Hempcrete I- beams- Structural

Durability ●●●○○
Cost ●●○○○
Sustainability ●●●●○
Carbon ●●●●●
Fire resistance ●●●●●
Breathability ●●●●○

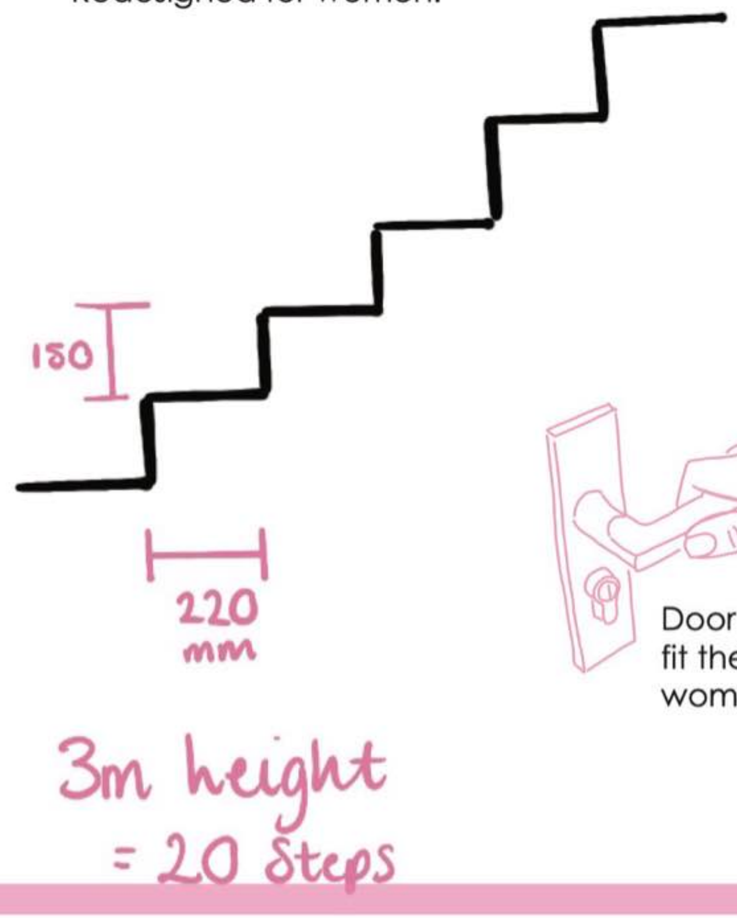
Stair height:

"Female participants perform stair negotiation using greater angular excursion and muscle activation than male participants. This could impose greater mechanical burden on lower extremity structures and, consequently, increase energy consumption. Therefore, sex-based differences should be considered when planning a stair-negotiation rehabilitation program." (Farrag, 2016)

Building reg standard height:

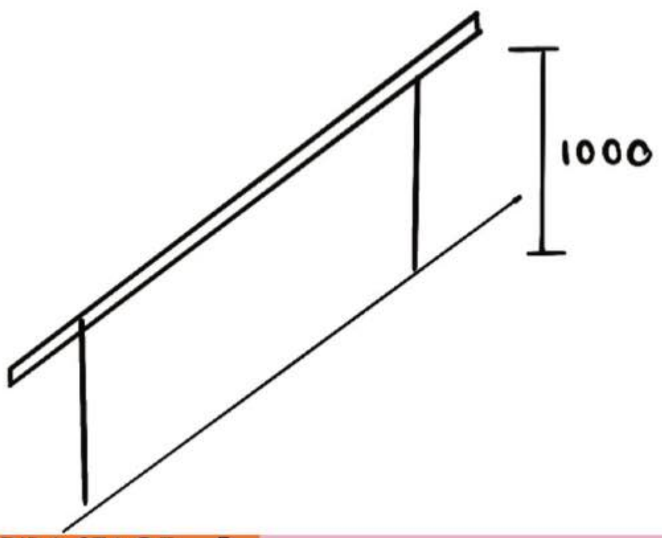


Redesigned for women:

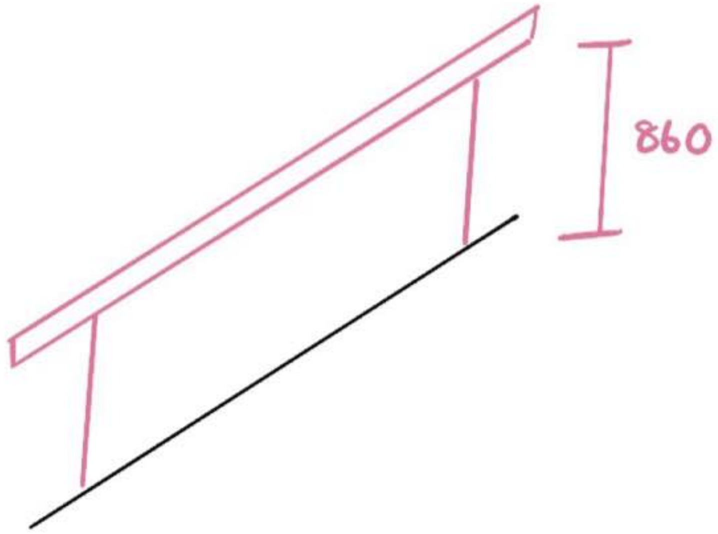


Hand Rail Height:

Building reg standard height:



Redesigned for women:



MAKE SPACE FOR GIRLS

"We campaign for parks and public spaces to be designed for girls and young women, not just boys and young men."

"Planning and other policy documents may create barriers."

"Derived from the measurements of men's bodies, dimensions become so encoded in the world of design and construction that discrimination against women is subconscious"

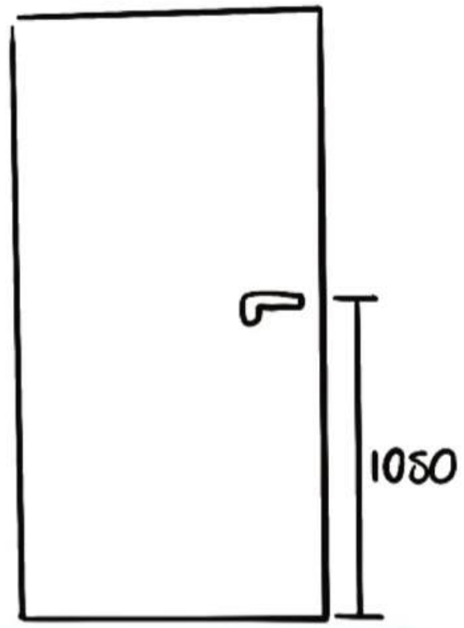
"The male body itself has become the principal site of contemporary male construction."

"the temple is the body, the body is a temple" (Heathcote, 2020)

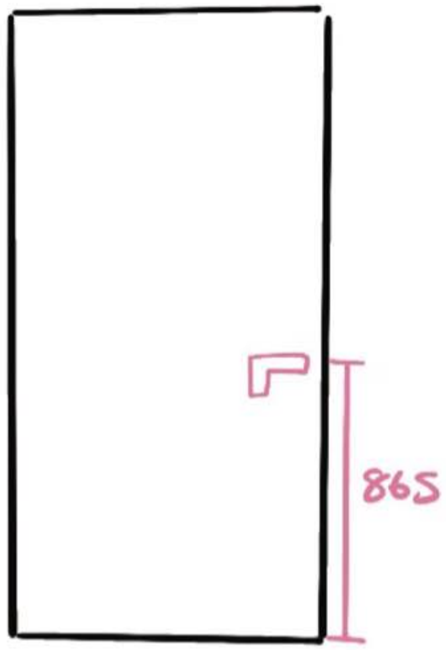
Door handle height:

Door handle to fit the hand of women

Building reg standard height:

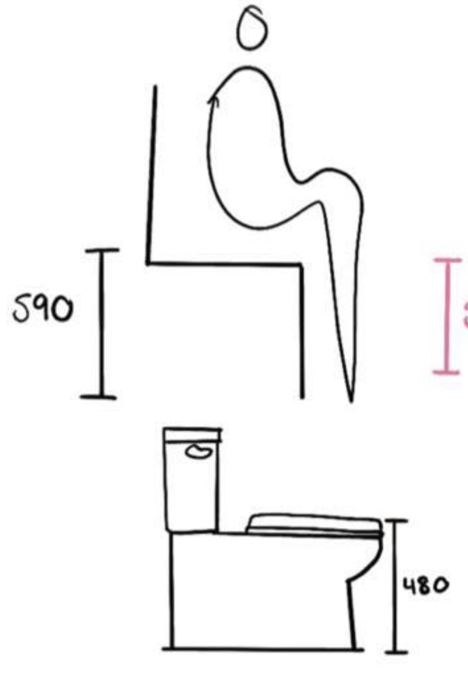


Redesigned for women:

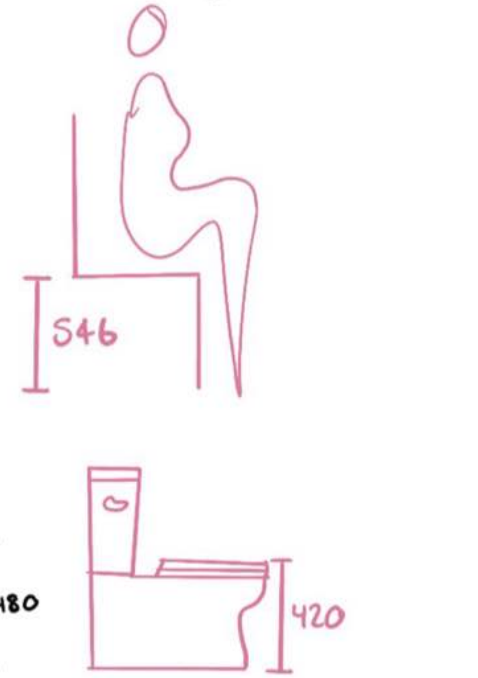


Toilet:

Building reg standard height:

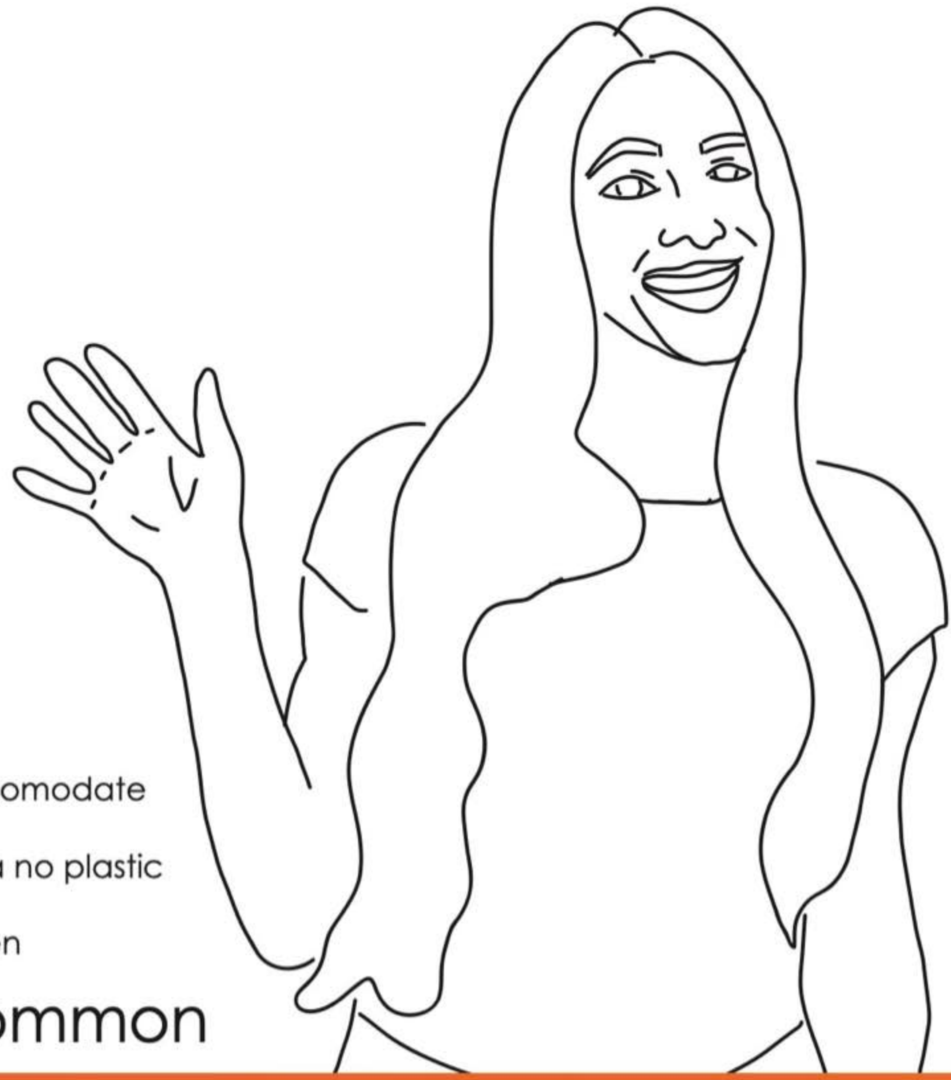


Redesigned for women:



-Changes in building regulations to accomodate women
-Changes in material use and applying a no plastic architecture approach
- Building is to be built by women

Applying the Uncommon

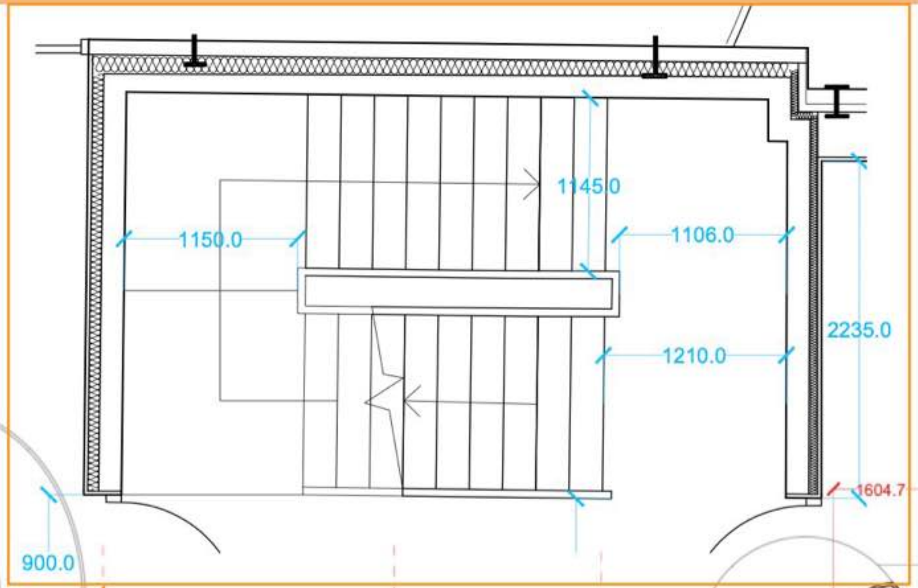


Replanning

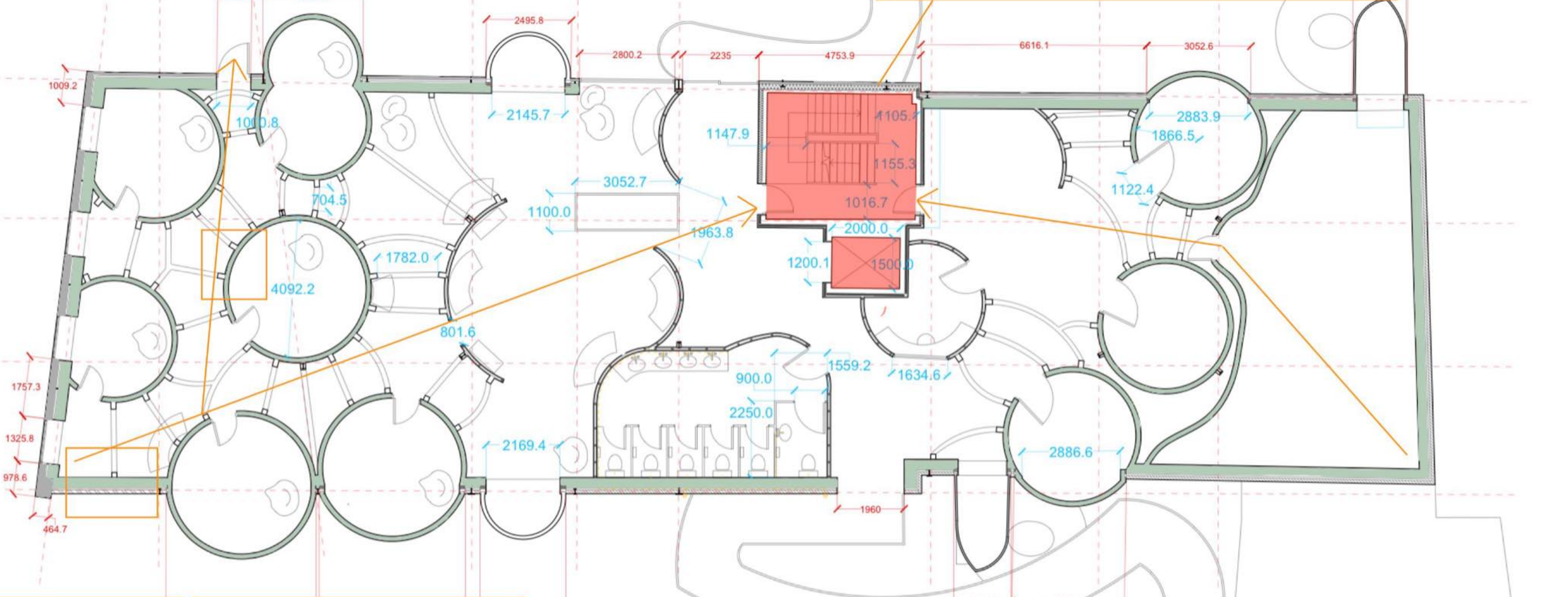
First Floor Plan
with the new materials and
building regulations

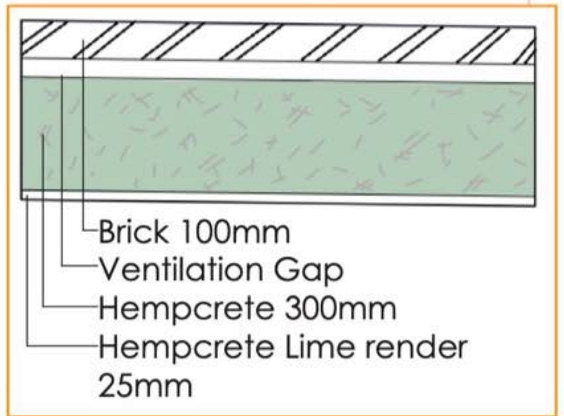
Structural lines

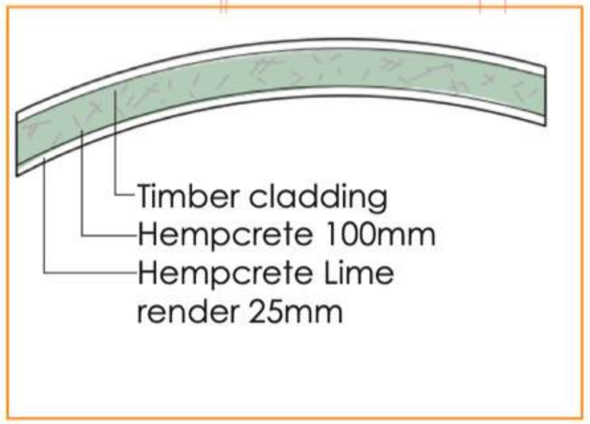
Making the staircase larger also reduces the fire escape distances which helps women



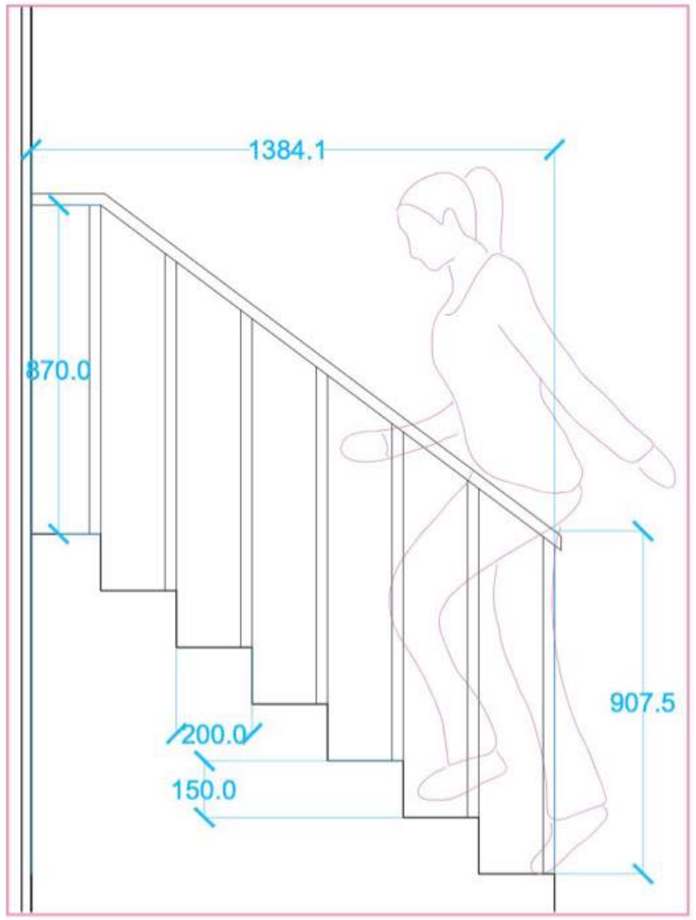
21 steps 150mm heigh, wider staircase required







Section
with the new materials
a no plastic approach



Building Regulation L

4.9 In new and existing buildings both of the following should apply.

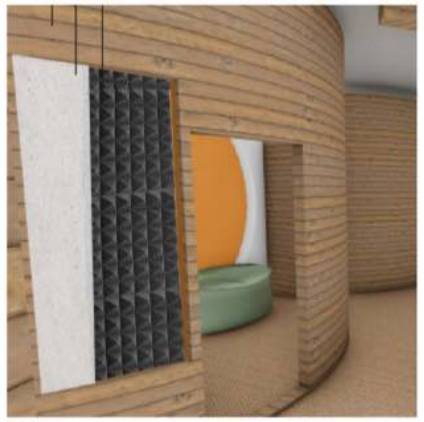
a. The insulation should be reasonably continuous across newly built elements.

b. Thermal bridging, including at the party wall, should be reasonably limited.

NOTE: Any solution to edge sealing or thermal bridging in new buildings should take particular account of Part E of the Building Regulations.

Hempcrete lines all walls to reduce the cold bridging

Internal acoustic barrier comparison



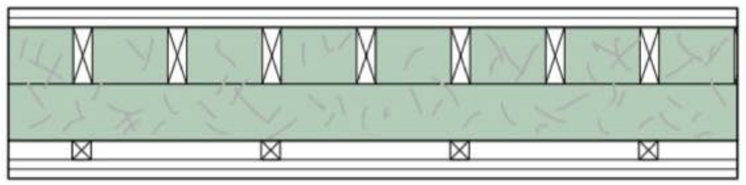
Common approach

New uncommon

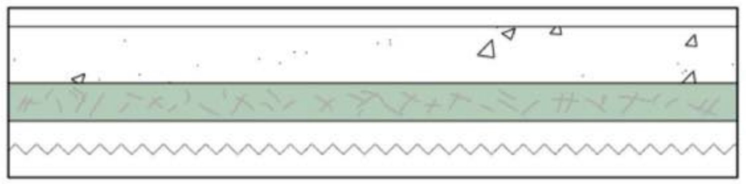
Wall Types
Scale 1:20 @A3

Corrugated steel roof 20mm
Timber joists 50mm
Ventilation gap 50mm
Hempcrete Insulation 100mm
Hempcrete Structure 300mm
Joists 50mm
Lime render 25mm

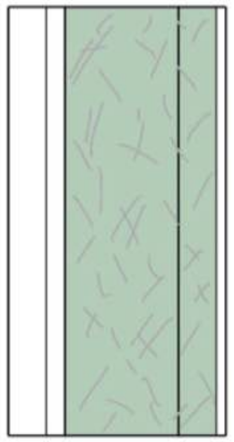
First Floor:



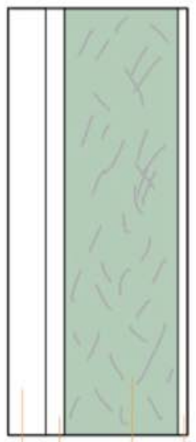
Ground Floor:



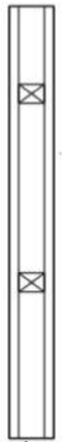
Second Floor wall:



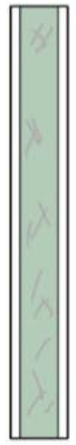
Ground and First Floor wall:



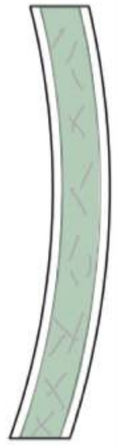
Partiton:



Insulated partition:

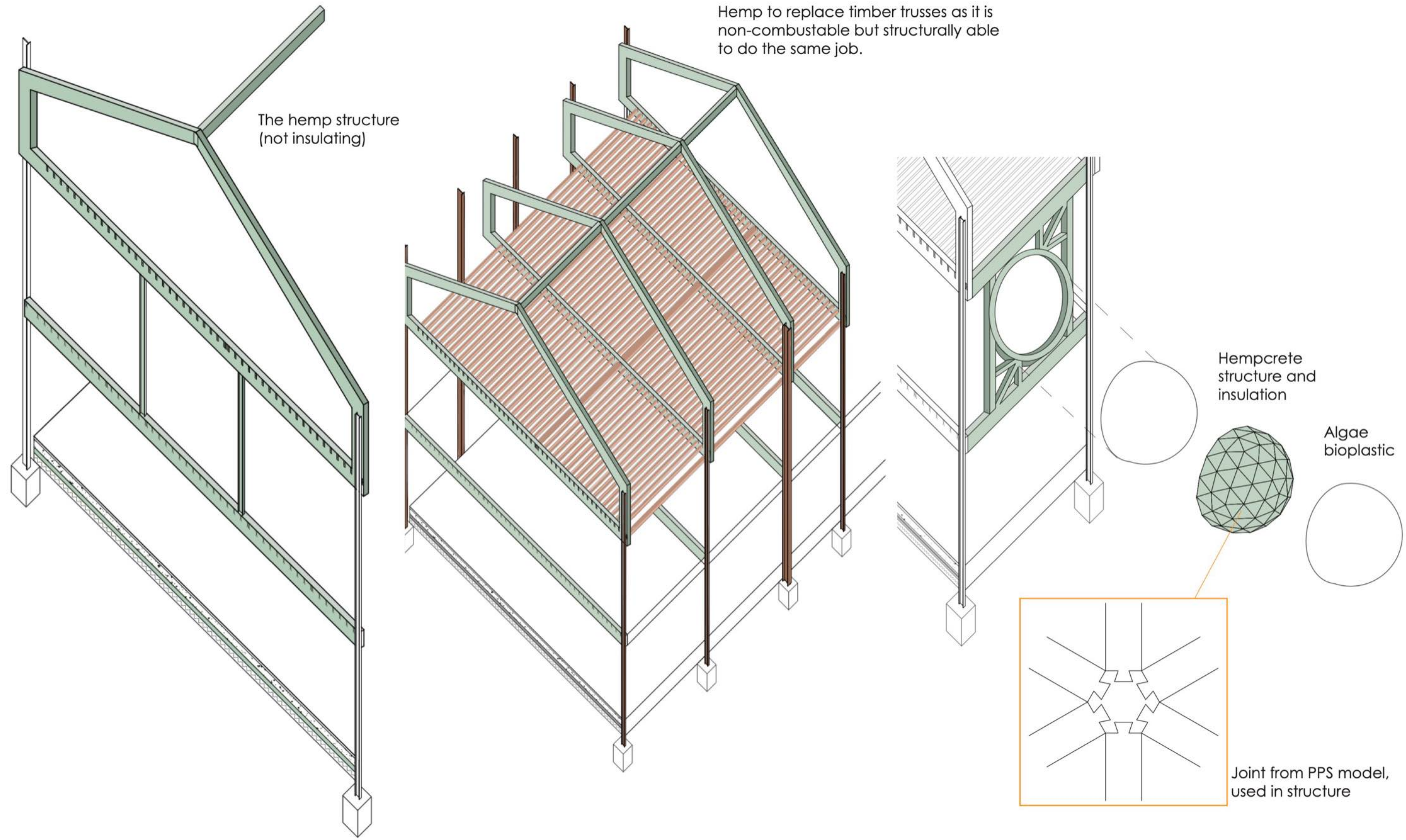


Dome wall:

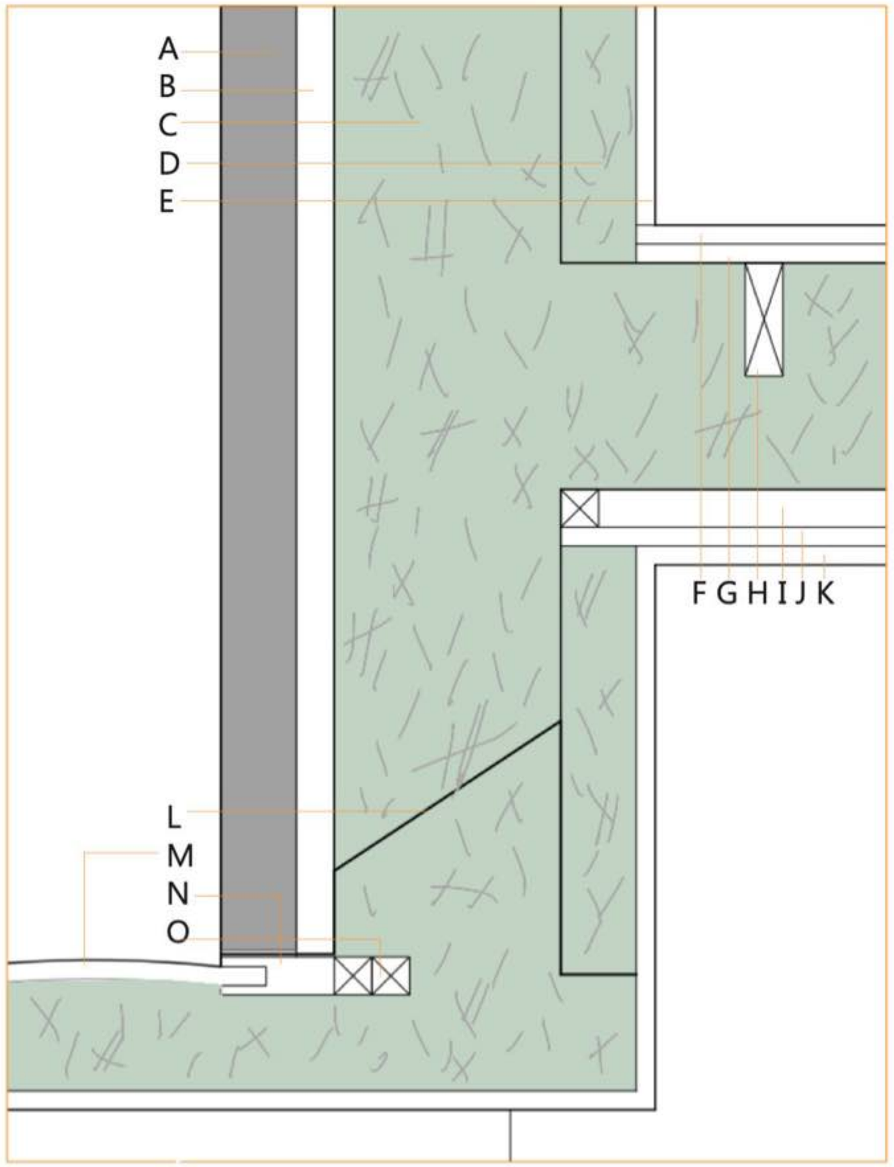


Limerender
300mm Hempcrete insulation
50mm Ventilation gap
Brick

Construction Isometric
New materials

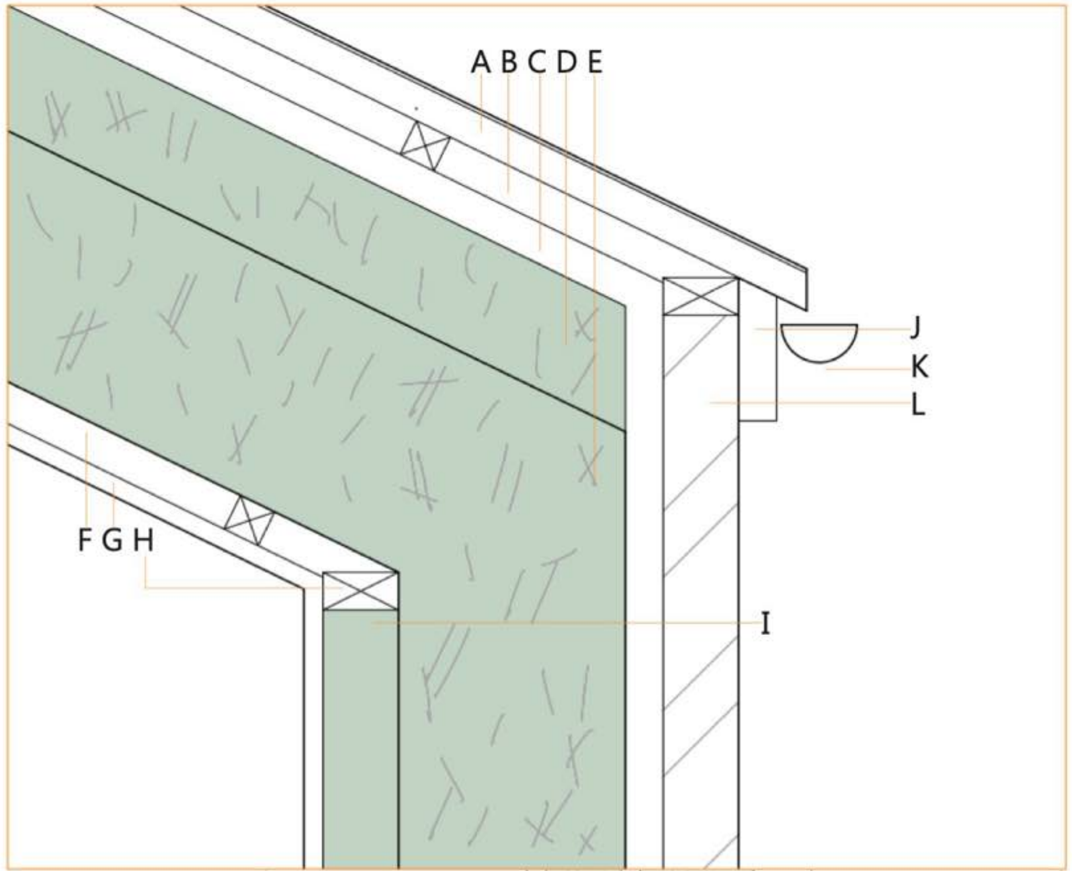


Construction Details
New materials

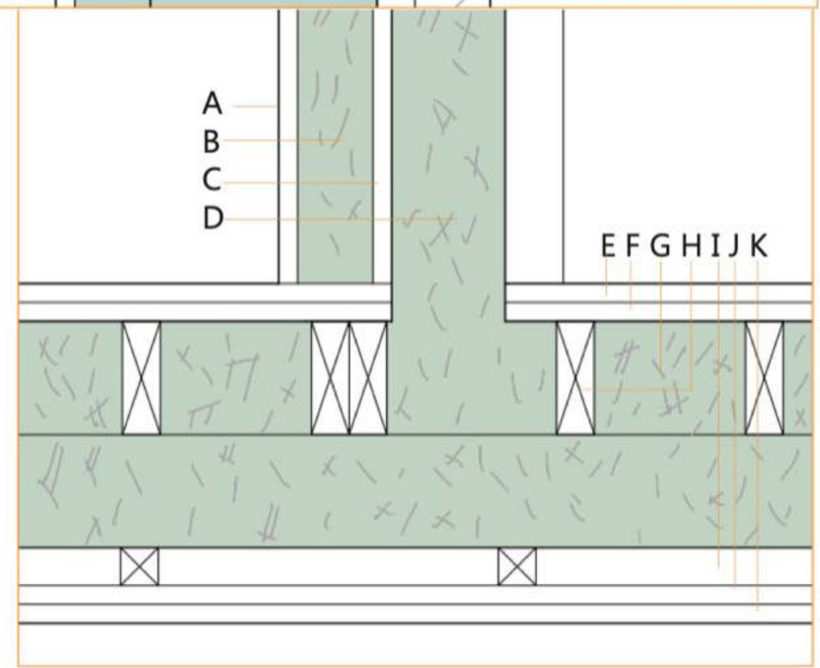


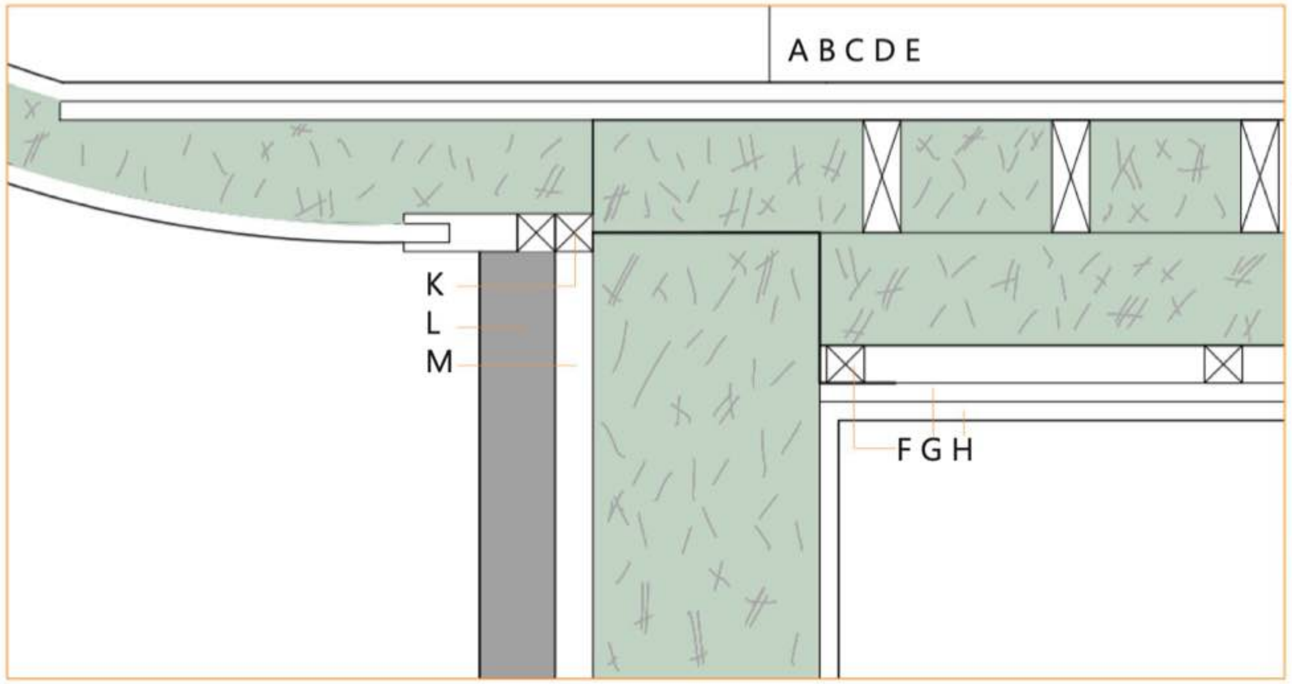
A) Existing brick 100mm
B) Ventillation Gap
C) 300mm Hempcrete Structure
D) 100mm Hempcrete insulation
E) Lime render
F) Timber Florring 30mm
G) Plywood 20mm
H) Timber joist 50x 200mm
I) Timber joists 50x50mm
J) 20mm plywood
K) Lime render
L) Lintel
M) Algae Bio-plastic

A) Corrugated steel
B) Timber supports 50mm
C) Ventilation gap 50mm
D) Hempcrete 200mm
E) Hempcrete structure 300mm
F) Timber joists 50mm
G) Limerender 25mm
H) Timber Joist
I) Hempcrete Insulation
J) Timber board 50mm
K) Guttering
L) Existing brick



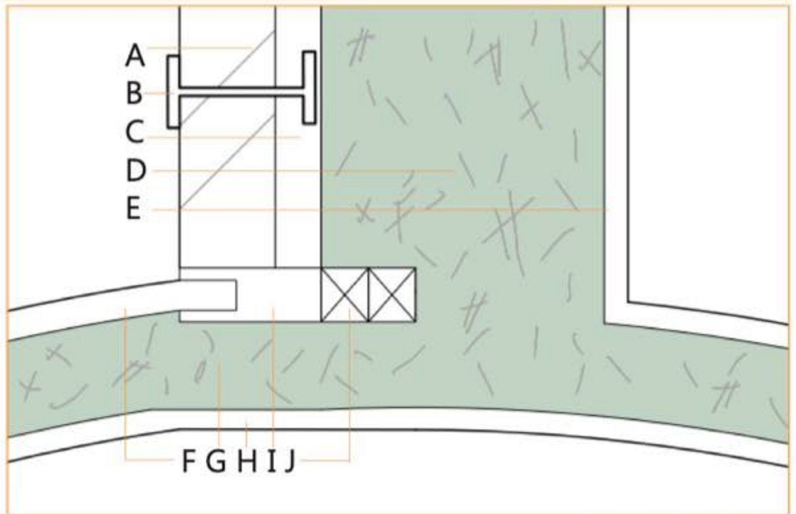
A) Limerender 25mm
B) Hempcrete insulation 100mm
C) Limerender 25mm
D) Hempcrete Structure 150mm
E) Flooring 20mm
F) Plywood 20mm
G)Hempcrete Structure 300mm
H) Timber Joists 150x 50mm
I) Timber joists 50x50mm
J) Plywood 20mm





A) Flooring 20mm
B) Plywood 20mm
C) Timber Joists 150 x50mm
D) Hempcrete 200mm
E) Support structure
F) Timber joists 50mm
G) Plywood 25mm
H) Limerender 25mm
I) Algae bio-plastic
J) Frame
K) Timber supports
L) Existing brick
M) Ventilation Gap

A) Existing Brick 100mm
B) Existing I-Beam 150x100mm
C) Ventilation Gap 50mm
D)Hempcrete Insulation 300mm
E)Limerender 25mm
F) Algae Bio-plastic
G) Hempcrete insulation 100mm
H) Limerender
I) Bio-plastic Frame



The critique on the uncommon

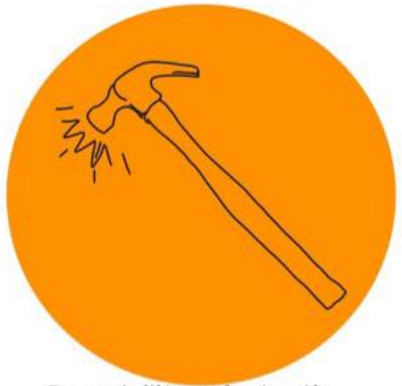
Why do we not use no-plastic architecture?


Cost for new materials

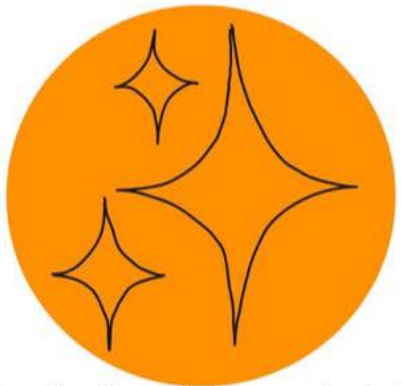

Readily available


Will require change to building standards


Less time consuming use

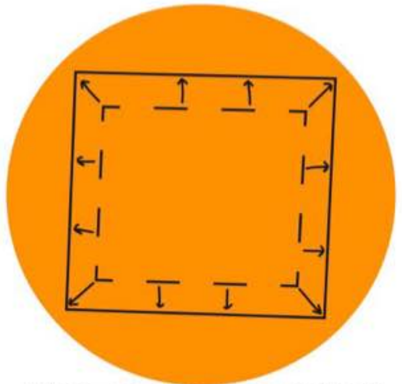

Durability of plastic

Client approval is rare


Aesthetics of new materials


alternative materials have a higher u-value


more land required for growth of materials


More space is required for alternative materials


Limited knowledge on new materials compared to well established materials

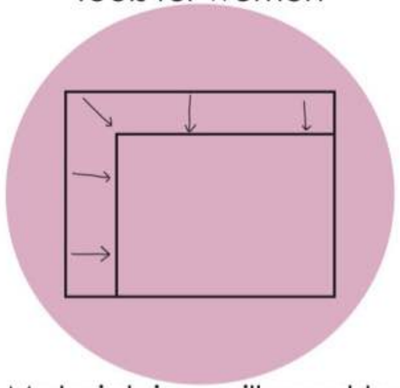

When those heavier construction materials need to be transported over long distances, carbon emissions grow even more.

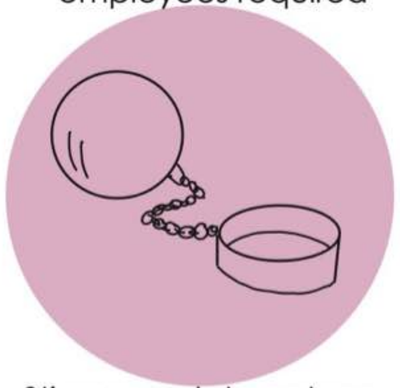
Why do we not have more women in construction?


Cost of manufacture of tools for women


Higher cost as more employees required

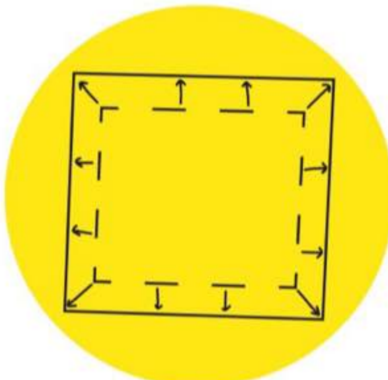

Projects will have longer construction times


Material sizes will need to change


Stigma and stereotype change


Strength differences

Why do we not design for women?


More space required


Cost of heating


Lack of understanding and knowledge


Cost of safety and prevention


Not inclusive to design for just women


Will require change to building standards

What does this mean for the future of construction?

What effect will these healthy materials have in construction?

- Carbon negative materials, reducing air pollution
- Renewable sources, more available materials
- Breathable materials, reduces damp
- Higher fire resistance, safer buildings
- Accoustic values, reduces noise pollution
- Positive mental health benifits, connecting user to nature

What would happen to the ocean if we stopped using plastic in construction?

- Reduce plastic pollution
- Benifits to the marine life
- Decrease the formation of microplastics
- Improvement to the ecosystem

As larger plastics take decades to break down, "if we simply stopped adding new plastic pollution to the oceans tomorrow, microplastics would continue to increase over the next decades – but by removing the existing debris as well, we could stop that surge" (Oakes, 2022)

What would happen to the Canal if we harvested *some* algae for construction?

- Reduce blue and green algae
- Reduces toxins produced by algae
- Improvement to the ecosystem
- prevents oxygen depletion caused by decaying algae

Positive effects on women and Neurodiversity

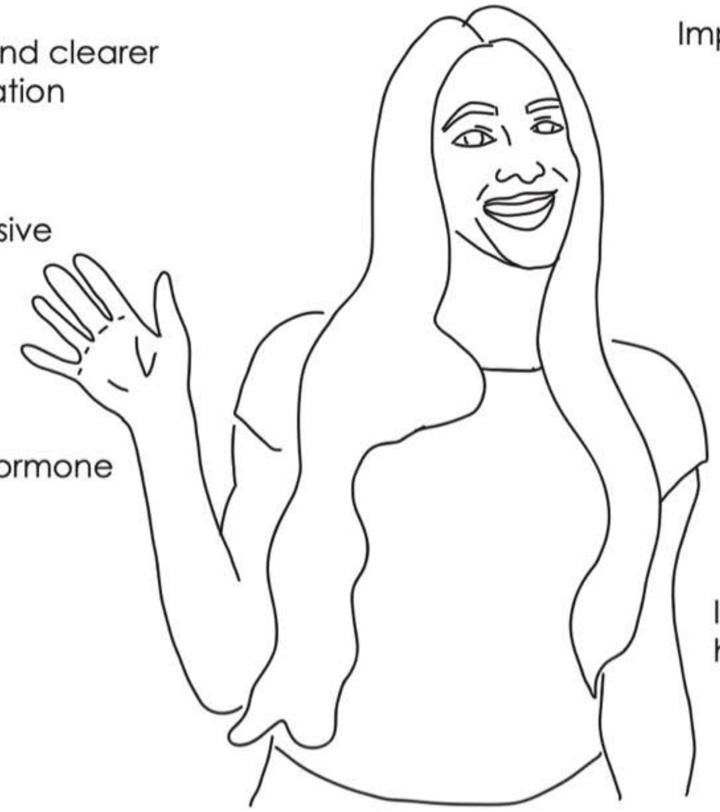
What are the positive effects of Hemp-crete and Algae bioplastics on women and Neurodiversity? These materials are more breathable and produce cleaner air in the building. Cleaners effects neurodiversity and women in the following ways:

"children living in greener neighborhoods with low air pollution had substantially lower risk of ADHD" (Yuchi et al., 2022)

Better sleep quality

Increased and clearer Communication

Improved Concentration



Improved Memory

Reduced agressive behaviour

Improves brain health

Reduces stress hormone

Improves reproductive health

Effects on women in construction?

- Fresh ideas
- More collaboration and teamwork
- Higher diversity in construction to address more users needs (including womens needs)
- Improved workplace culture
- More jobs
- Closing the Gender pay gap
- Improvements in health and safety
- Improvements on gender equality and social perception

Effects for designing for women

- Improvements on safety in design and visibility, reduction in crime
- Family- Centered design
- Promoting a positive work life balance
- Improvements to public restrooms and facilties for everyone
- Psychological Comfort
- Shift in societal expectations about the role of women
- Inclusive spaces
- Improvements not just for women but for everyone!

2
4
1
3
Key:
1) The construction of the building by women
2) The hempcrete manufacturing
3) Harvesting algae from the canal
4) Manufacturing Algae

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Farrag, A. (2016) ‘Comparison of stair walking mechanics between adult males and females’, Bulletin of Faculty of Physical Therapy, 21(2), pp. 88–93. Available at: https://doi.org/10.4103/1110-6611.196781.

Key:
1) Hempcrete
2) Lime render
3) Non adhesice timber
4) Timber flooring
5) Algae bio-plastic