



# Cameron Linden Green

## BSc1/AD1 Spring Portfolio



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# DP3 Culinary Kiosk

“How can a food kiosk make a positive impact on the issue of E-waste?”

Food topic- AMERICAN-WELSH FUSION

## Food Topic Analysis-

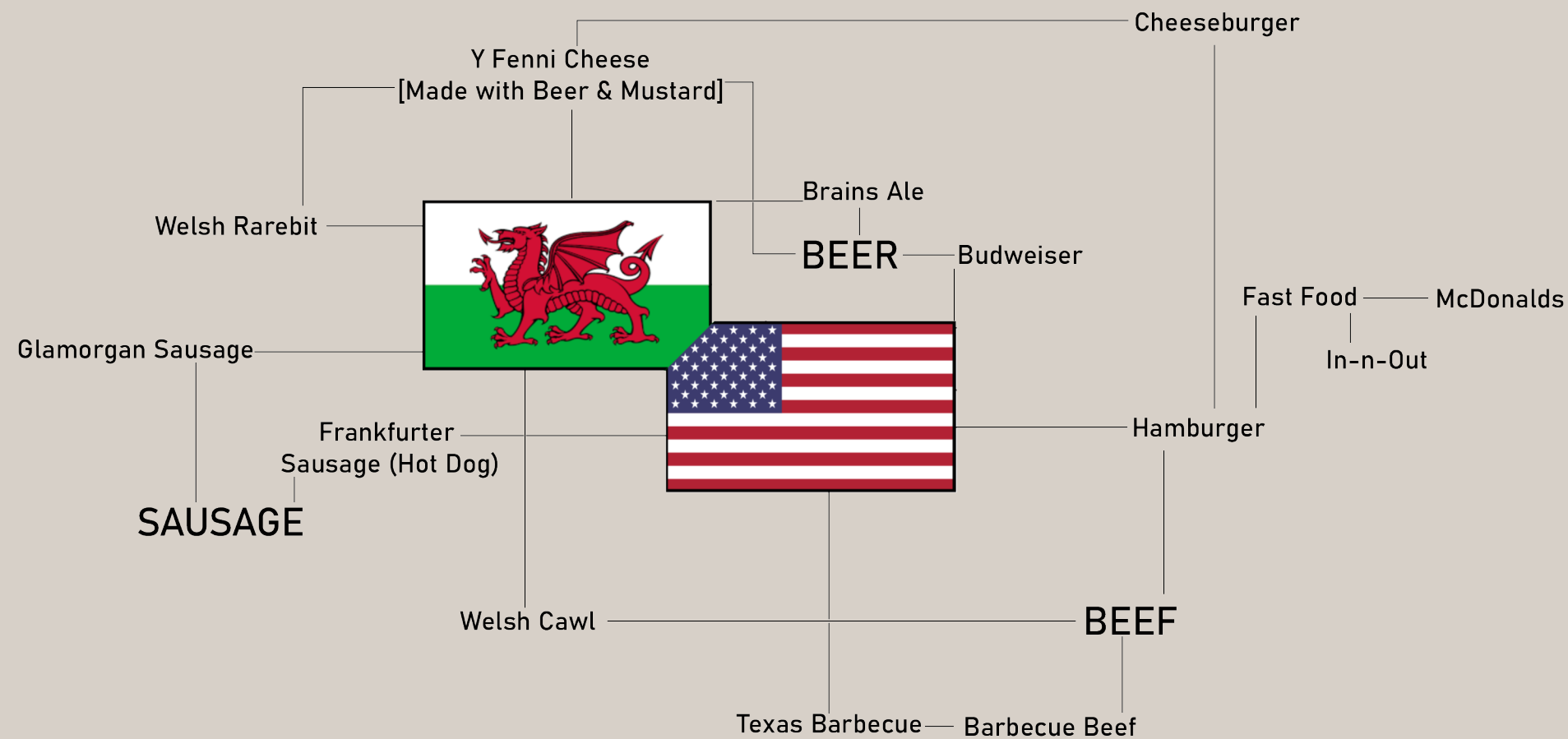


Figure 1- Budweiser, America's most popular beer



Figure 2- Brains, Cardiff's local beer



Figure 3- Glamorgan Sausage [see footnote]



Figure 4- Frankfurter Sausage [see footnote]

## Kiosk Menu-

FOOD:  
Hamburger  
Cheeseburger [American or Y Fenni Cheese]

Hot Dog with  
-Frankfurter Sausage  
-Glamorgan Sausage

DRINK:  
Tap Water  
Coca-Cola  
Brains Ale [DRAUGHT]  
Budweiser [DRAUGHT]

## How will this influence my design?

In my kitchen I will need:

- Deep fat fryers
- Grills
- Food Refridgerators
- Beer taps & Refridgerated kegs

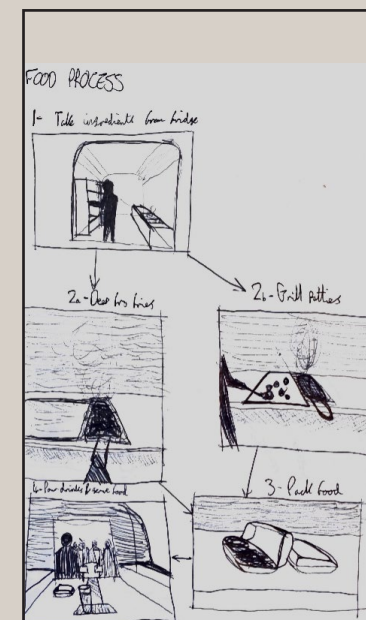


Figure 5- Welsh Cawl [see footnote]



Figure 6- Big Mac

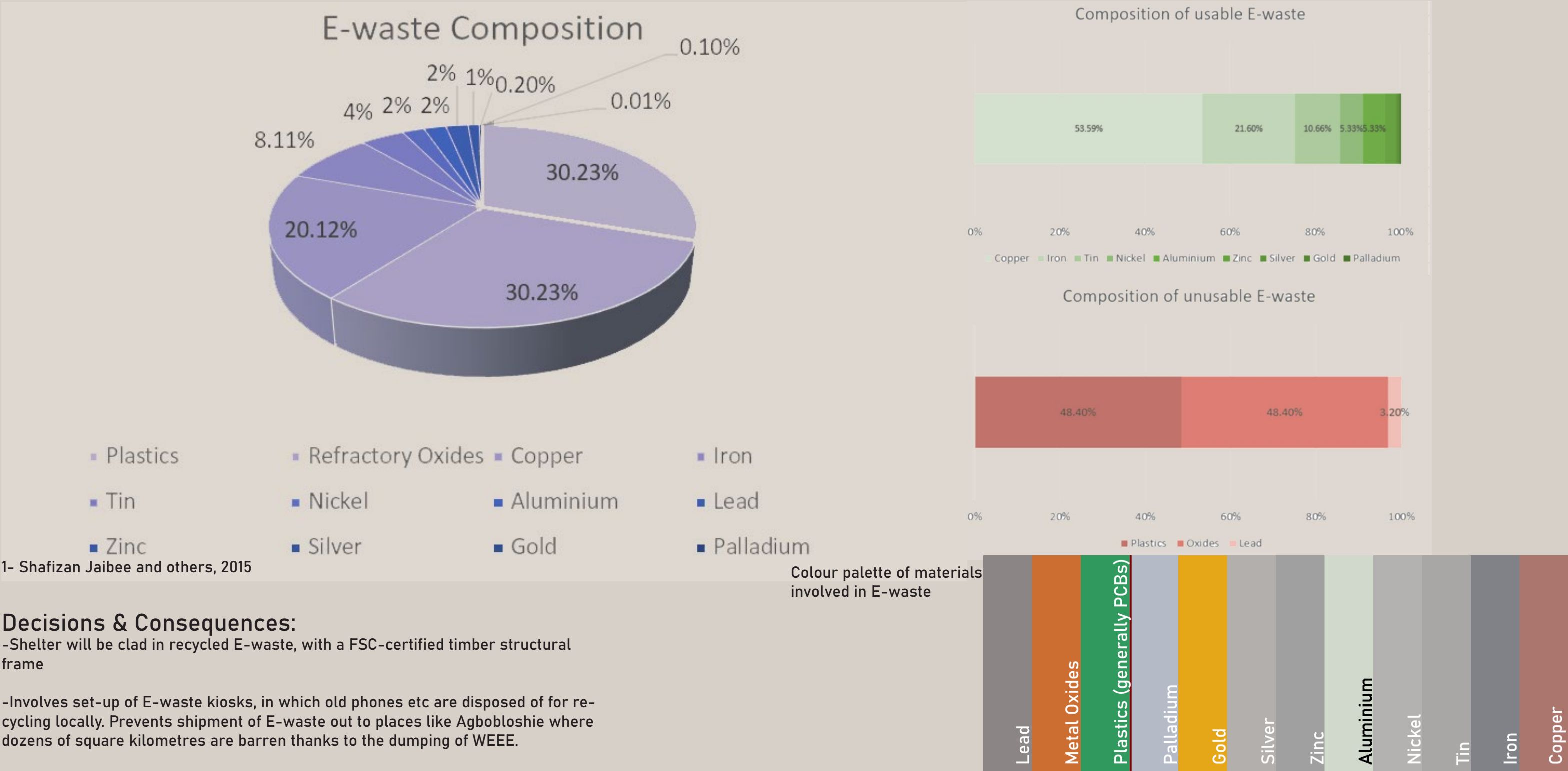
Figure 3- C Jill Reid, "Glamorgan Sausage", 2007, [https://commons.wikimedia.org/wiki/File:Glamorgan\\_sausage.jpg](https://commons.wikimedia.org/wiki/File:Glamorgan_sausage.jpg) accessed 2022-02-14

Figure 5- 'Rhyshuw1', "Cawl Cymreig", 2009, [https://commons.wikimedia.org/wiki/File:Cawl\\_Cymreig.jpg](https://commons.wikimedia.org/wiki/File:Cawl_Cymreig.jpg) accessed 2022-02-14



# Material & Sustainability Considerations- Tectonic

In my project, for sustainability I wanted to focus on E-waste - as it is an issue for the future that will only grow in prominence. Research by Jaibee et al. showed me that in terms of usable E-waste, copper formed the majority - and most of the unusable e-waste was thermoset epoxy resin PCBs, refractory oxides which would require too much energy to extract the raw metal, and lead which is toxic and whose inclusion in commercial products above a certain level is outlawed.

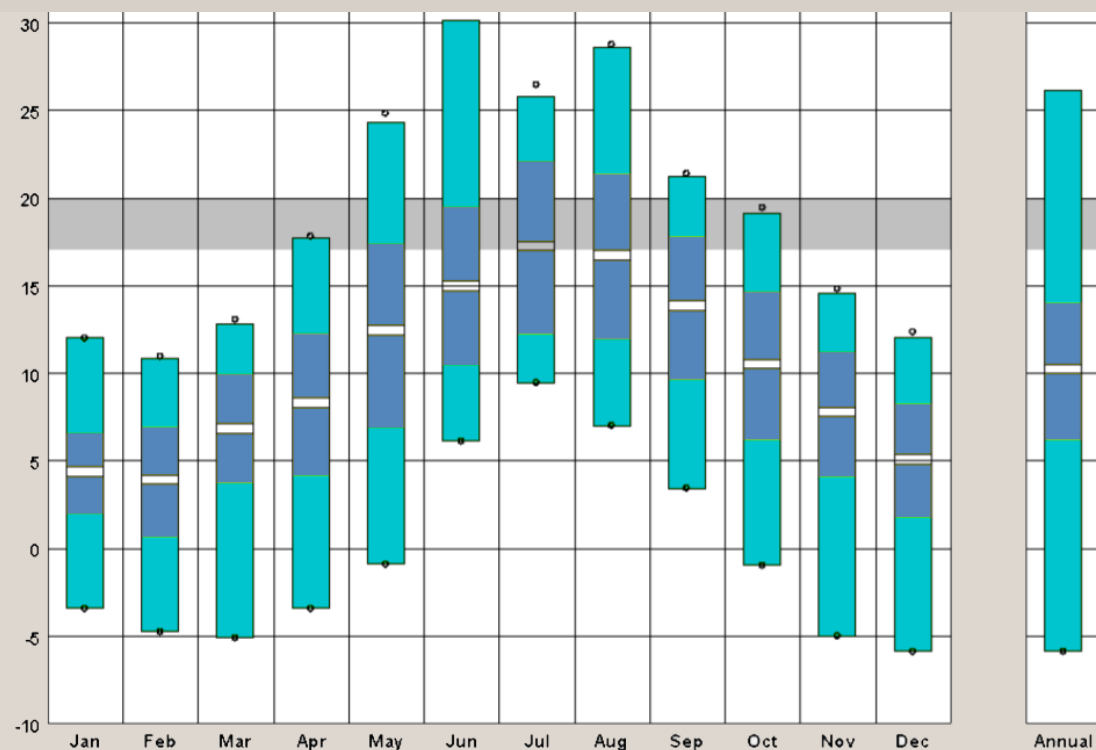




# DP3 Culinary Kiosk | “How can a food kiosk make a positive impact on the issue of E-waste?”

## Food topic- AMERICAN-WELSH FUSION

### Material & Sustainability Considerations- Environmental



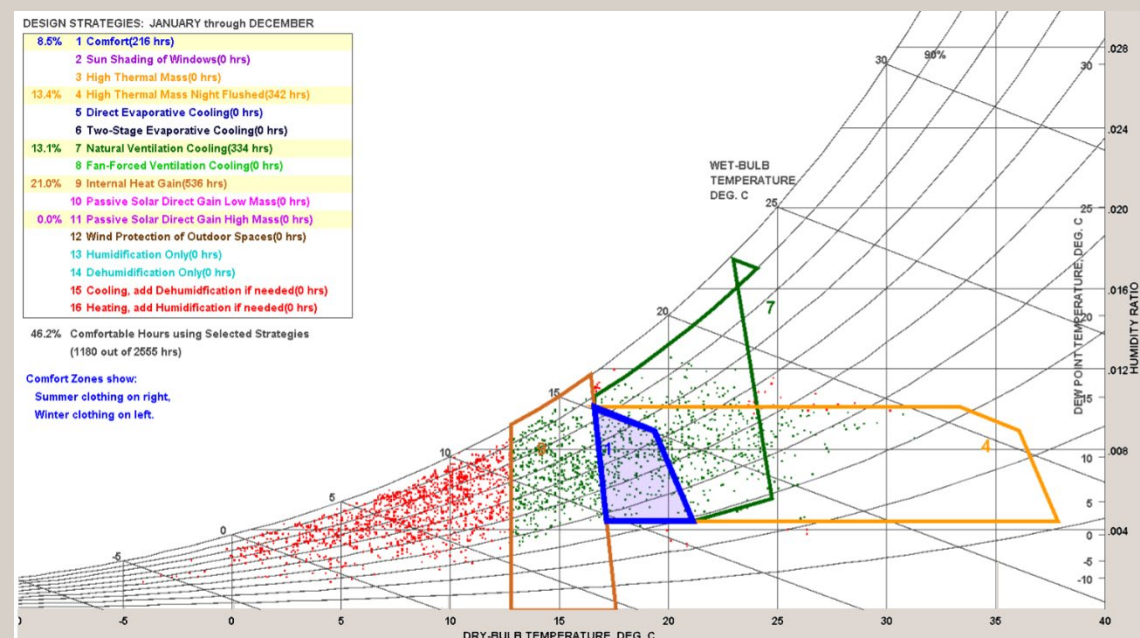
-For sustainability, a passive approach is preferred energy-wise. This is achievable due to the high internal heat gains from the deep fat fryers and grills.

-A kitchen's comfort temperature is 17-19°C (CIBSE Guide A)

-For opening hours 11am-5pm, the temperature (with specified design strategies, see psychrometric graph) is at comfort for 46.2% of the time [main discomfort from cold]



Figure 7- Thermofloc Insulation, Photographer Unknown



-To achieve this passive approach I intend to insulate my kiosk well - in this case, with 'Thermofloc', a cellulose insulation made from recycled newspaper. Its' R-value is similar to that of conventional insulation.



# DP3 Culinary Kiosk | “How can a food kiosk make a positive impact on the issue of E-waste?”

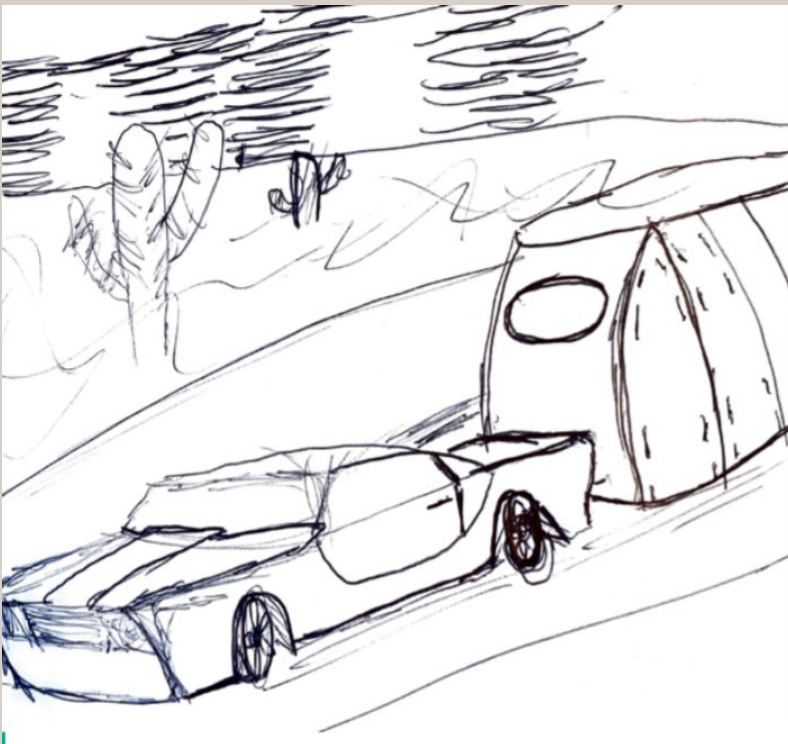
Food topic- AMERICAN-WELSH FUSION

## Precedent Analysis

### Precedent 1 Airstream Caravan



Figure 8- Airstream Trailer [see footnote]

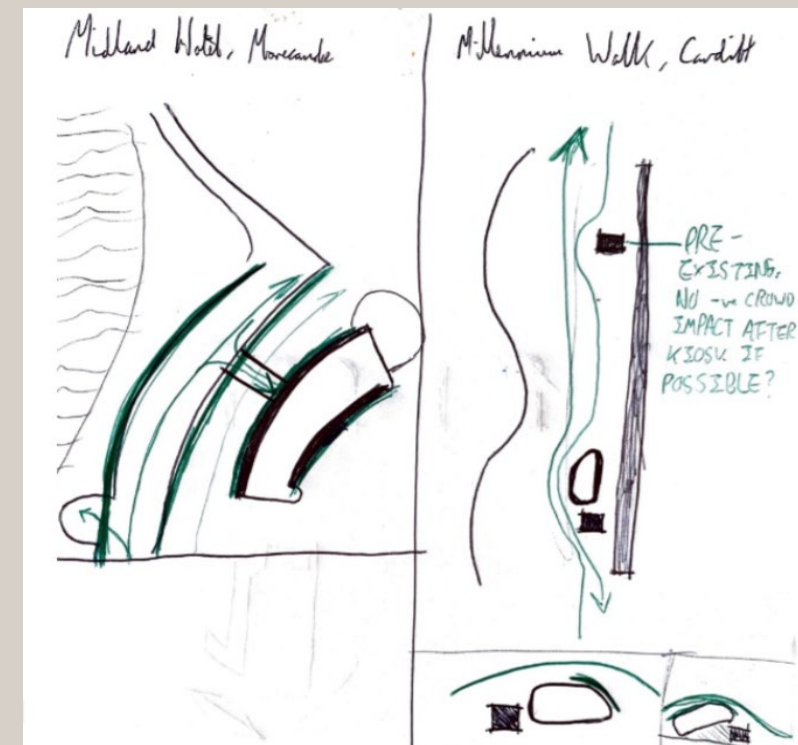


- Designed in 1930s USA, not many units were sold before the 2nd World War
- Became far more popular post-war, became a symbol of American prosperity
- Is nowadays associated with America, Hollywood and general US culture, something I would like to employ to reflect the food topic.

### Precedent 2 Midland Hotel, Morecambe



Figure 9- Midland Hotel, Morecambe



- Made in the style of the Streamline Moderne, in vivo the curve is very visible, yet the building itself is experienced more like a straight line when the curve is followed.
- This could have a positive impact on the situation of crowd control through gradually redirecting the flow of the crowd.



# Appendix I - Unfolded Precedent

UNFOLDED PRECEDENT:  
CONTAINER KIOSK IN TEHRAN,  
ISLAMIC REPUBLIC OF IRAN

NAPP ARCHITECTS 2018  
REDRAWN BY CL GREEN 2022

1:50 SCALE

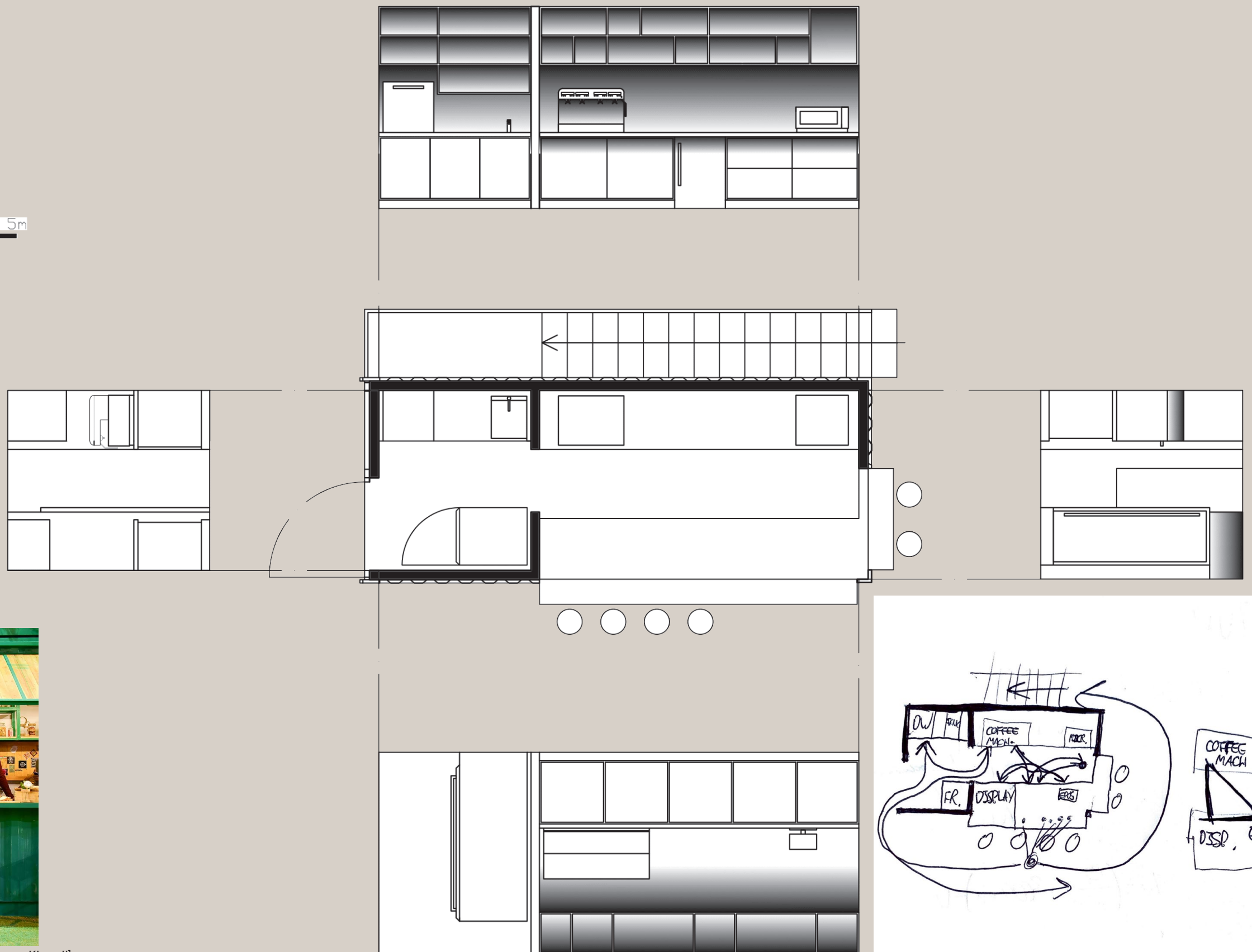
0m 1m 2m 3m 4m 5m

-I chose this as my unfolded precedent and focused mainly on the interior experience - as it shows how a kitchen may work efficiently in vivo.

-It is a coffee shop which differs from the food topic I am focusing on, but it still shows the general flow of work in a confined kitchen space.



Figure 10- Container Kiosk in Tehran, NAPP Architects [Mehrad Habibi & Shabnam Khezeli]



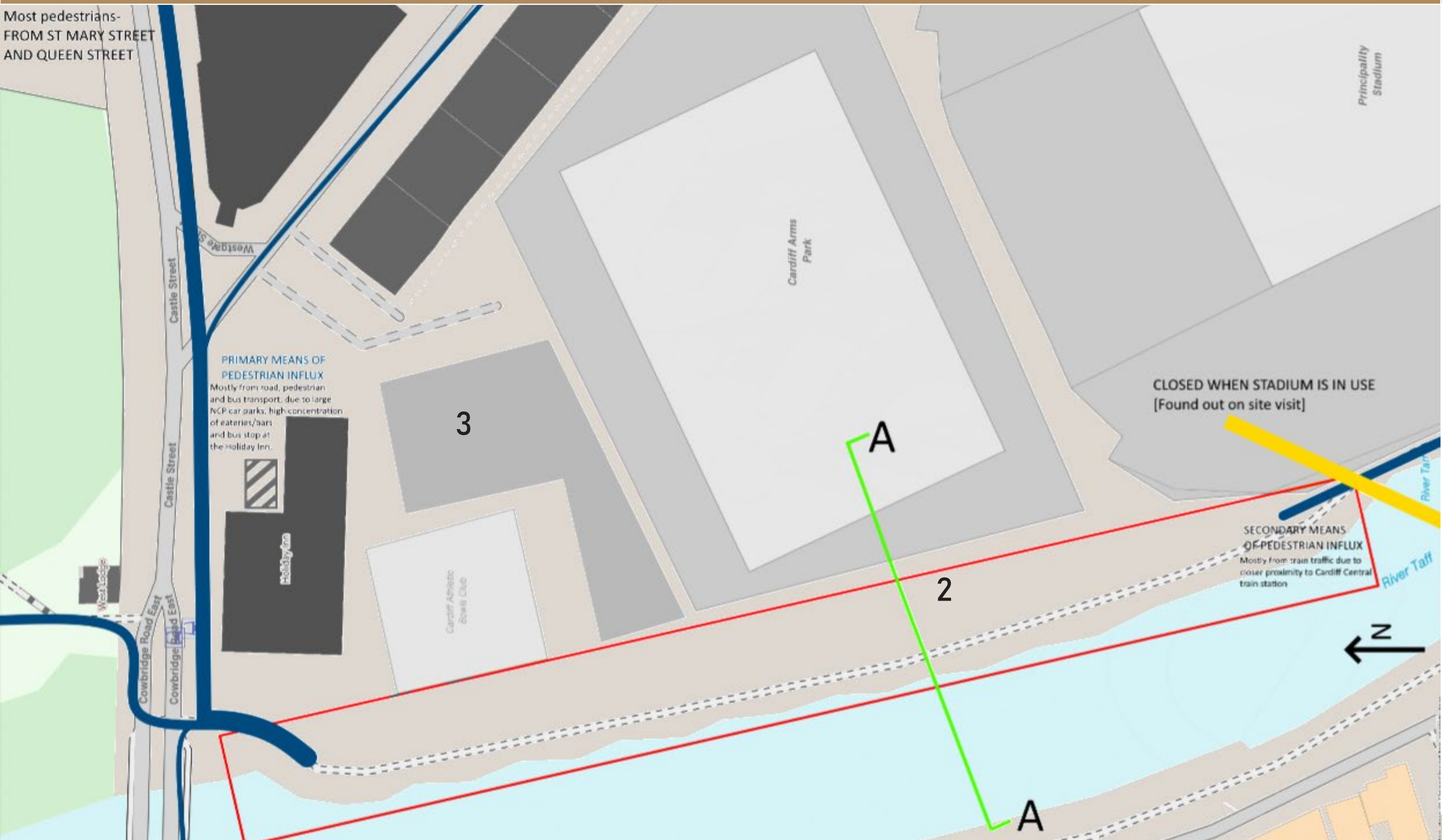


# DP3 Culinary Kiosk

“How can a food kiosk make a positive impact on the issue of E-waste?”

Food topic- AMERICAN-WELSH FUSION

## Site Analysis - Plan 1





# DP3 Culinary Kiosk

"How can a food kiosk make a positive impact on the issue of E-waste?"

Food topic- AMERICAN-WELSH FUSION

## Section AA

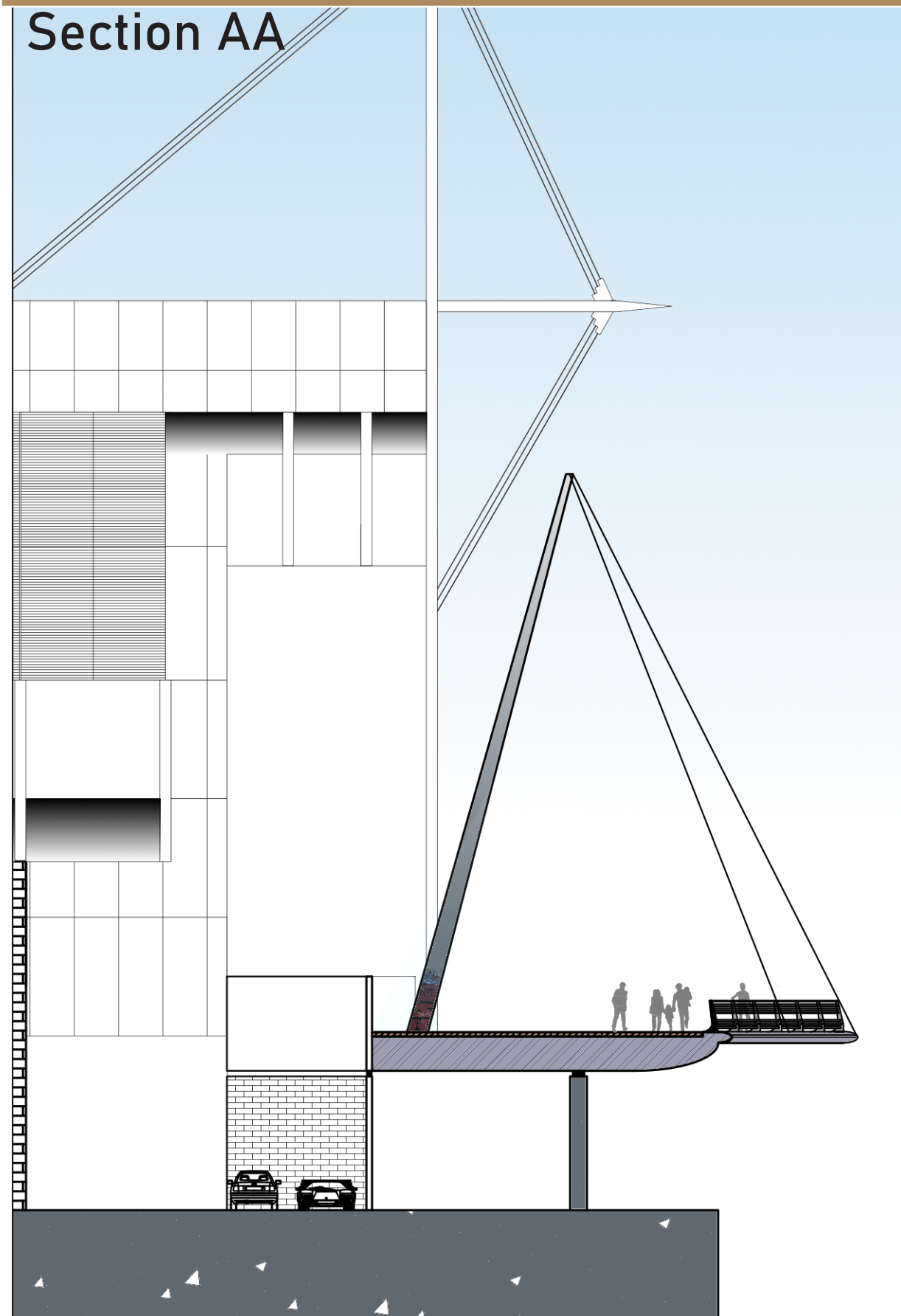


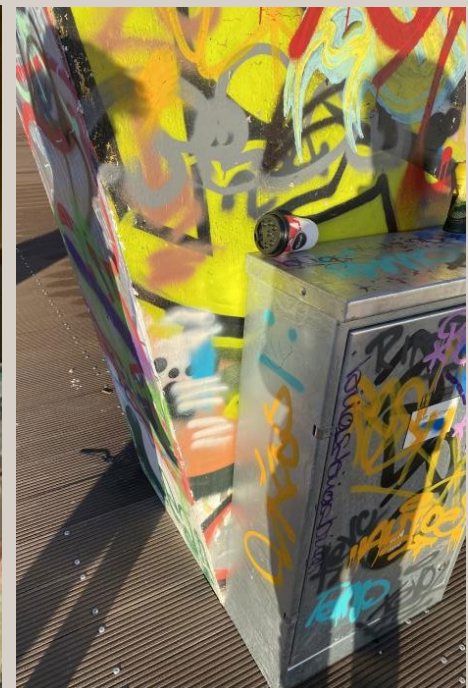
Figure 12 - Taken by William Parris, 2022



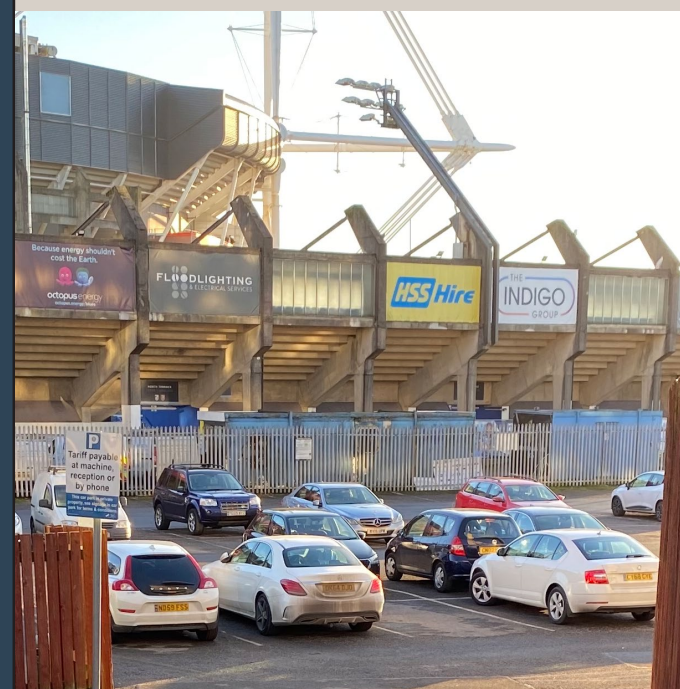
[1 on plan] Figure 11 - Information about opening times of gate



[2 on plan] Figure 12 - Purchasing a coffee to assess waste disposal systems



[2 on plan] Figure 13- Litter thanks to lack of waste disposal solutions



[3 on plan] Figure 14 - Parking near the site



Figure 15 - Warning sign showing the floor is slippery when wet



Figure 16 - Ample lighting on site







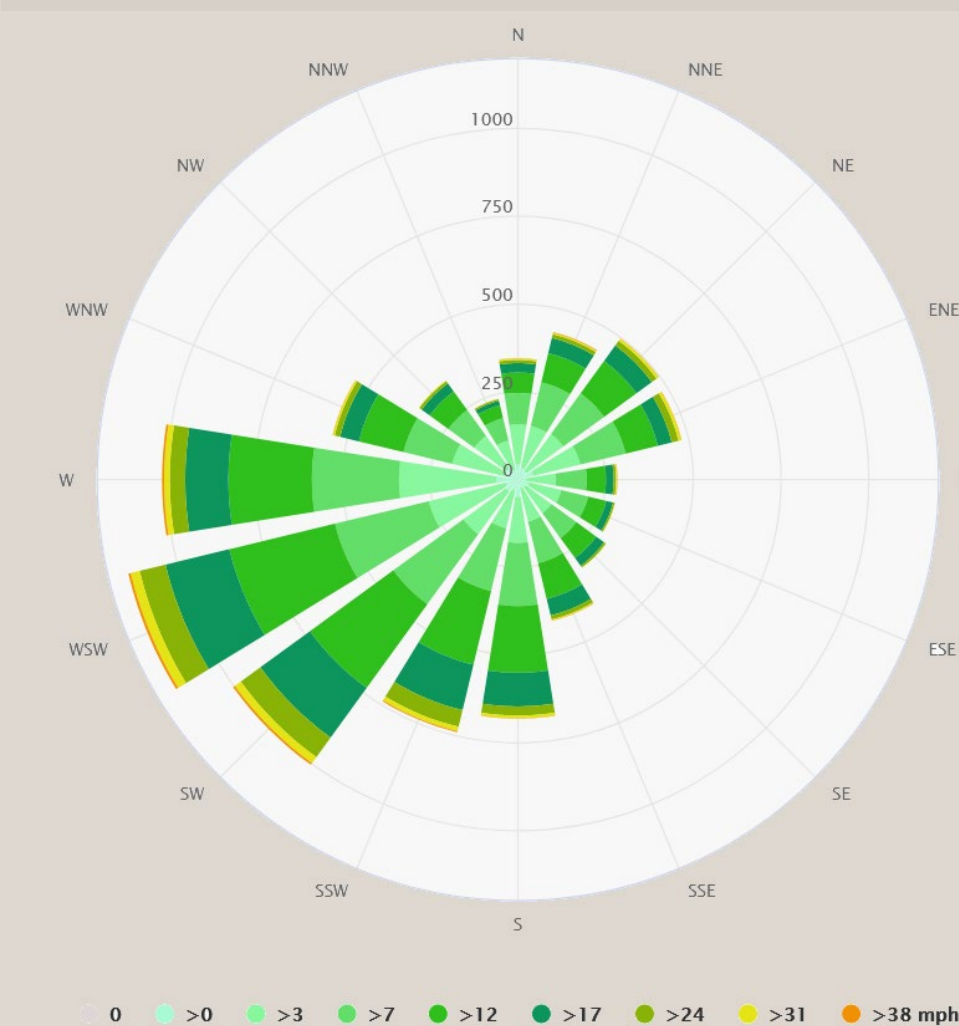
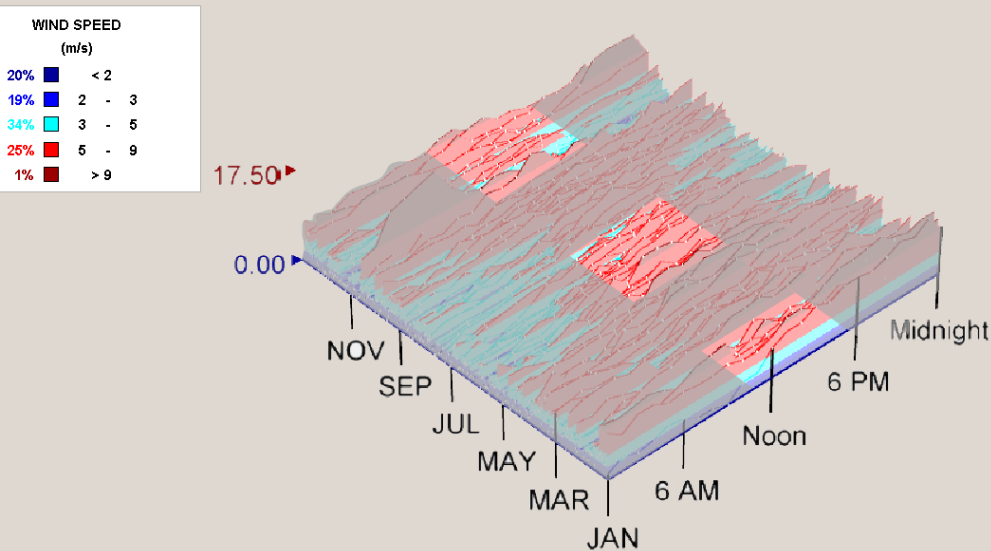
# DP3 Culinary Kiosk

"How can a food kiosk make a positive impact on the issue of E-waste?"

Food topic- AMERICAN-WELSH FUSION

## Site Analysis - Wind

### LEGEND



-The main rugby seasons for the Welsh national team are November-March and June/July.

-The winds are at their weakest in June/July at around 7m/s during opening hours.

-This would need to be shielded against somehow, as CPP Wind states that 4m/s(9mph) and below is comfortable for sitting.

-For most of the year, the prevailing wind is from the West-erly South-West however there is a significant wind from the north in winter months. There is also a wind from the North-East that follows the River Taff.

## Design Decisions from Site Analysis

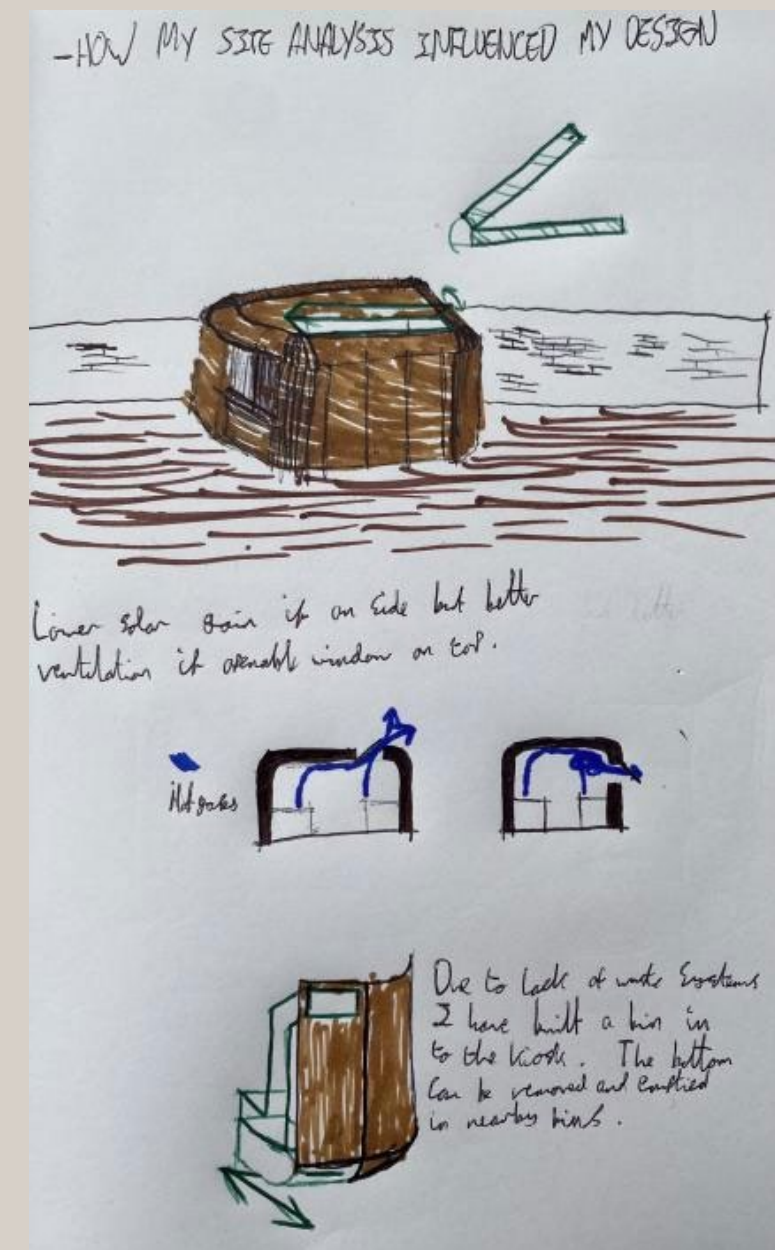
### -GLAZING

I placed the hinge for the glazing's opening to the east, as this then means the westerly wind enters the kiosk and naturally ventilates it.

While the glazing on top will create more solar gains, it will allow for the easier escape of hot and potentially choking gases.

### -WASTE

To counteract the lack of waste solutions, I will build a bin into the kiosk, with waste collection underneath.



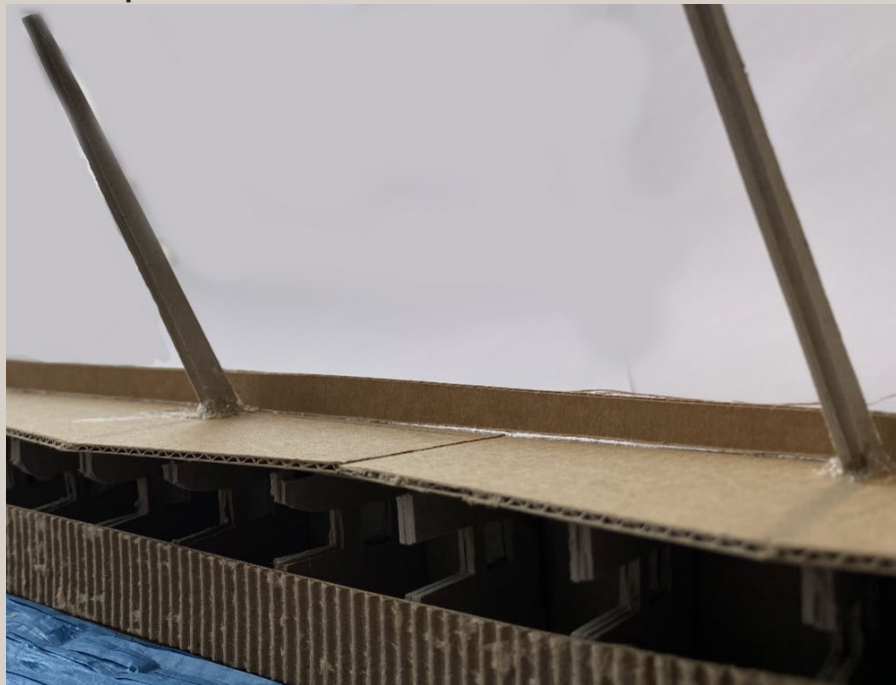


# DP3 Culinary Kiosk | “How can a food kiosk make a positive impact on the issue of E-waste?”

Food topic- AMERICAN-WELSH FUSION

## Site Models [NB - These were made in parallel with the First Iteration of my design.]

1:200 | Made in collaboration with Studio B3



1:2000 | Made in collaboration with Studio B3





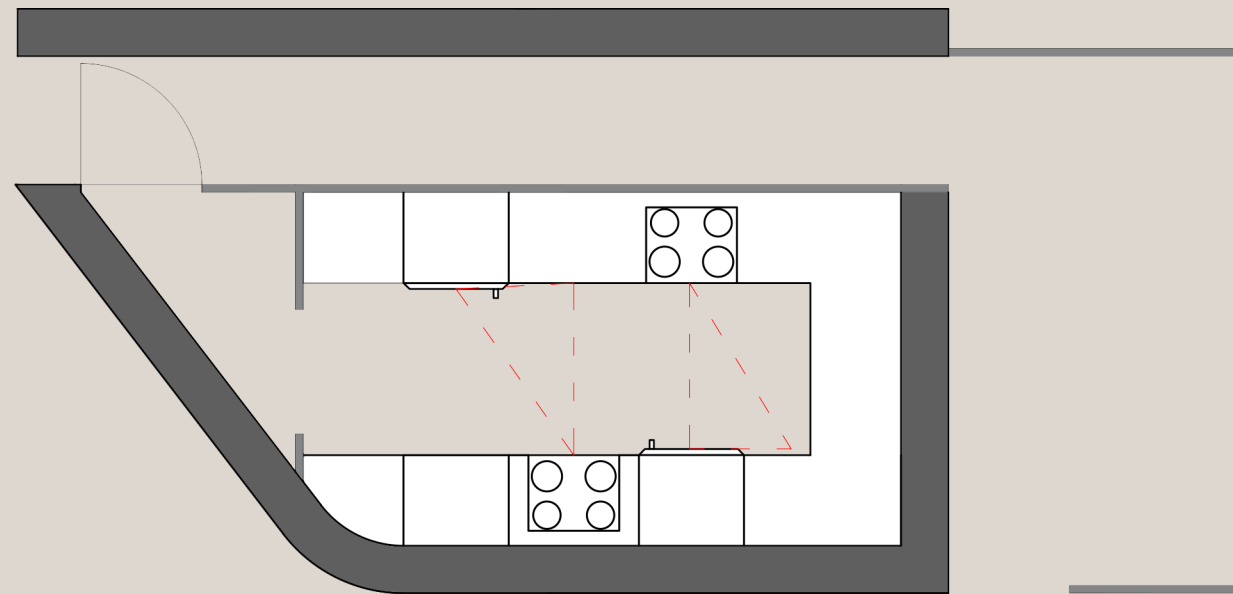
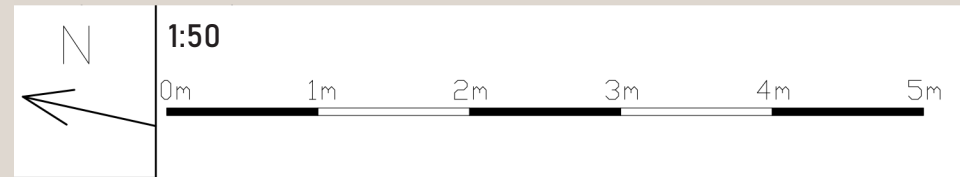
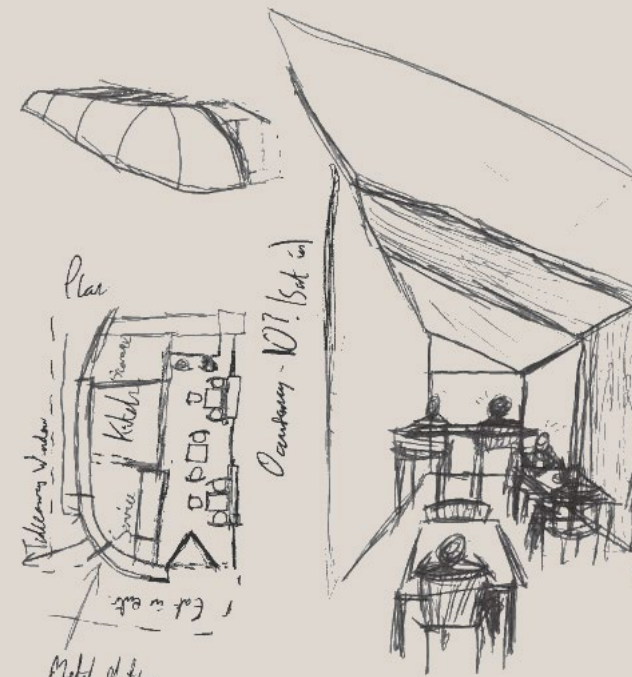
# DP3 Culinary Kiosk

"How can a food kiosk make a positive impact on the issue of E-waste?"

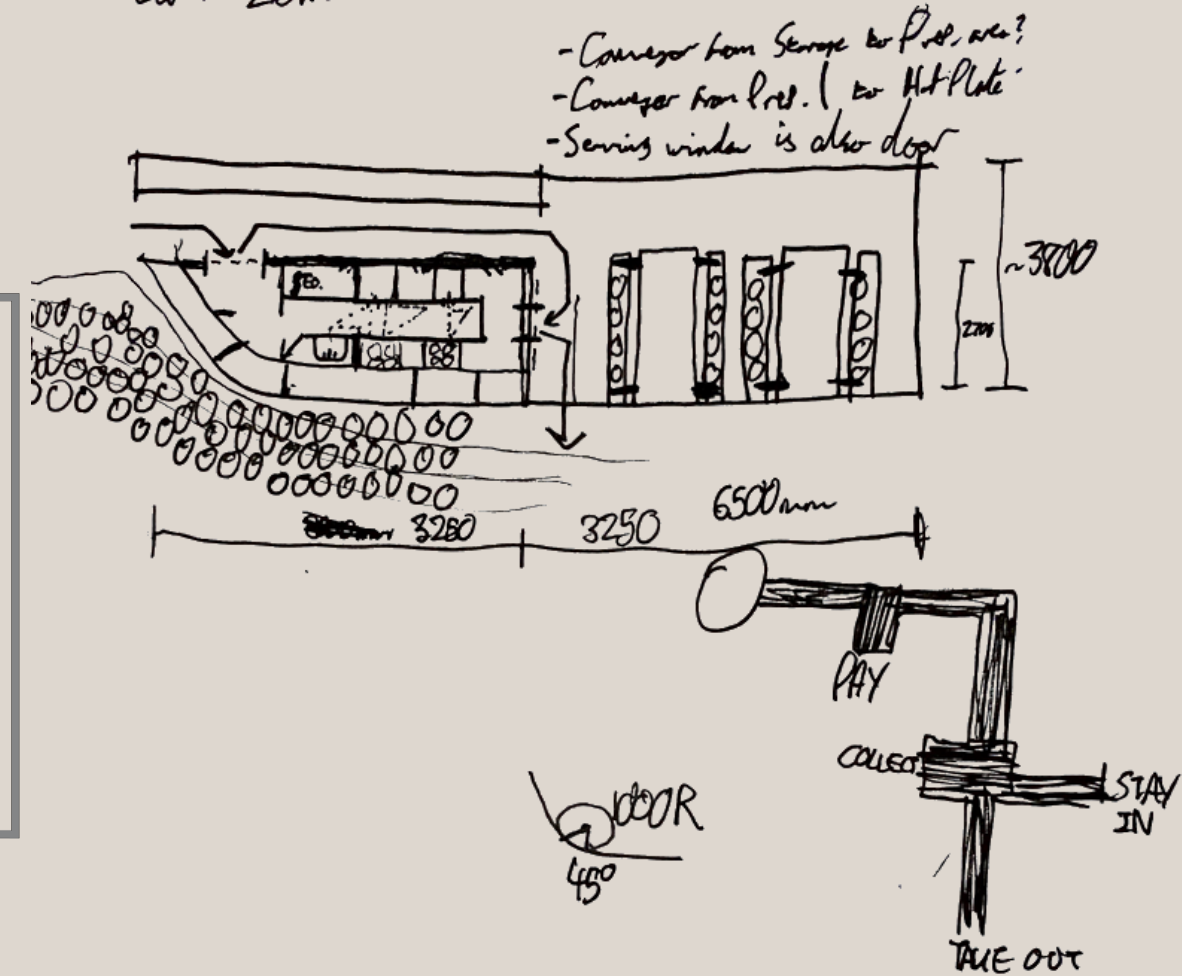
Food topic- AMERICAN-WELSH FUSION

## Initial Concept

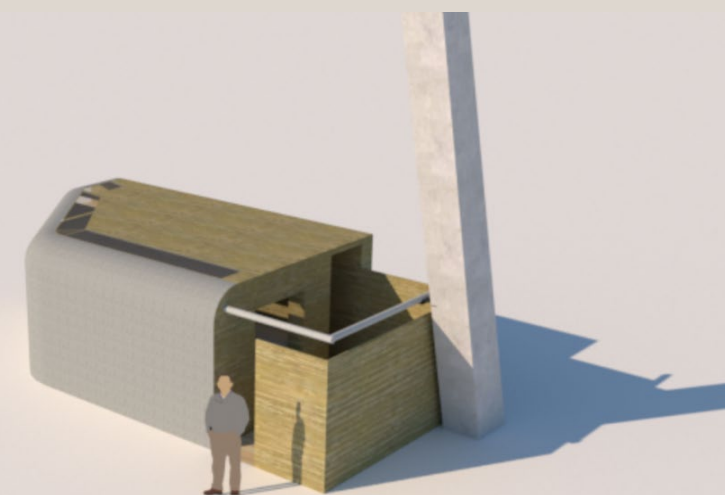
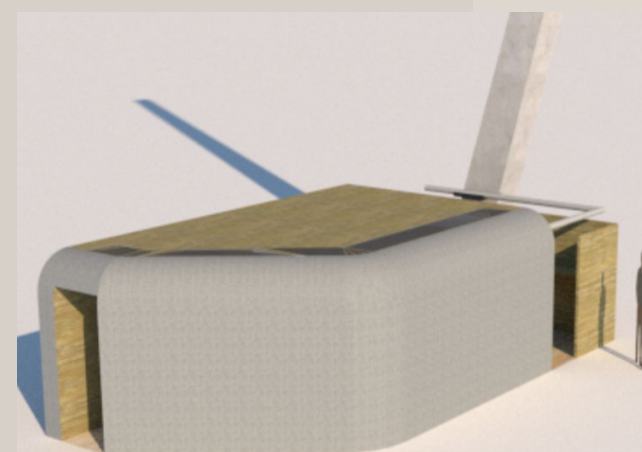
Kiosk - Initial ideas



Limit 28m<sup>2</sup>



3 things needed:  
- Chimney ✓  
- Canals ✓  
- Collector/Permeant ✓

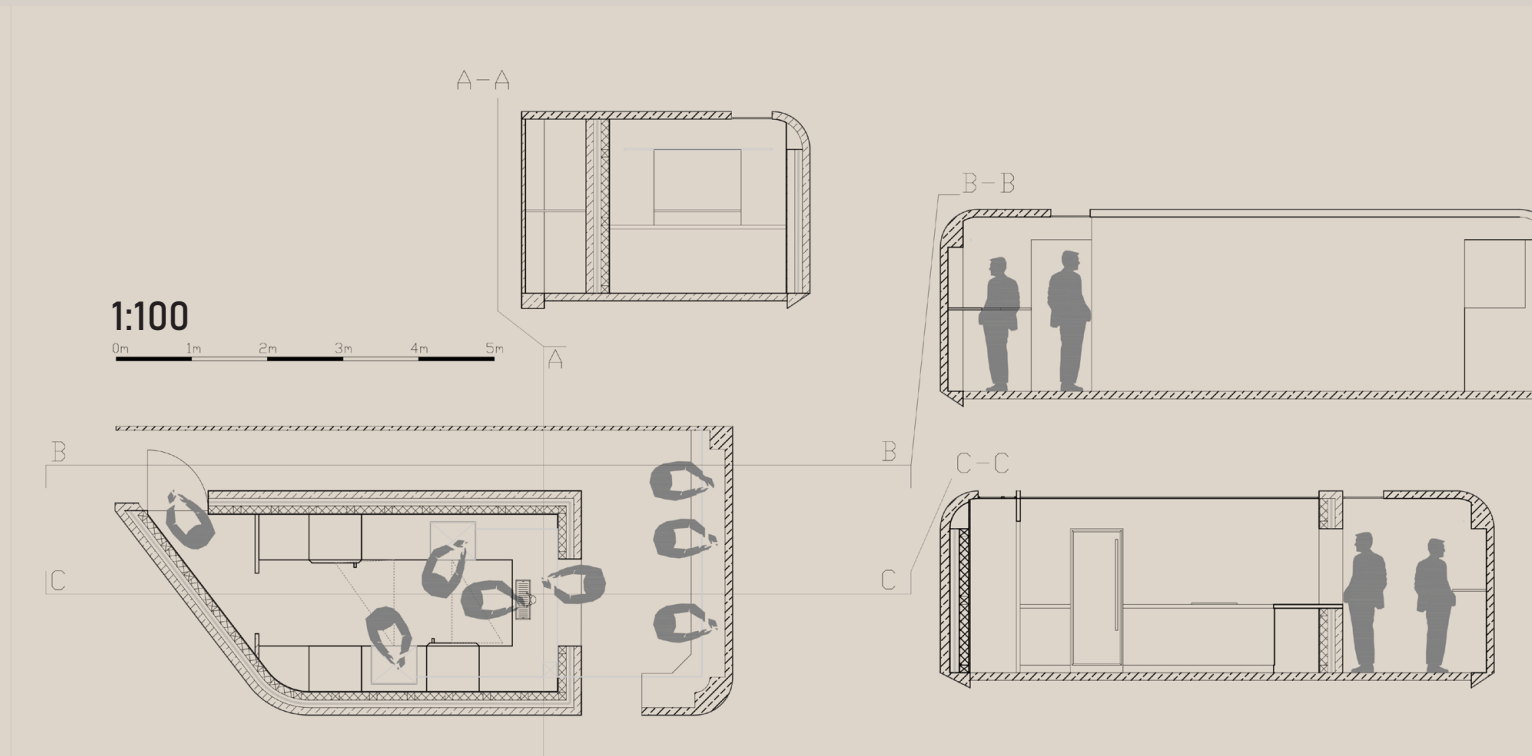




# DP3 Culinary Kiosk | “How can a food kiosk make a positive impact on the issue of E-waste?”

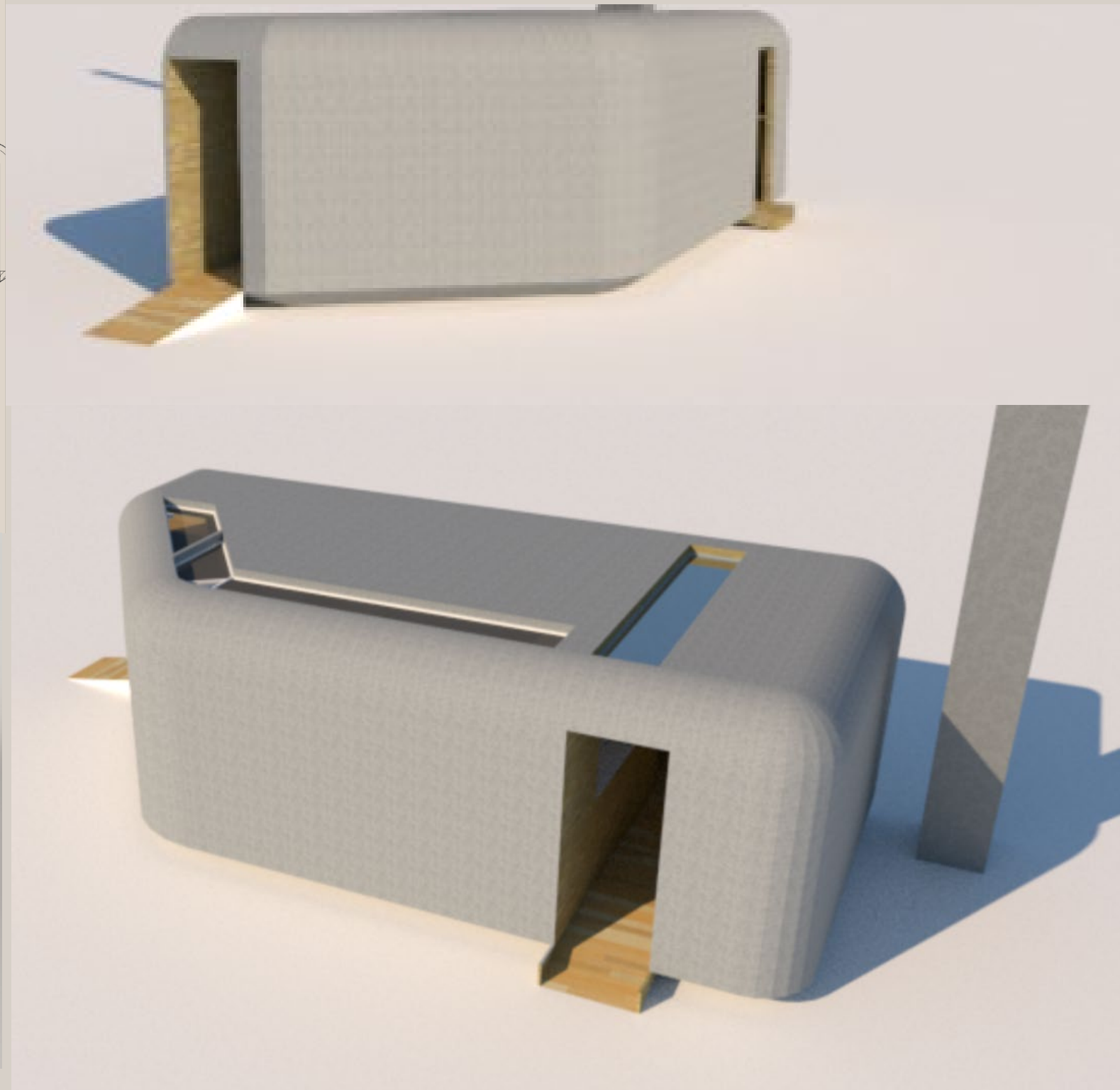
Food topic- AMERICAN-WELSH FUSION

## First Iteration



-The canopy was also clad in E-waste to better reflect the Air-stream caravan idea.

-To make the insulation effective, I totally enveloped the kitchen area with it.



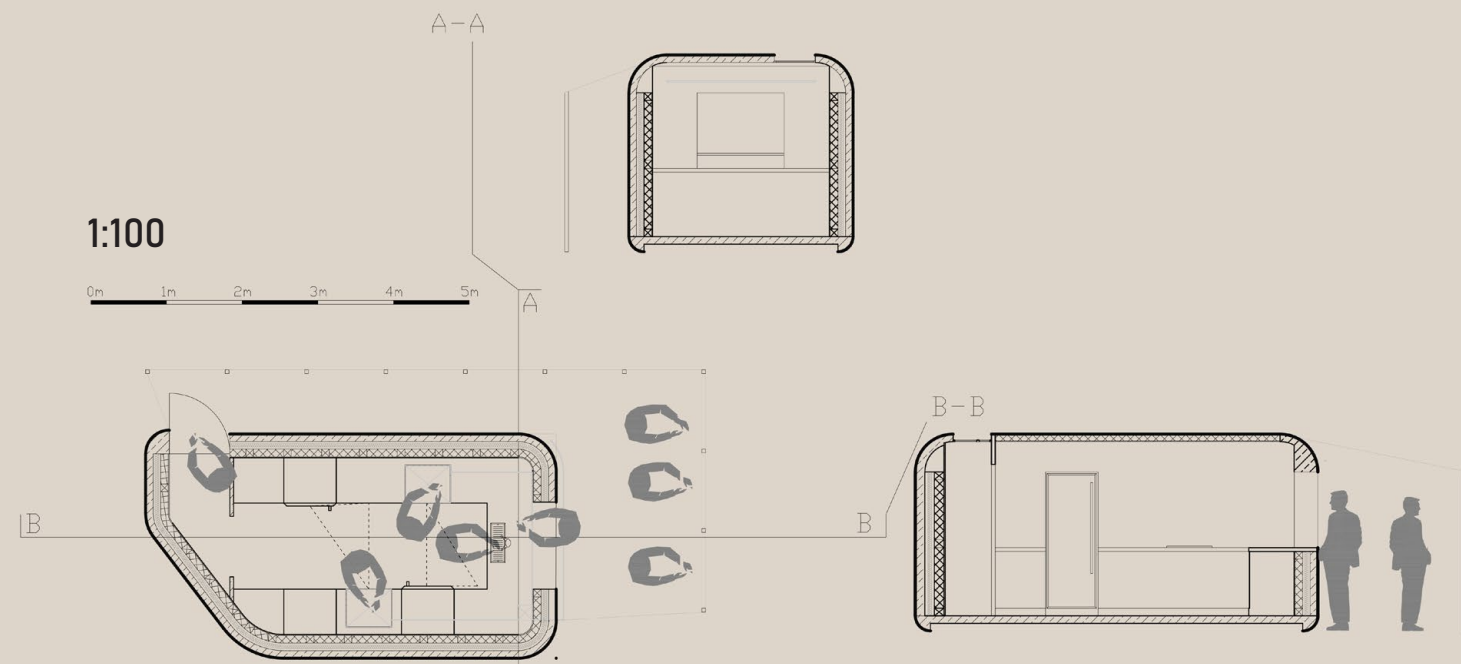


# DP3 Culinary Kiosk |

"How can a food kiosk make a positive impact on the issue of E-waste?"

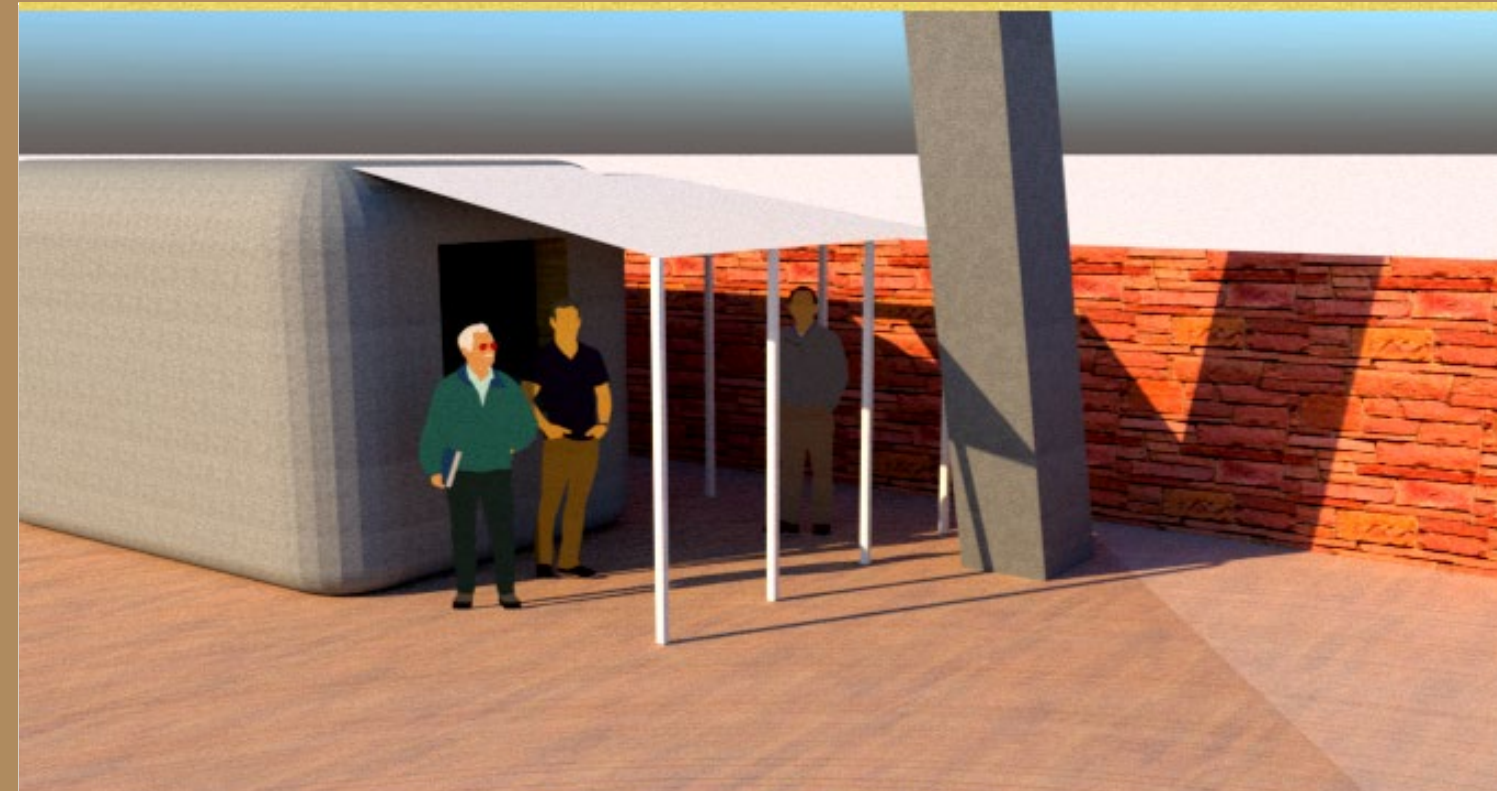
Food topic- AMERICAN-WELSH FUSION

## Second Iteration

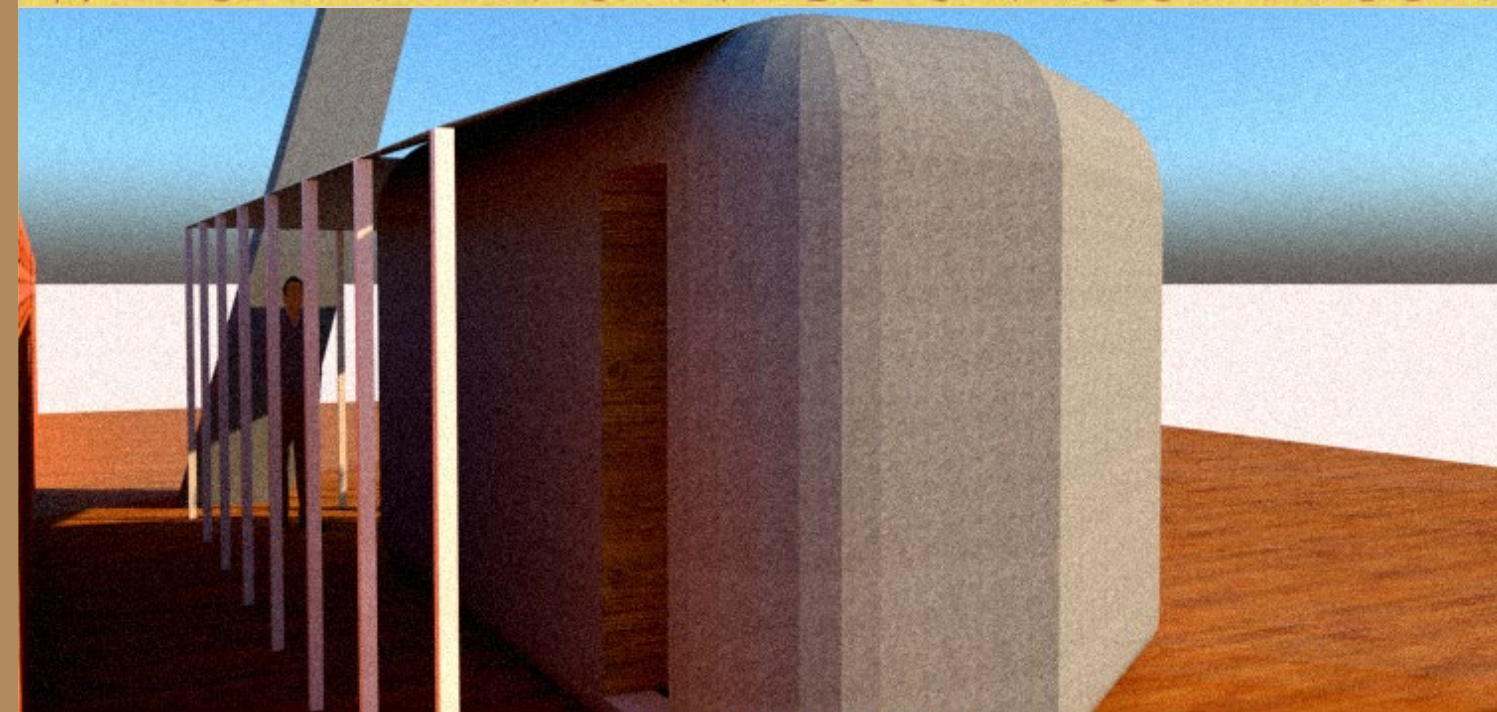


-I removed the party wall entirely, so the kitchen became the only enveloped element. The canopy was replaced with a fabric shelter.

-The lower edges of the kiosk were rounded rather than chamfered to further emphasise the streamlined bullet aesthetic.



**C. L. GREEN'S  
WELSH-AMERICAN FUSION FOOD KIOSK**



**C. L. GREEN'S  
WELSH-AMERICAN FUSION FOOD KIOSK**

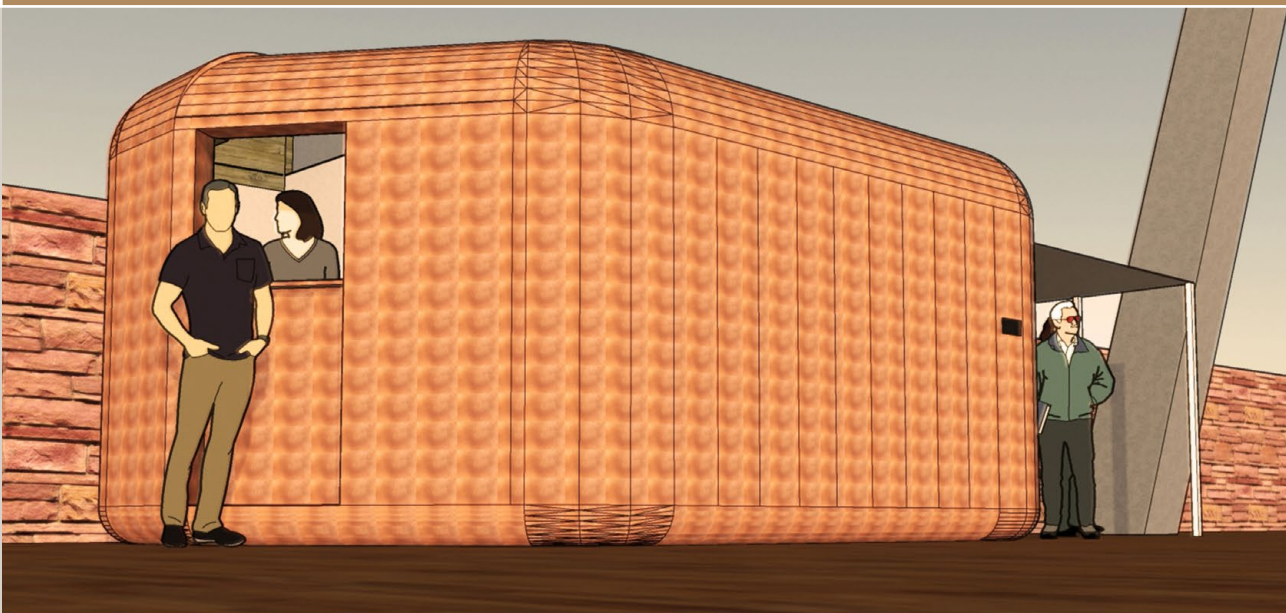


# DP3 Culinary Kiosk |

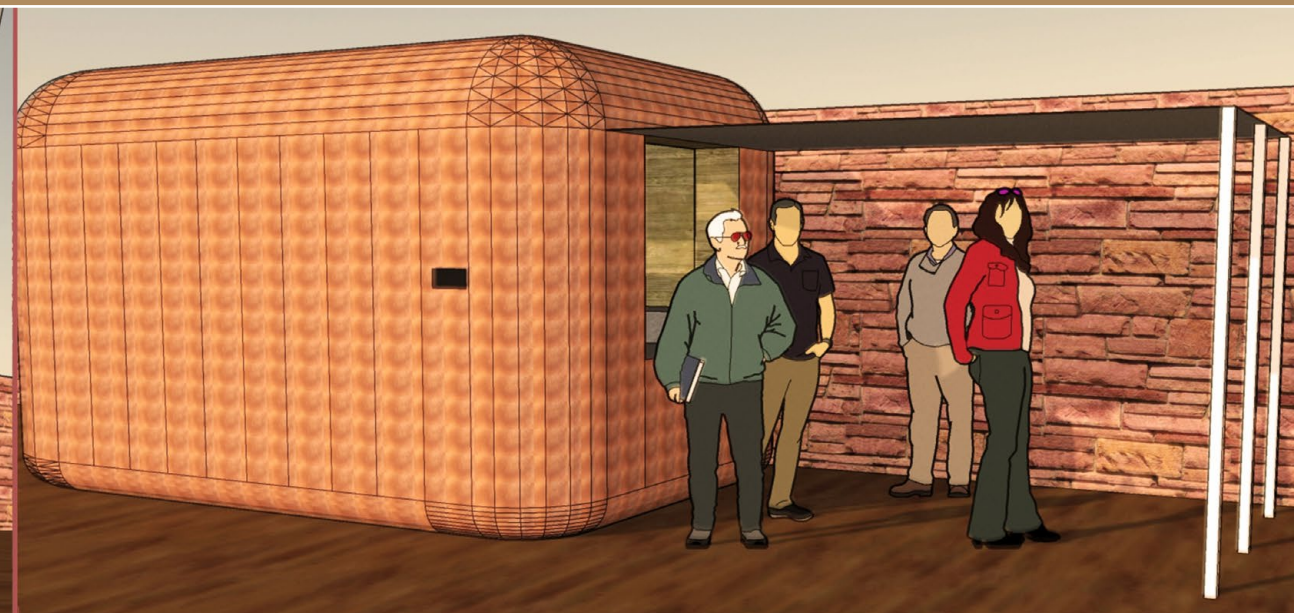
“How can a food kiosk make a positive impact on the issue of E-waste?”

Food topic- AMERICAN-WELSH FUSION

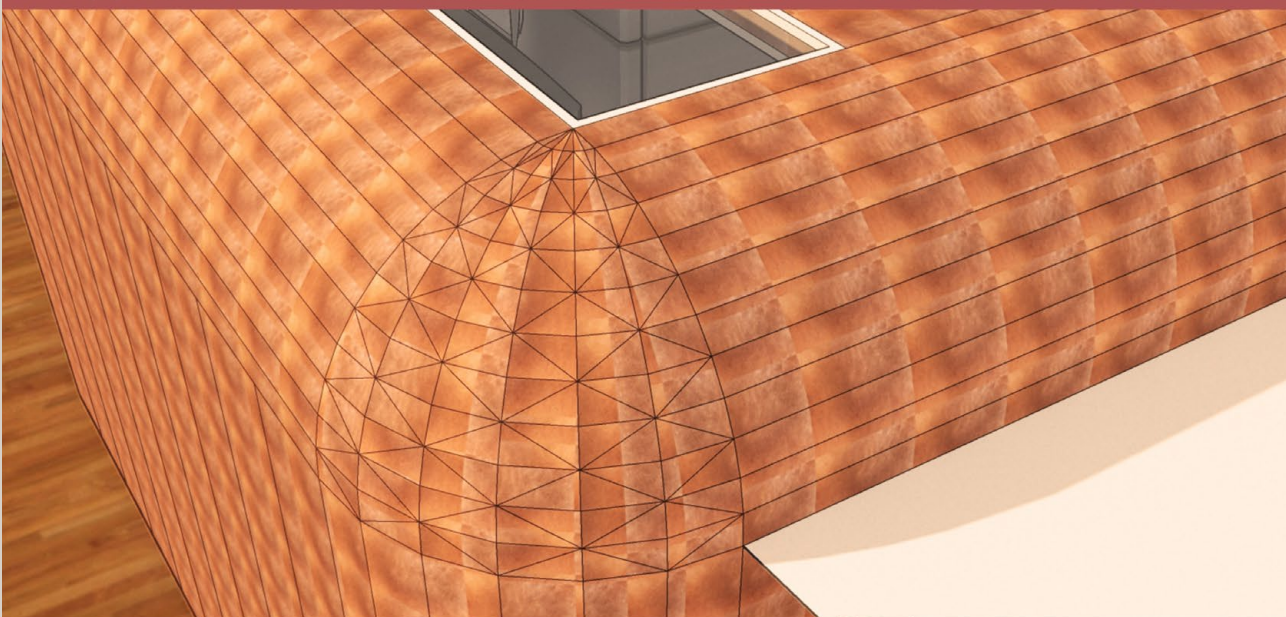
## Final Proposal - Renders



**C. L. GREEN'S  
WELSH-AMERICAN FUSION FOOD KIOSK**



**EXPERIENCE THE GREAT TASTES  
OF THE UNITED STATES OF AMERICA**



**...ALONGSIDE THE MARVELS OF  
ENGINEERING BORN OF WELSH STEELWORKS**



**ONE AND ALL ARE INVITED  
TO ENJOY THIS RARE MEETING OF CULTURES!**

### FINAL ITERATIONS-

-I moved the kiosk up to the wall (200mm away), so that there were no dark enclosed spaces (which could promote antisocial behaviour). This also meant a change to the canopy dimensions, within the constraints.

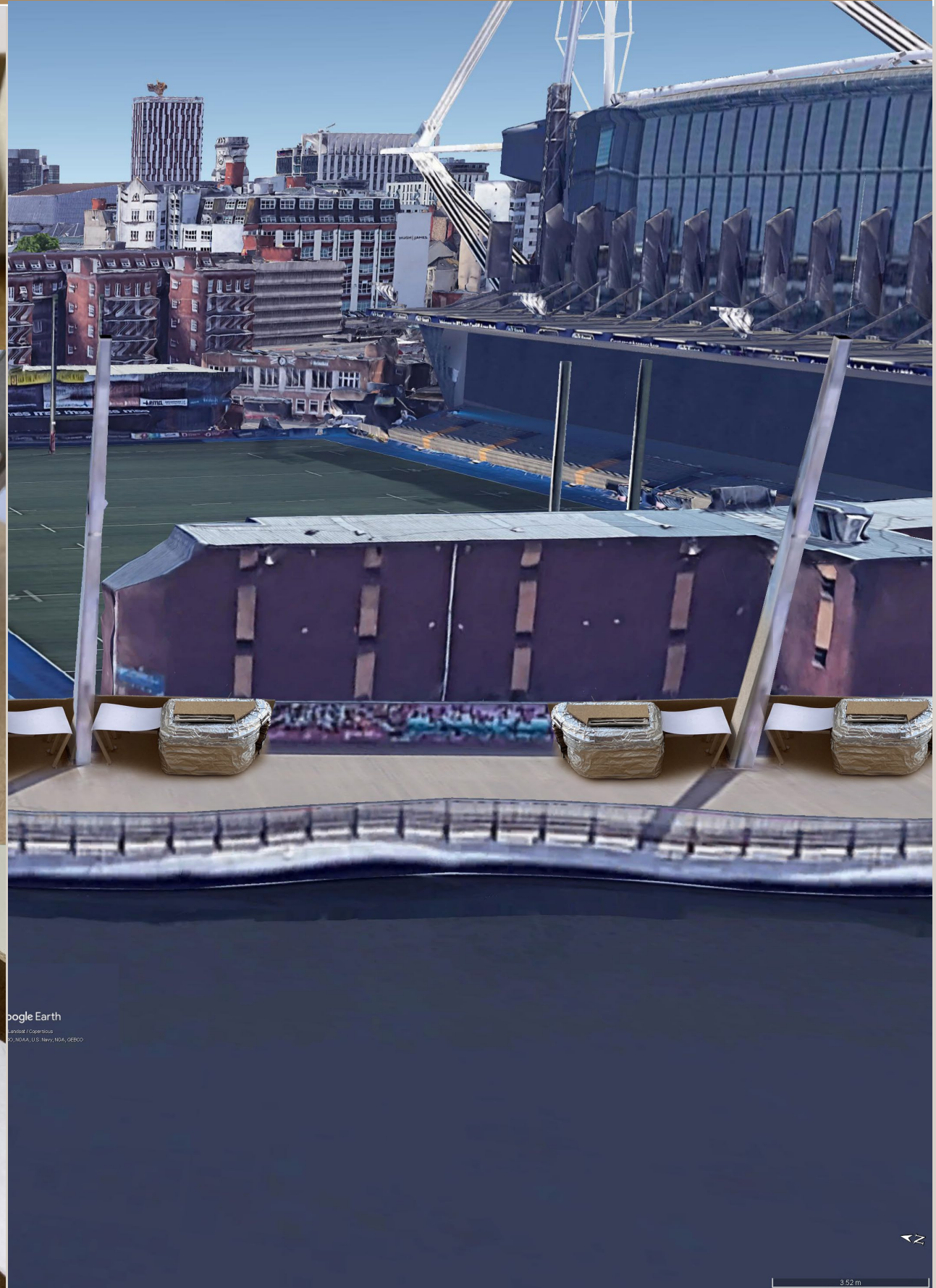
-I moved the serving window and recessed it into the kiosk - emphasising its' purpose and making the user follow and realise the streamlined form.



# DP3 Culinary Kiosk | “How can a food kiosk make a positive impact on the issue of E-waste?”

Food topic- AMERICAN-WELSH FUSION

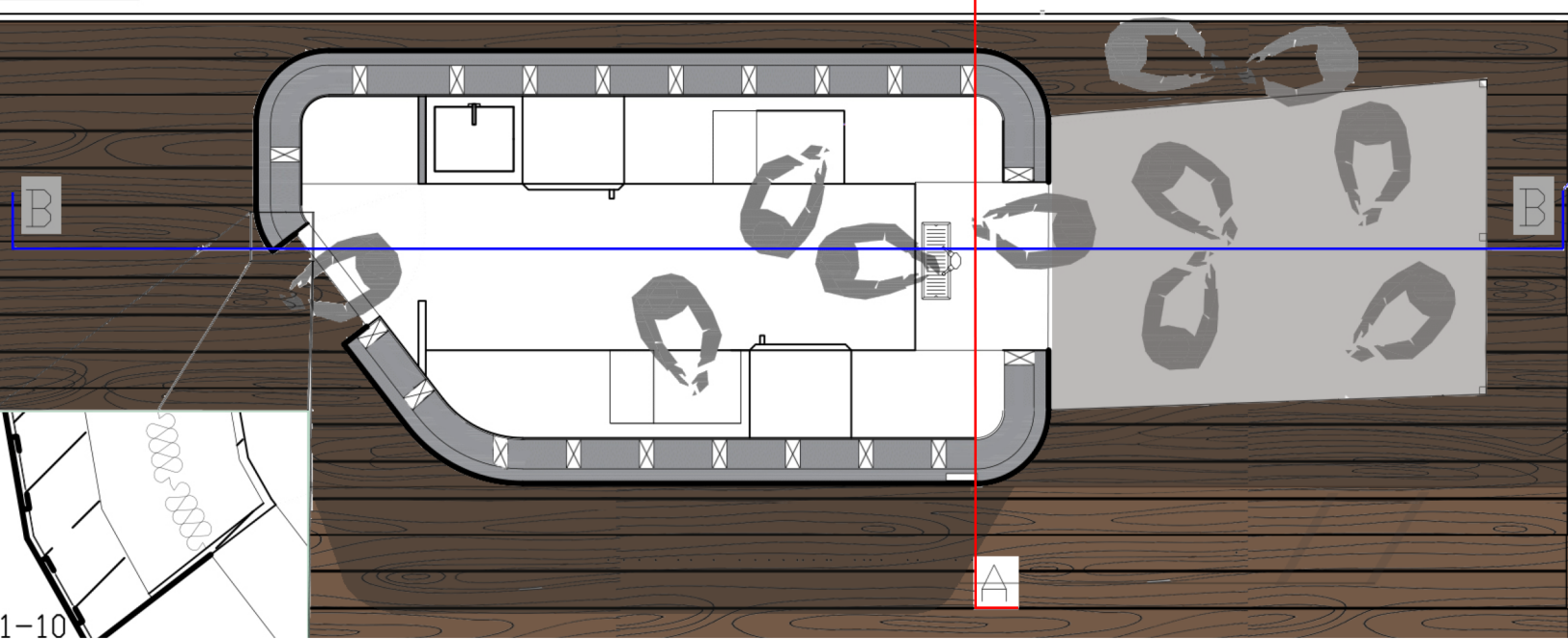
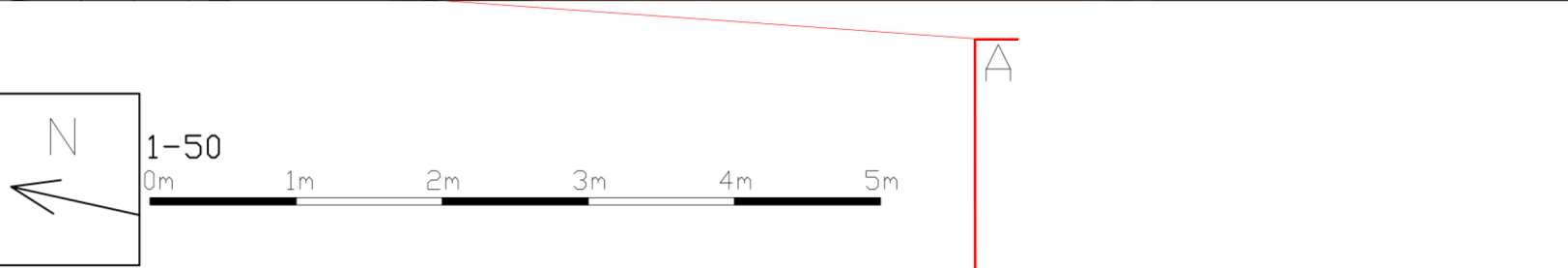
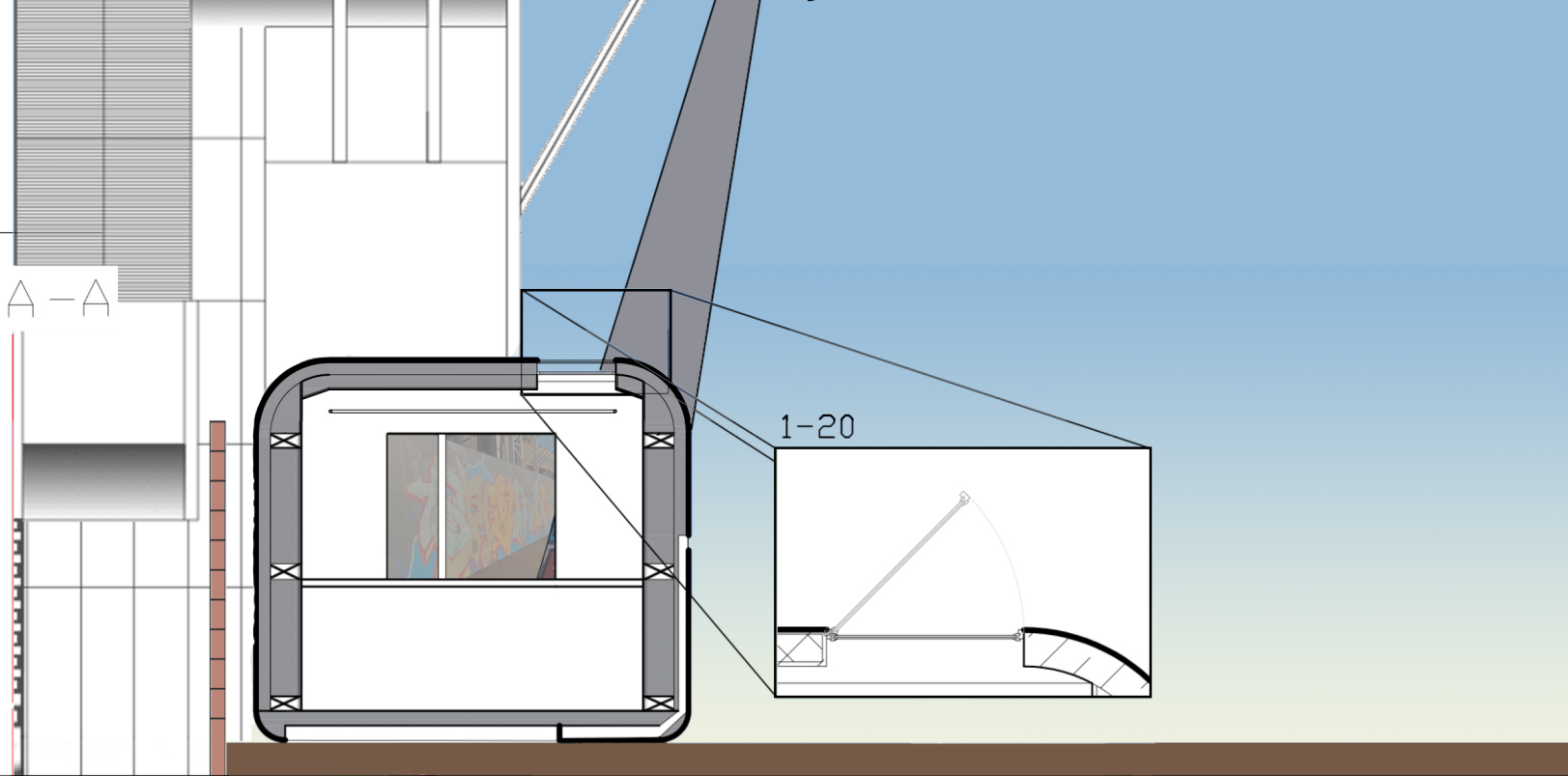
Final Proposal - 1:50 Model





01-2022 DP3 American-Welsh Food Kiosk

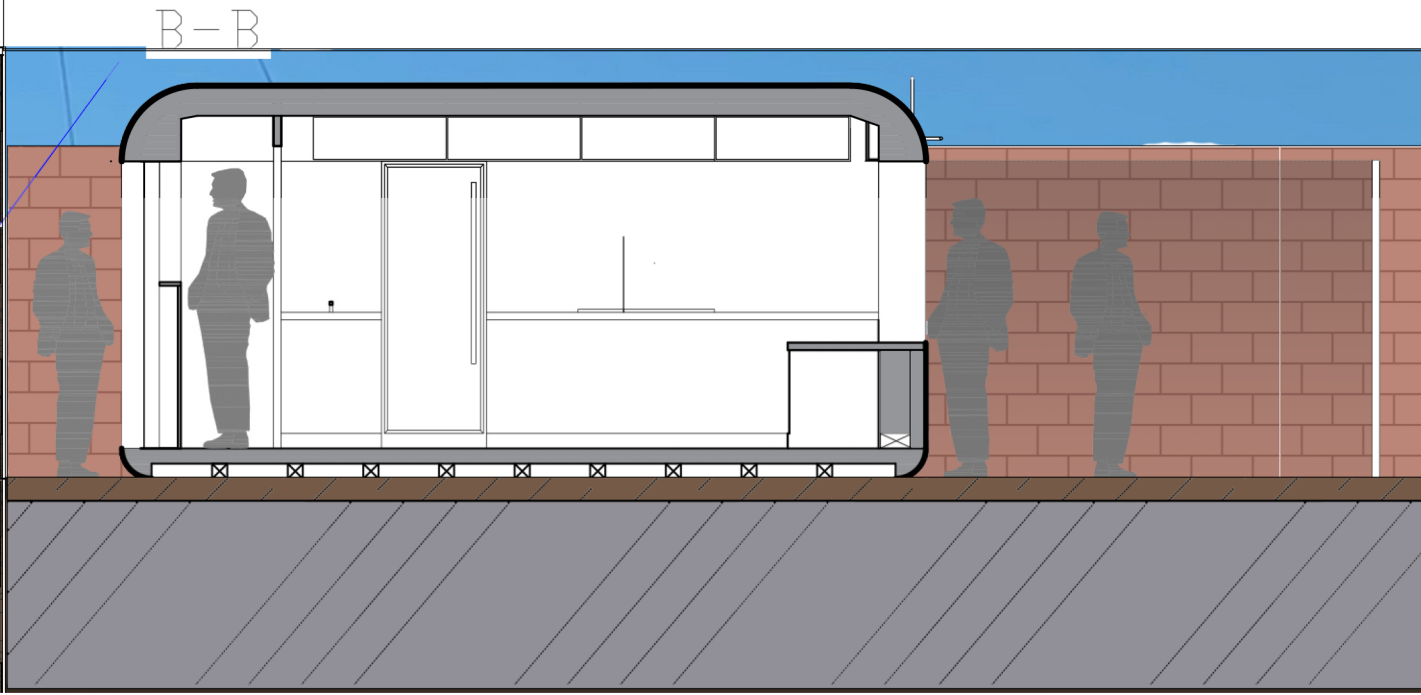
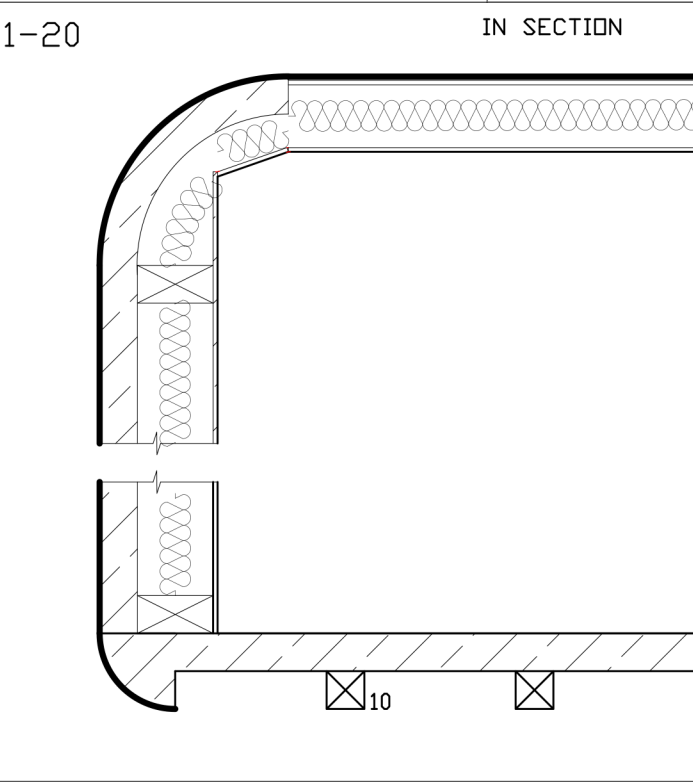
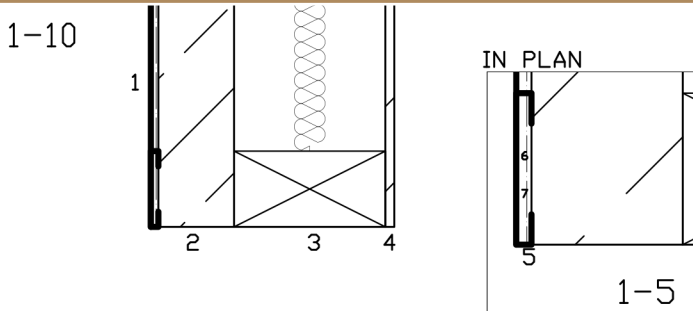
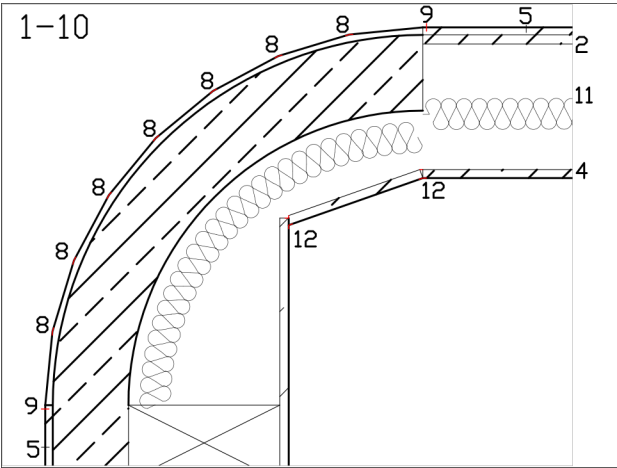
SCALE 1-50 [A3 SHEET], by CL GREEN 2022



ASSEMBLAGE DESCRIPTION:

- 1- E-waste Alloy cladding ~54% Cu, ~22% Fe, ~10% Sn, 0,8mm
- 2- Cedar (Structural, 100mm Wall/12mm Roof
- 3- Stud Wall (Thermofloc Insulation within 200mm timber studs)
- 4- Birch interior cladding 12mm
- 5- Steel C-channel
- 6- Battens
- 7- Damp-proof Membrane (Attached to Cedar)
- 8- Metal-Inert Gas welds
- 9- Bolt connectiong curved E-waste panels to straight E-waste panels
- 10- Cedar plank, 100mm
- 11- Thermofloc Insulation
- 12- Aluminium Flashing

Total thicknesses: 322mm wall, 200mm roof  
U-values: 0,181W/m2K Wall, 0,222W/m2K Roof





# DP3 Culinary Kiosk

“How can a food kiosk make a positive impact on the issue of E-waste?”

Elevations & other diagrams

1-50

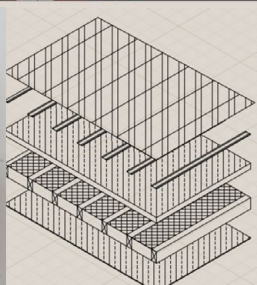
0m 1m 2m 3m 4m 5m

FRONT

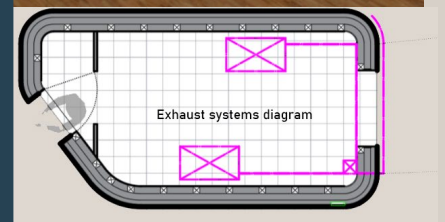
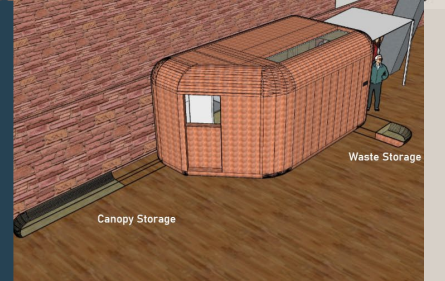
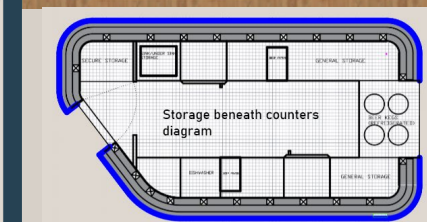
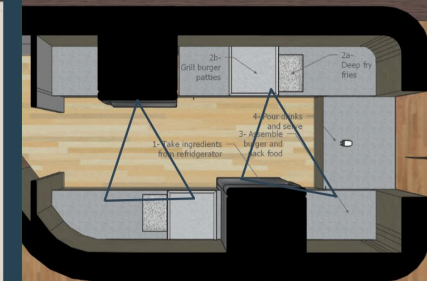
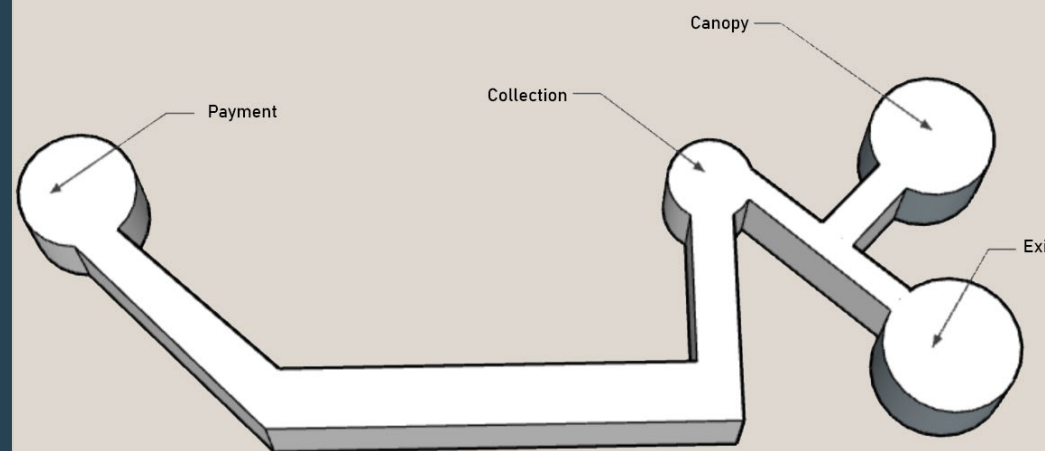
RIGHT

LEFT

TOP



**E-waste Cladding-**  
The copper's weather and fungal resistance protects the timber frame from environmental attack as well as being a positive element on the natural E-waste.  
**Battens with mid-carbon steel C-channel-**  
This will support the cladding from the timber, preventing damp. The C-channel is positioned at the centre of the metal sheet.  
**100mm structural Cedar, FSC certified-**  
Cedar resists environmental attack and has good toughness, giving it load-bearing properties.  
**200mm Thermofloc insulation between 200x100 studs every 400mm-**  
The thick insulative layer maintains comfort temperatures as positively as possible.  
**12mm Birch interior cladding, FSC certified-**  
Birch is lightweight and local, so it is an appropriate and sustainable substitute for plaster.





# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

## Contextual Analysis- Eisteddfod Festival

### WHO?

The Eisteddfod is a celebration of Welsh culture, yet is attended by many across the European continent.



Figure 17- Welsh flag [see footnote]



Figure 18- Eisteddfod at Carnarvon Castle 1862

### WHAT?

The Eisteddfod includes many exhibitions - including Welsh poetry, art, sculpture, literature, music and more.

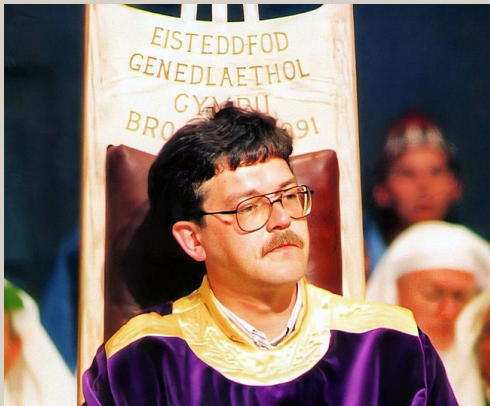


Figure 19- Prifardd Robin Owain, Welsh poet



Figure 20- “Y Lle Celf 2018 paintings in the Senedd”

### WHERE & WHEN?

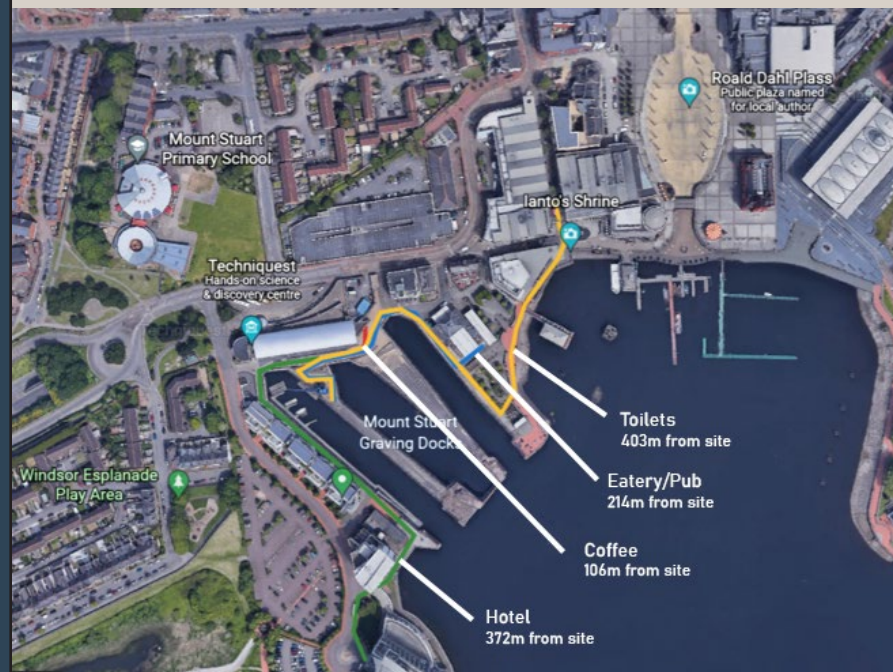
A rich history comes with the Eisteddfod - the first being held in 1176 at Cardigan Castle. It is held across Wales to this day in different locations each year.

### DESIGN BRIEF

My project is to make an urban stage for Y Lle Celf, and general public use thereafter, at the Mount Stuart Graving Docks.

## Site Analysis- Amenities & Services

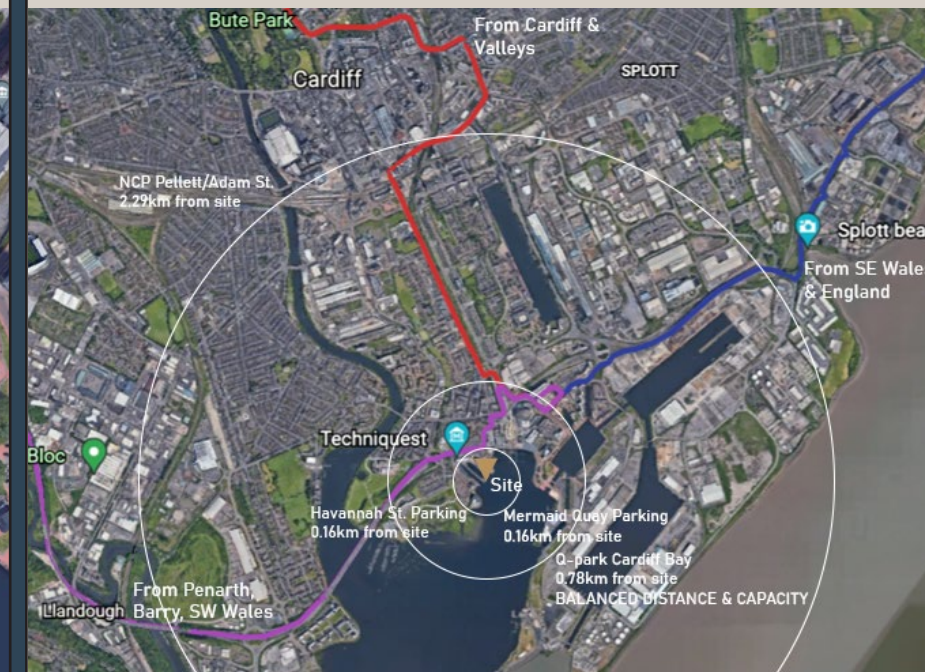
Local amenities - closest toilets, eatery, coffee and hotel.



Local public transport links - closest train station and bus stop.



Parking opportunities in the area



What this means for my scheme:

-Toilets are inconveniently far away, so these must be provided.

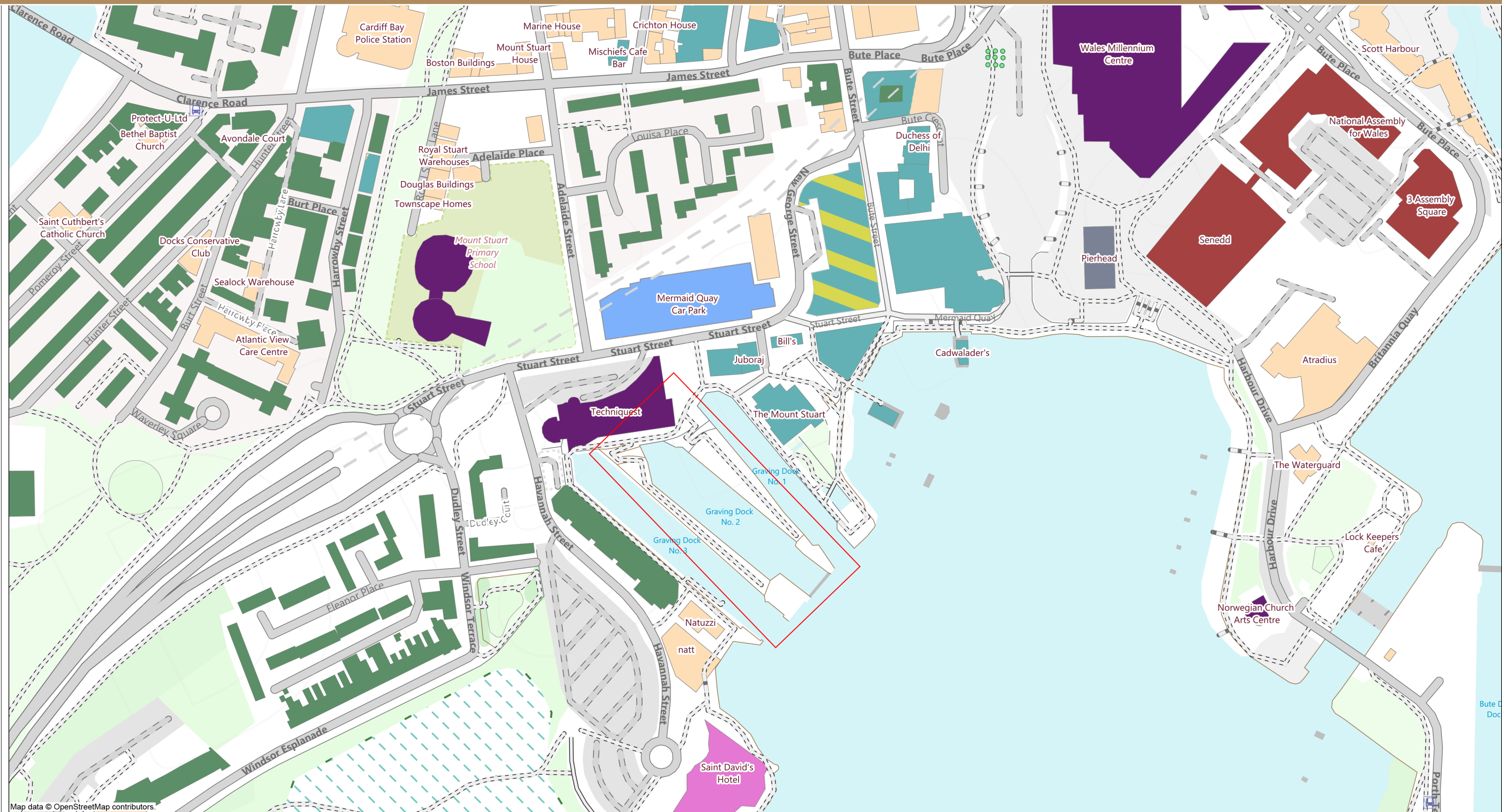
-The site has good access for pedestrians, and any parking/public transport links are at reasonable distances.

-Q-park Cardiff Bay [Pierhead St.] is likely the most desirable car park. Mermaid Quay is closer but has lower capacity.



# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

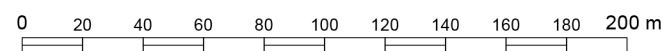
## Site Analysis- Local Zoning [1-2500 Site Plan]



Map data © OpenStreetMap contributors.



Scale 1:2500



- Legend:
- Eatery
  - Entertainment
  - Lodgings
  - Educational/Cultural
  - Governmental
  - Residential
  - Other

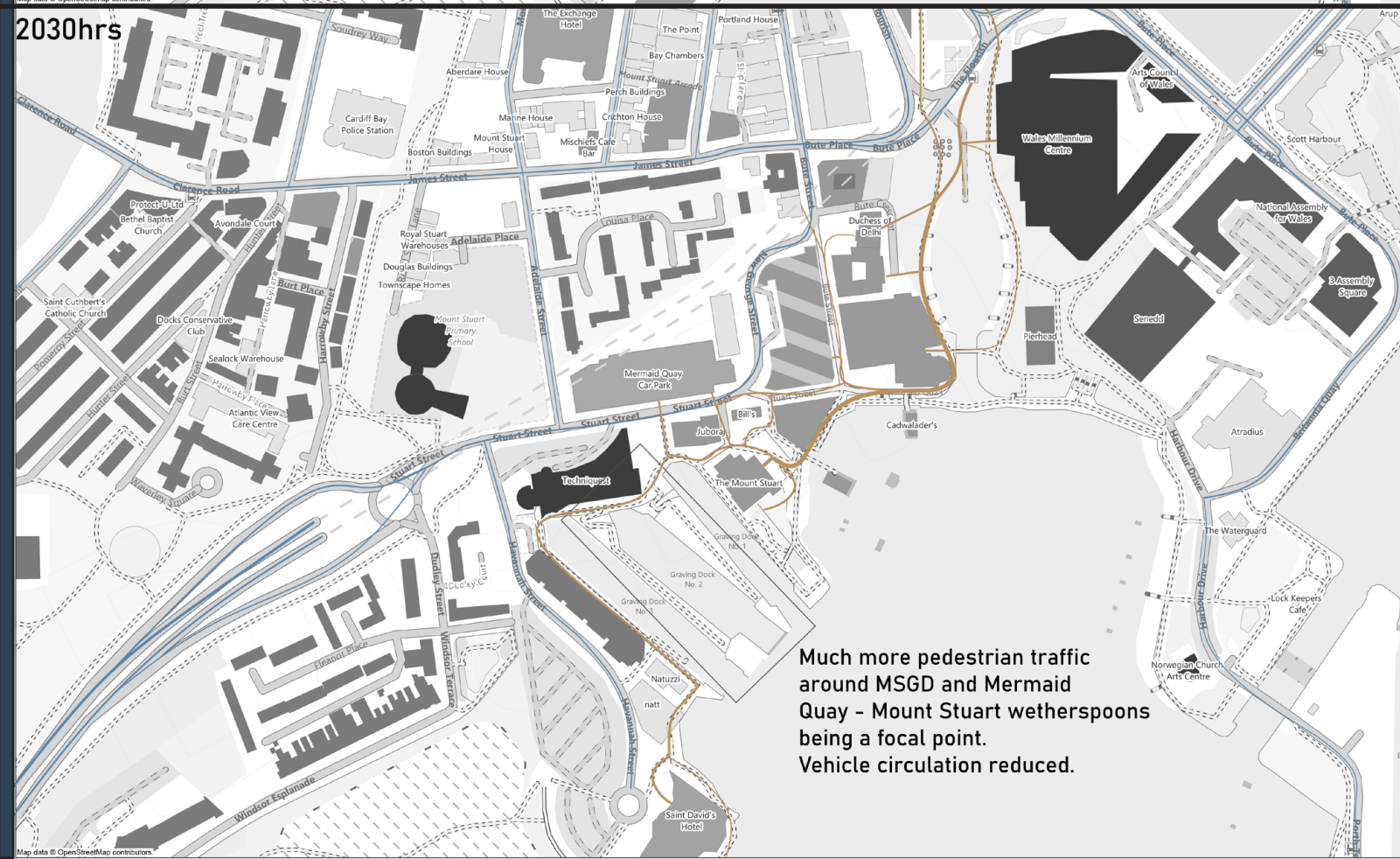
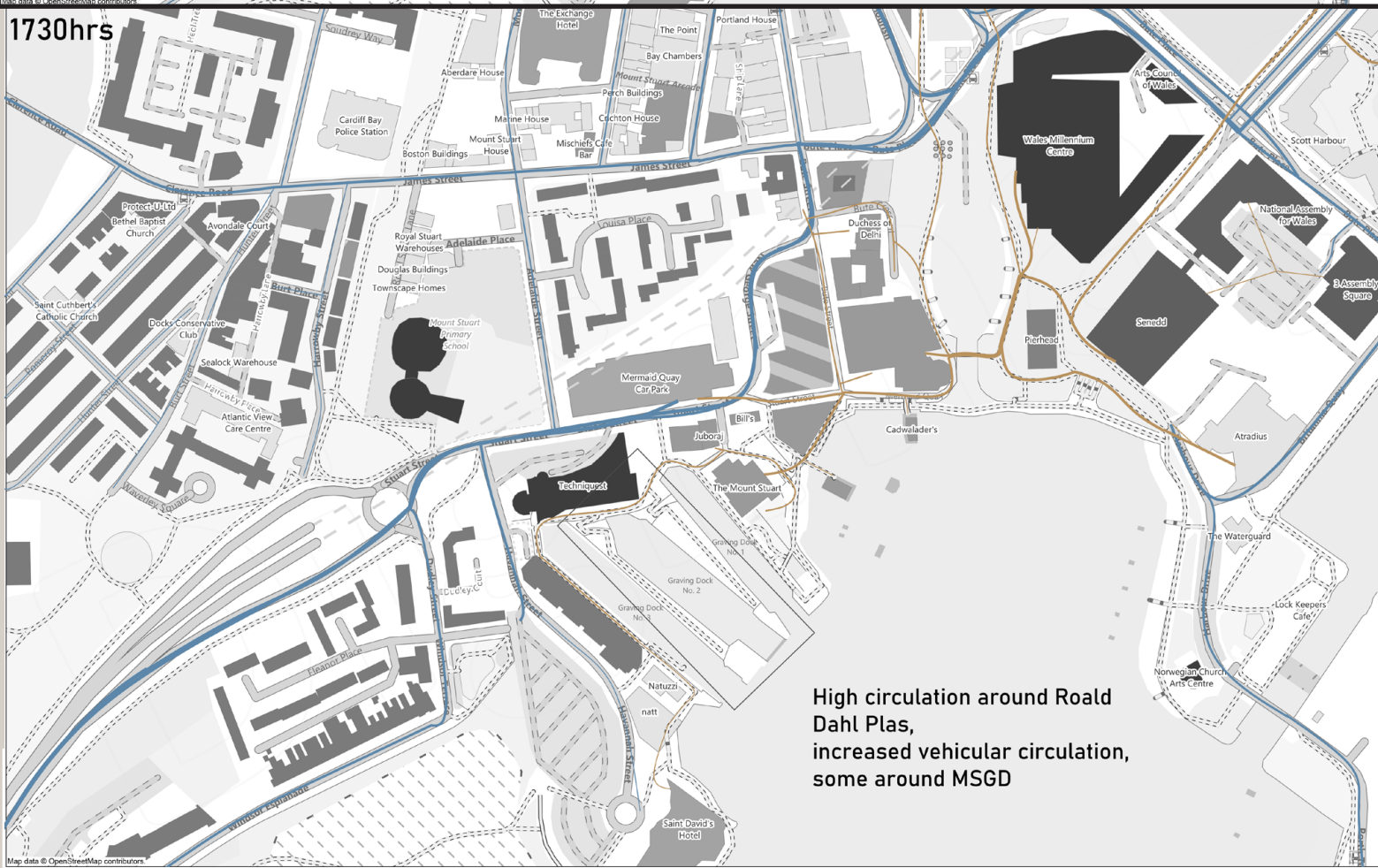
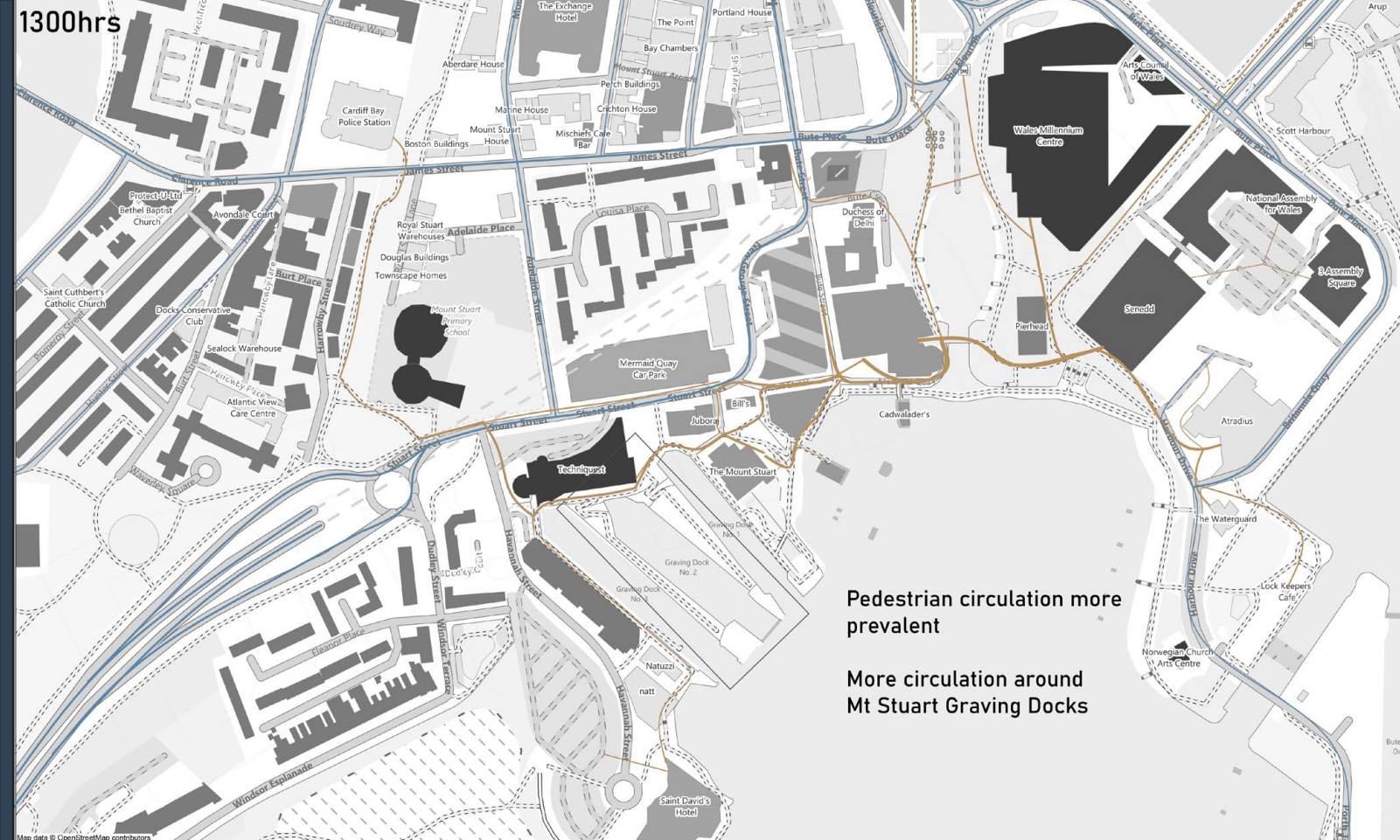
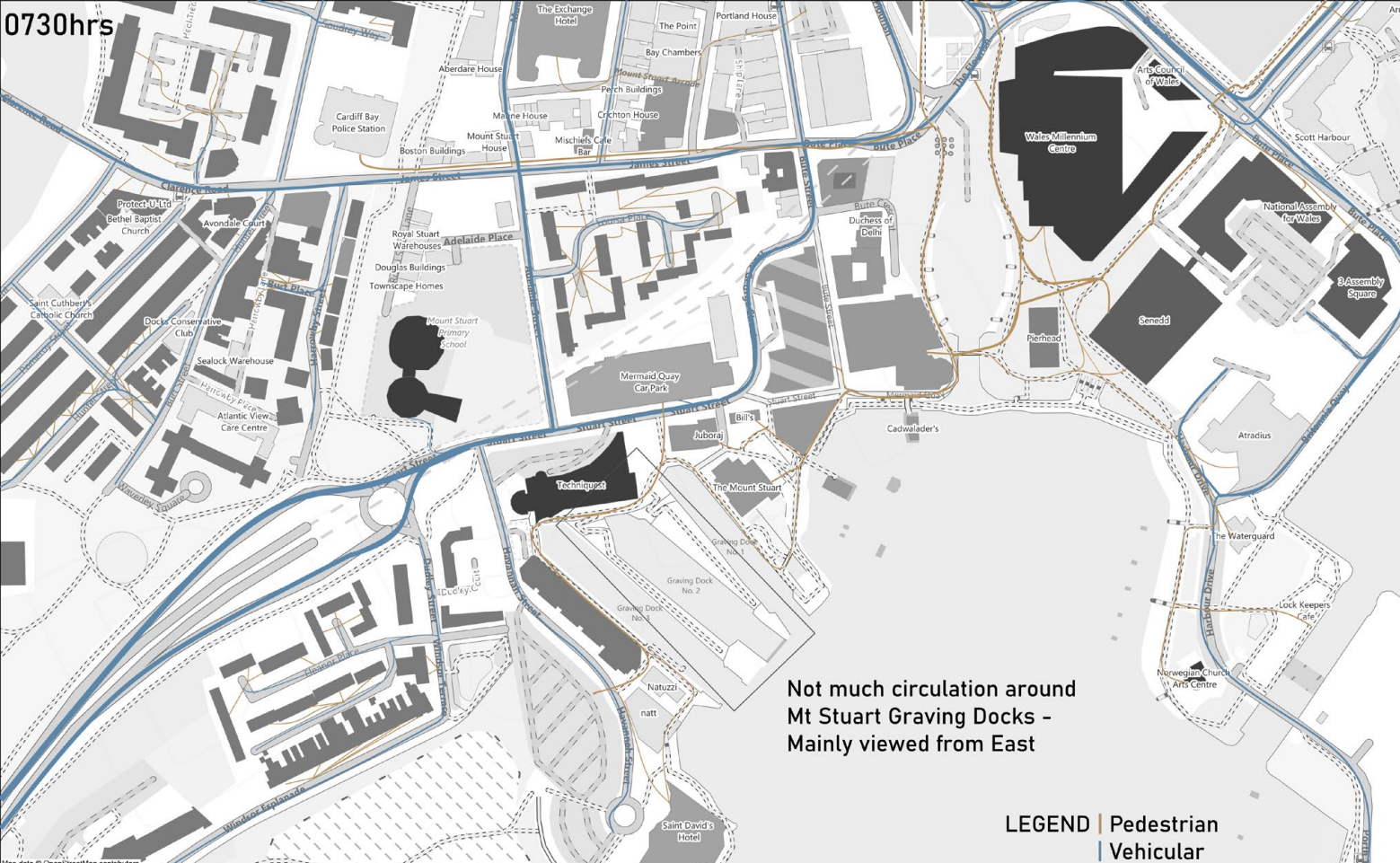
Mar 02, 2022 08:48



# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

## Site Analysis- Circulation around site

Design aim - To increase the extent of the public realm in a way that responds to the opportunities of the Bay, and to answer the question of how Welsh culture can be futuristically displayed.

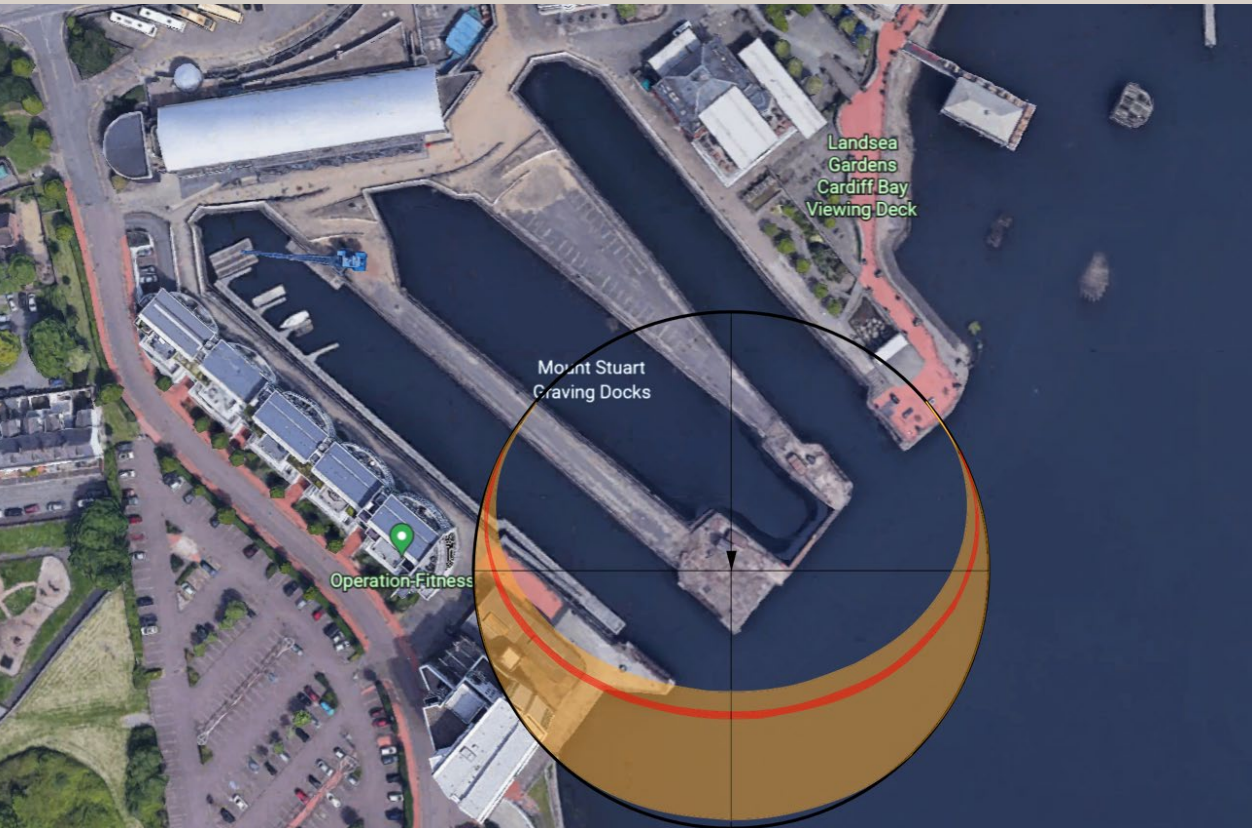




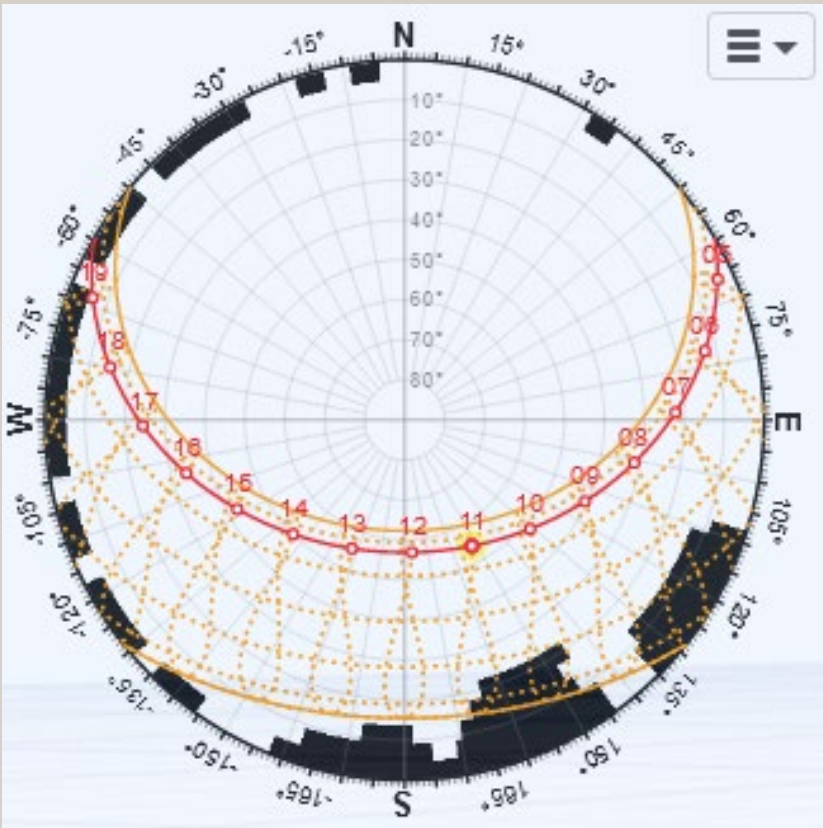
# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

## Site Analysis- Climatic

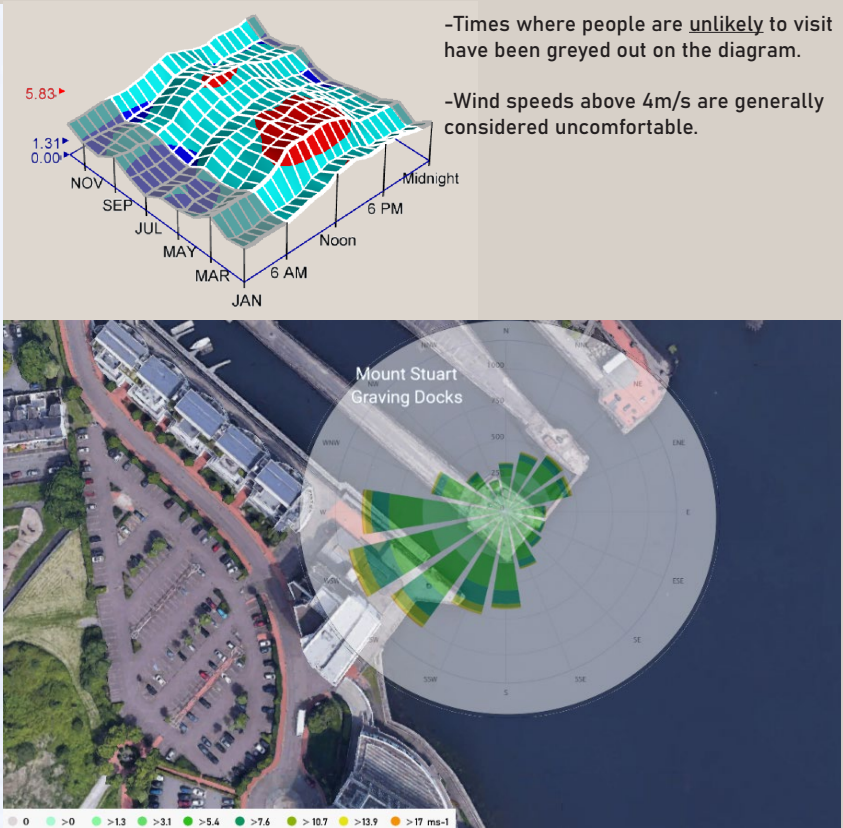
Sun path, with Eisteddfod 2022 dates highlighted in red



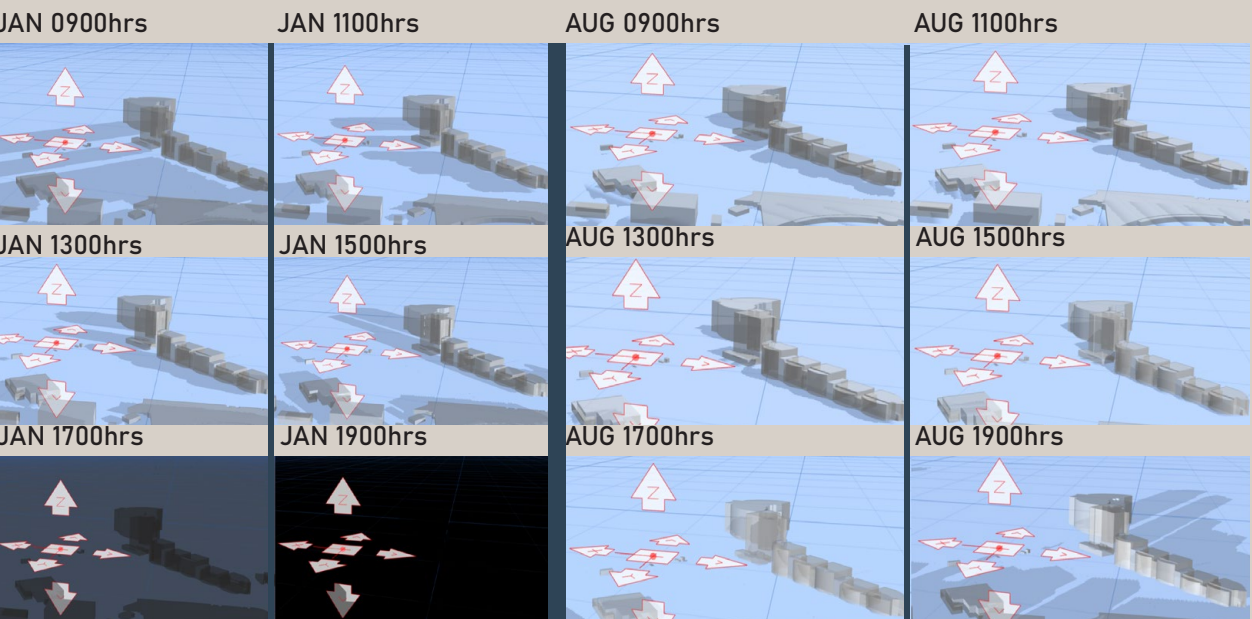
Overshadowing on sun path diagram



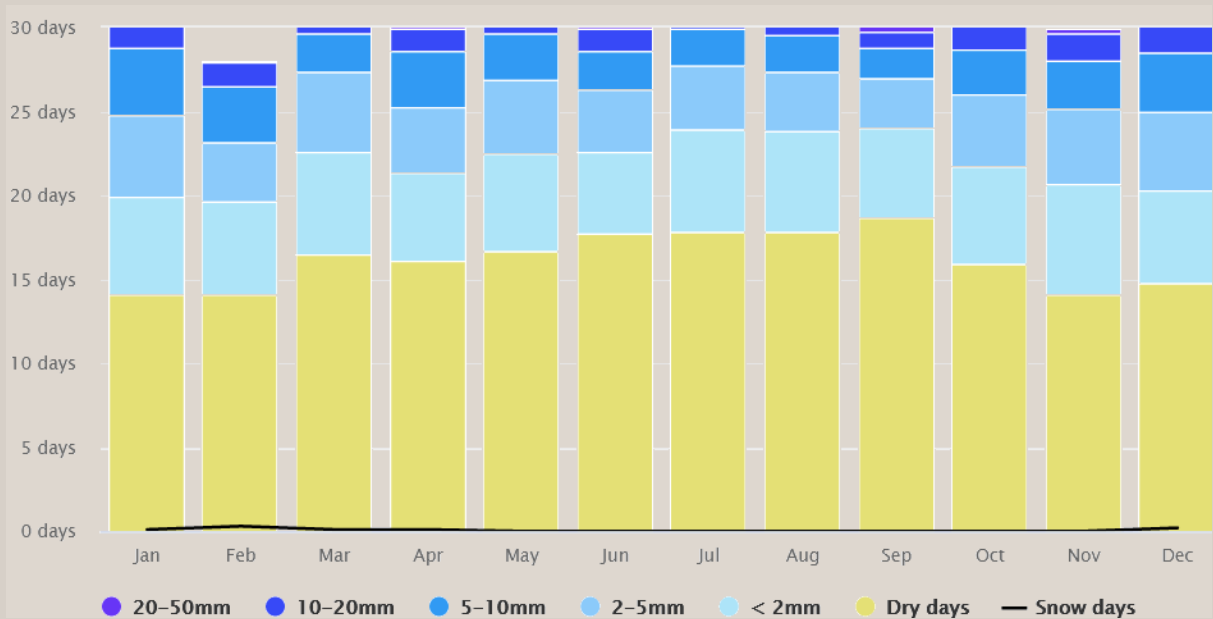
Average Wind Speeds + Modelled Wind Rose



Overshadowing Analysis



Modelled Precipitation Averages



Climatic Site Analysis Conclusions-

- The lowest wind speeds are from the South-East, so people should generally face this direction for maximum comfort.
- The amount of precipitation is considerable, so shelter should be provided.
- Not enough overshadowing is provided during summer months, so shading and the sun's path must be considered in my scheme for the comfort of the audience and the performer.



# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

## Site Analysis- Site Visit & Section



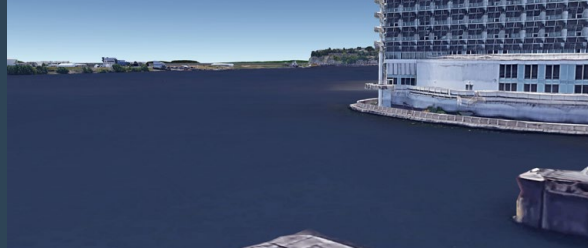
- Crane at the start of the docks - when entering my scheme one should 'walk through' Cardiff's history into the future.
- Bins are present frequently on the site, so there are already very good waste systems.
- Water tends to build up around the dock, causing deep puddles that could cause discomfort in crowds (Sub-par drainage systems)
- The area around the dock is already part of the public realm - with the high-tech Techniquet science museum being close by.
- The Graving Docks are considered as Artificial Deposits and so are suitable for excavation and sufficiently load bearing.



-East view (bottom-right corner of pierhead in plan)

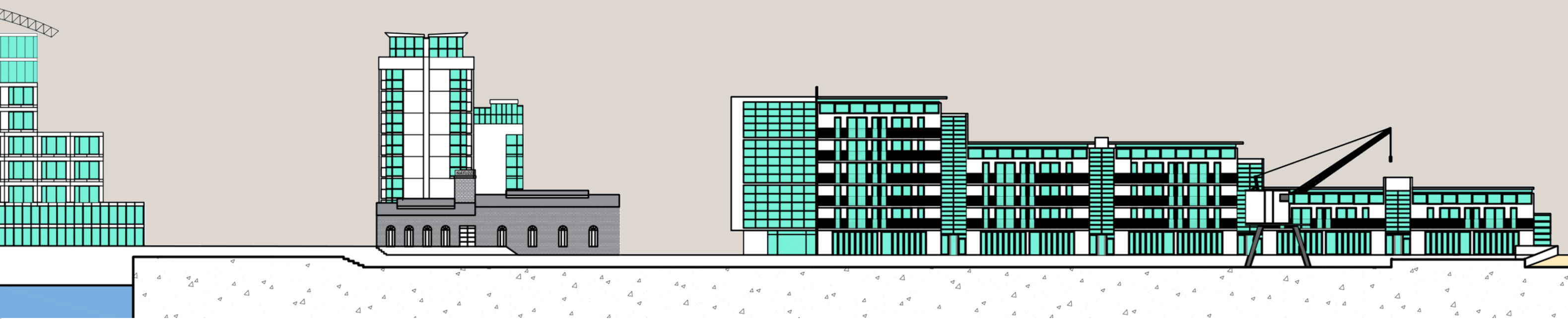


-South view (bottom-left corner in plan)



### Conclusions:

- Lack of drainage on site must be considered.
- I wish to make the journey from the past, through the present and INTO THE FUTURE the main theme in my project.
- High-tech architecture forms the backdrop of the general surroundings of the site.
- The east view is preferable, as it provides a more open view, promoting the outward-looking futuristic idea of my scheme.



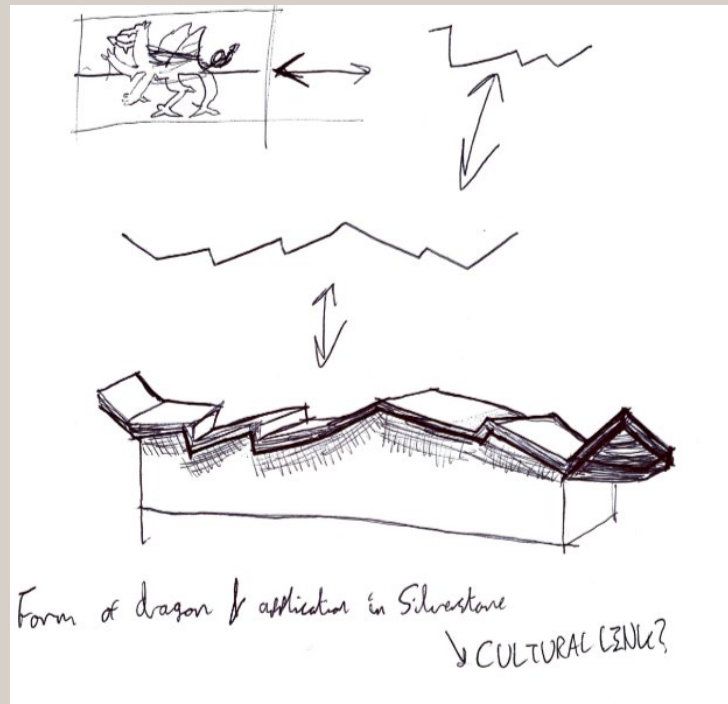


## Precedent Analysis

### Precedent 1 Silverstone Pit Building Populous, 2011



Figure 21 - Silverstone Pit Building during the 2020 70th Anniversary Grand Prix

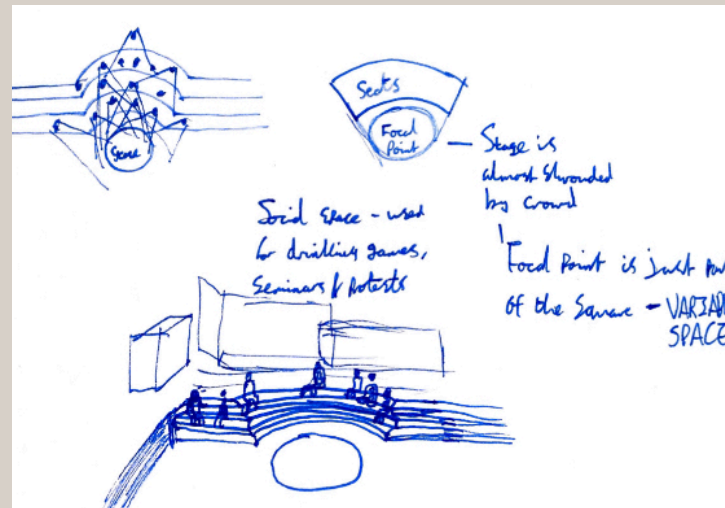


Throughout history, dragons have been intertwined with Welsh irredentism and culture - with its' roots being traced as far back as circa 650 AD through King Calafwaldr, and is seen throughout Welsh history including in Owain Glyndwr's 1400 struggle for Welsh independence and in today's Welsh flag. This, alongside principles of high-tech architecture is something I wish to reference in my stage design.

### Precedent 2 The Piazza Warwick University Eugene Rosenberg, circa 1970



Figure 22 - The Piazza, Warwick University

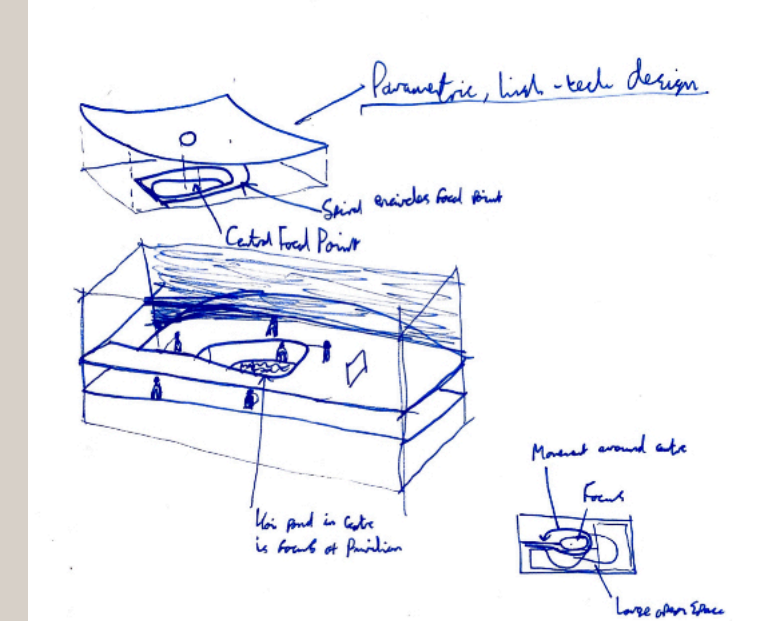


This is a good existing example of a seating area, and one I wish to use in my scheme. I especially wish to focus on the idea of digging into the dock for the seating area and reusing the waste material somehow. The Piazza can be used for performance viewing and for meeting, in the same way as I wish for my stage to operate.

### Precedent 3 The Brussels Pavilion Sergio Bernardes, 1958



Figure 23 - "Brussels Pavilion" in 1958

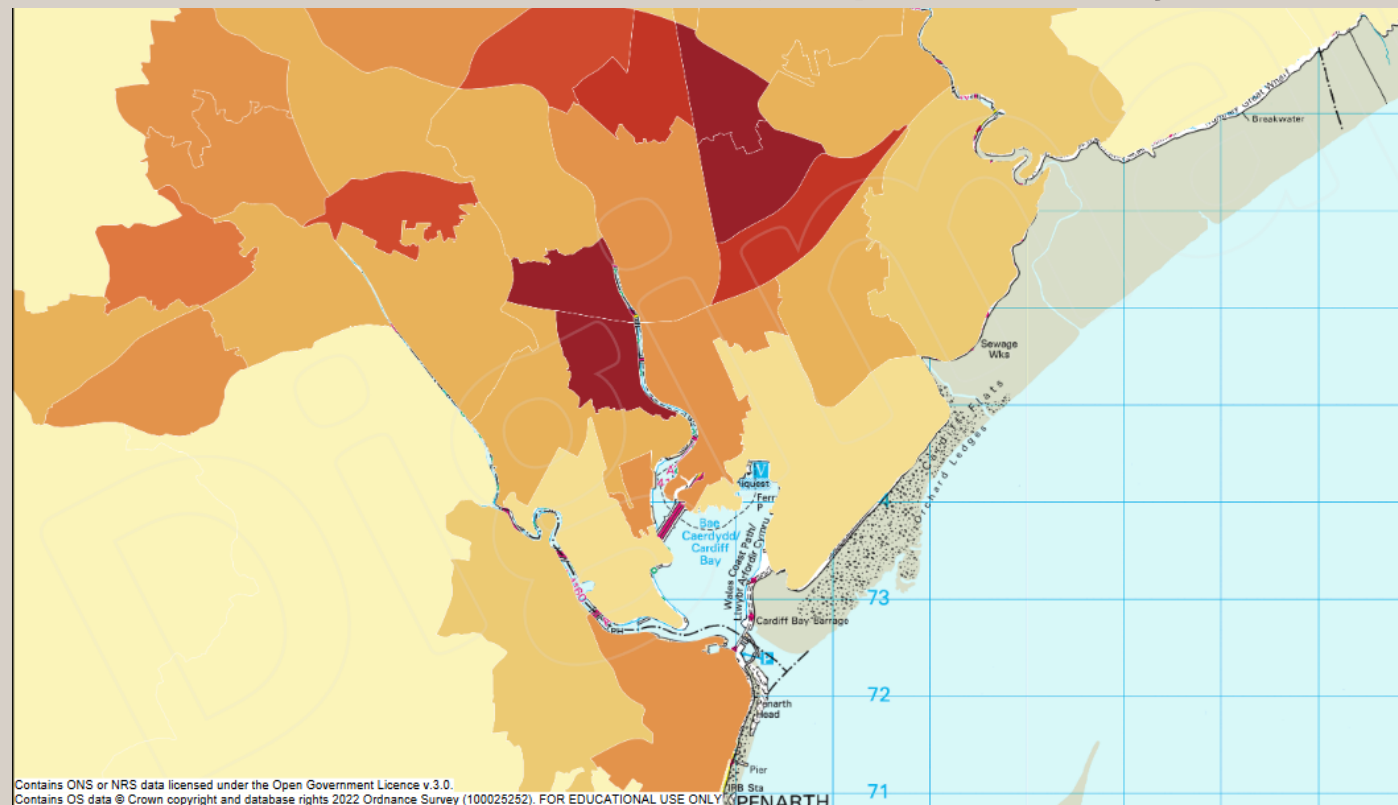


When I came to bring my design out of the concept stage I considered how I could convey a futuristic Wales through an exhibition stage - and I found the Modernist pavilions used in exhibitions to be a good case study for this. Here I especially liked the way the floor spirals down around a focal point - something I could make in conjunction with the amphitheatre design.

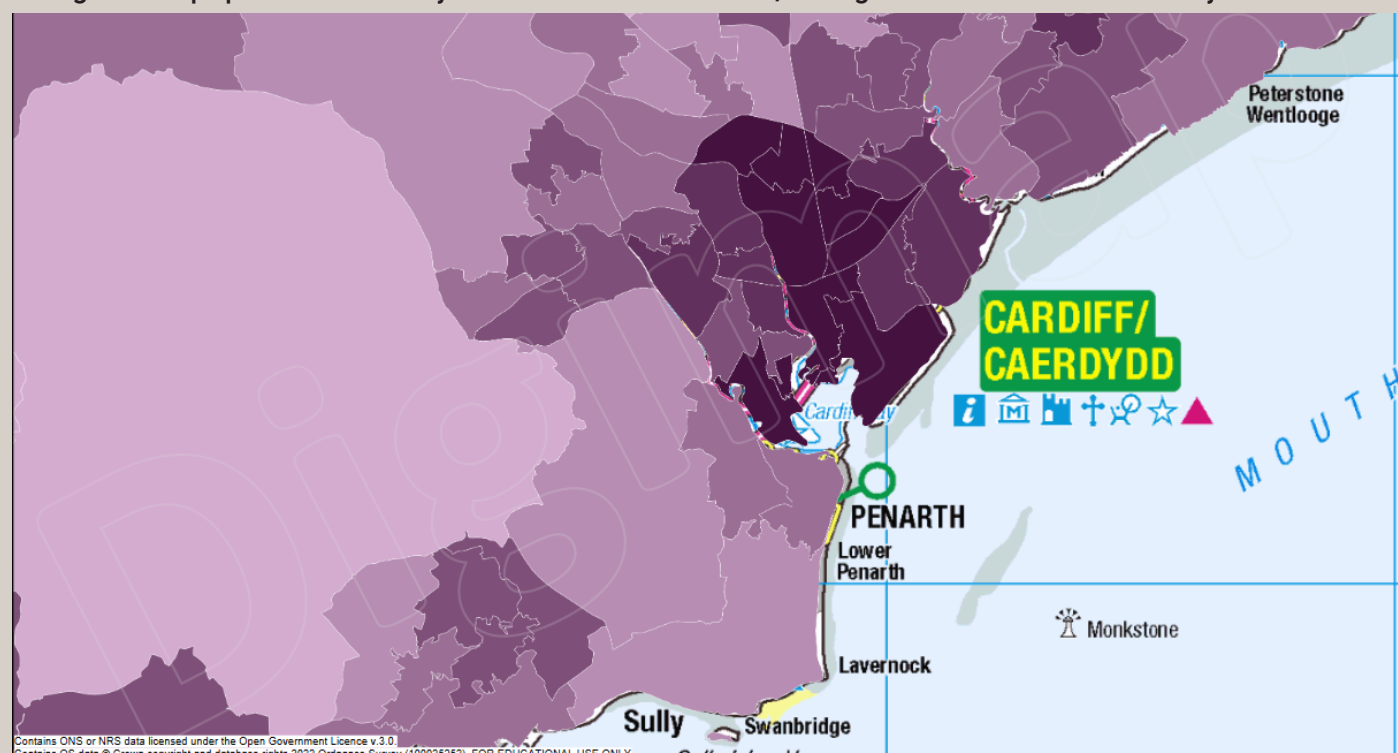


## DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

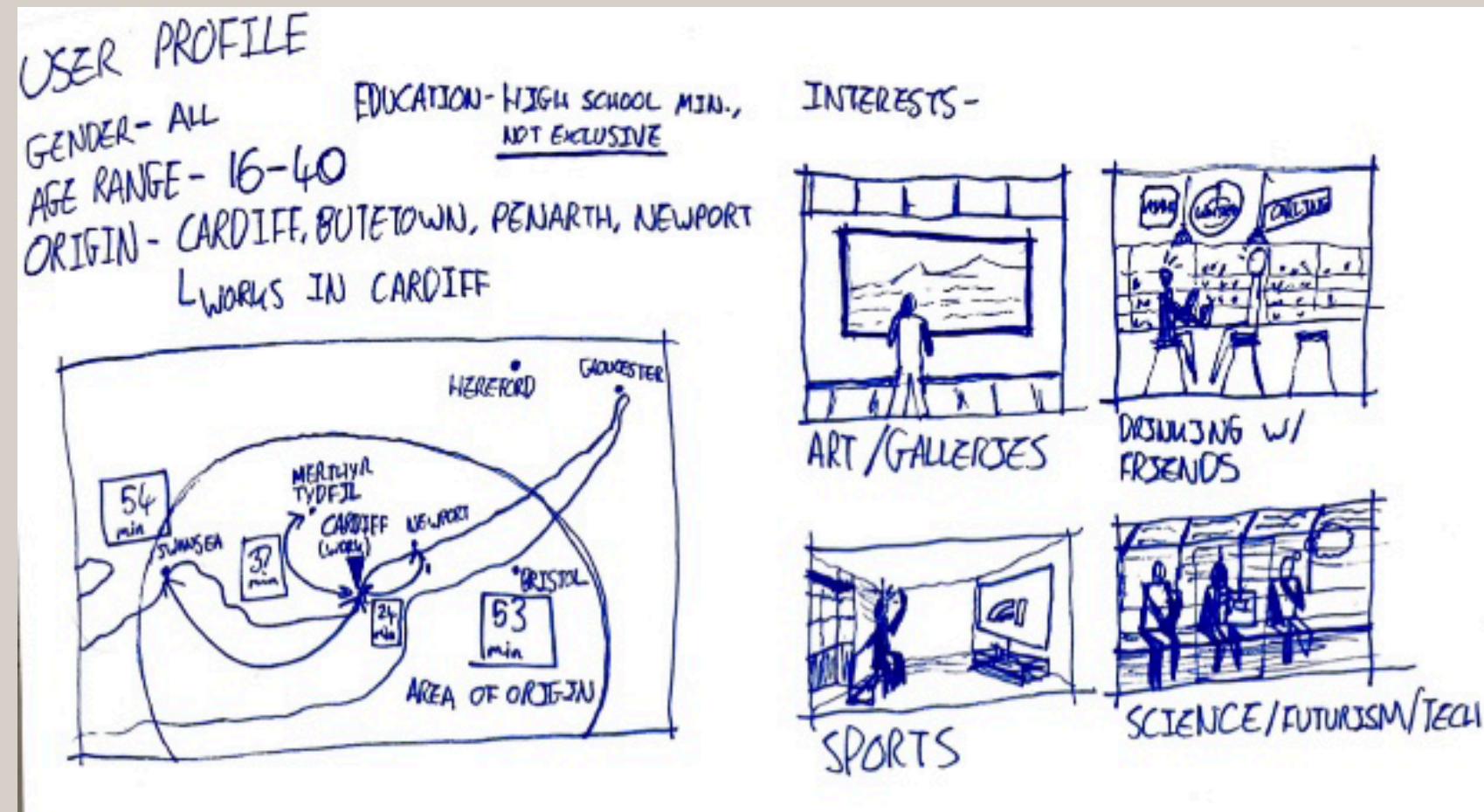
# User Profile and Demographic Analysis



The general population density of Cardiff - darker red/orange indicates more density.



The population density of 16-34 year olds in Cardiff - this population strata is much more dense near the Bay and so will likely be my main client.



I have chosen to exhibit futuristic/contemporary art and sculpture as a part of this stage's place in the Eisteddfod festival - as it is an existing part of the Eisteddfod (Y Lle Celf), and it caters best to the objective of my scheme and to the target user.

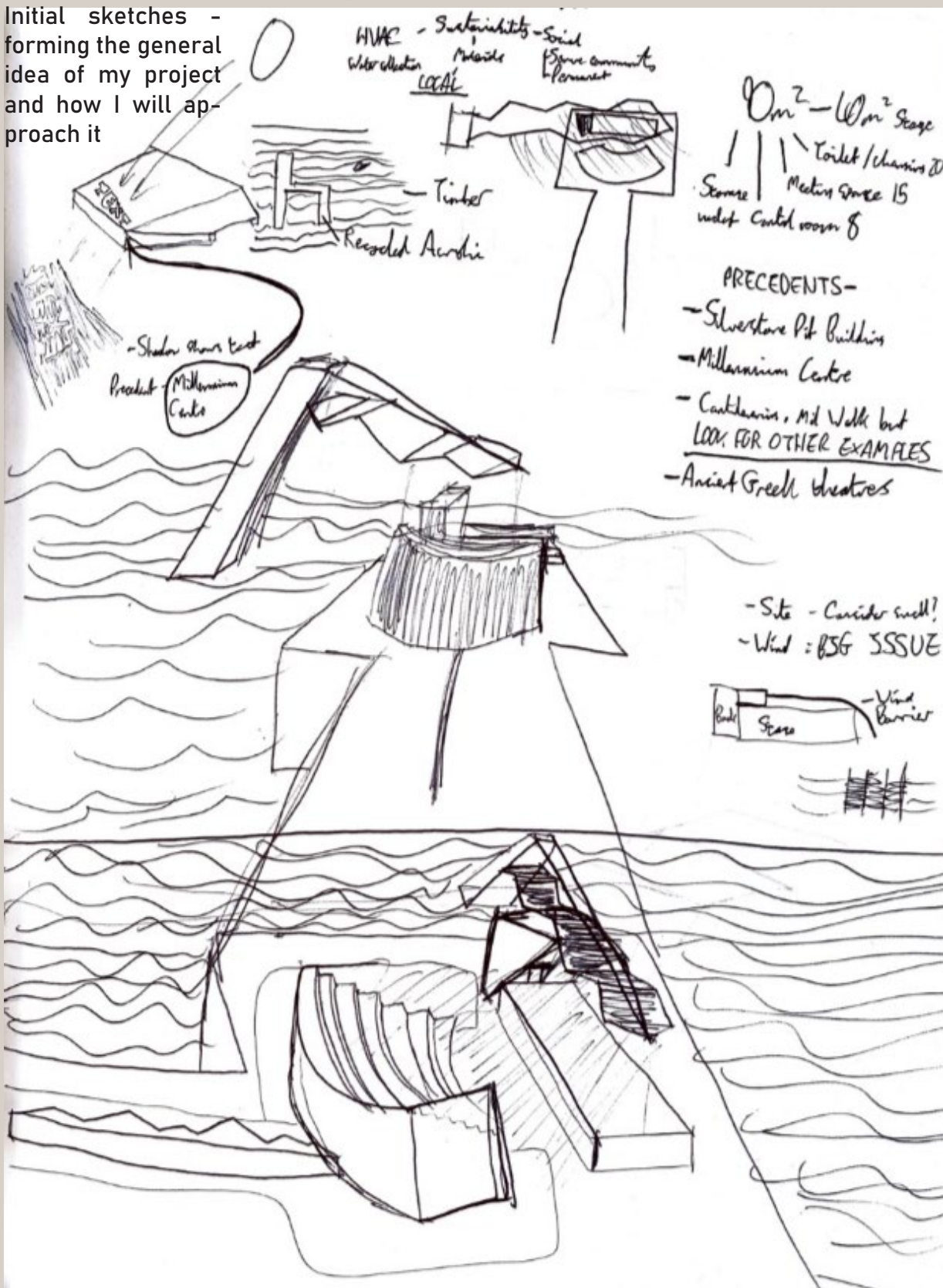


# DP4 Urban Stage

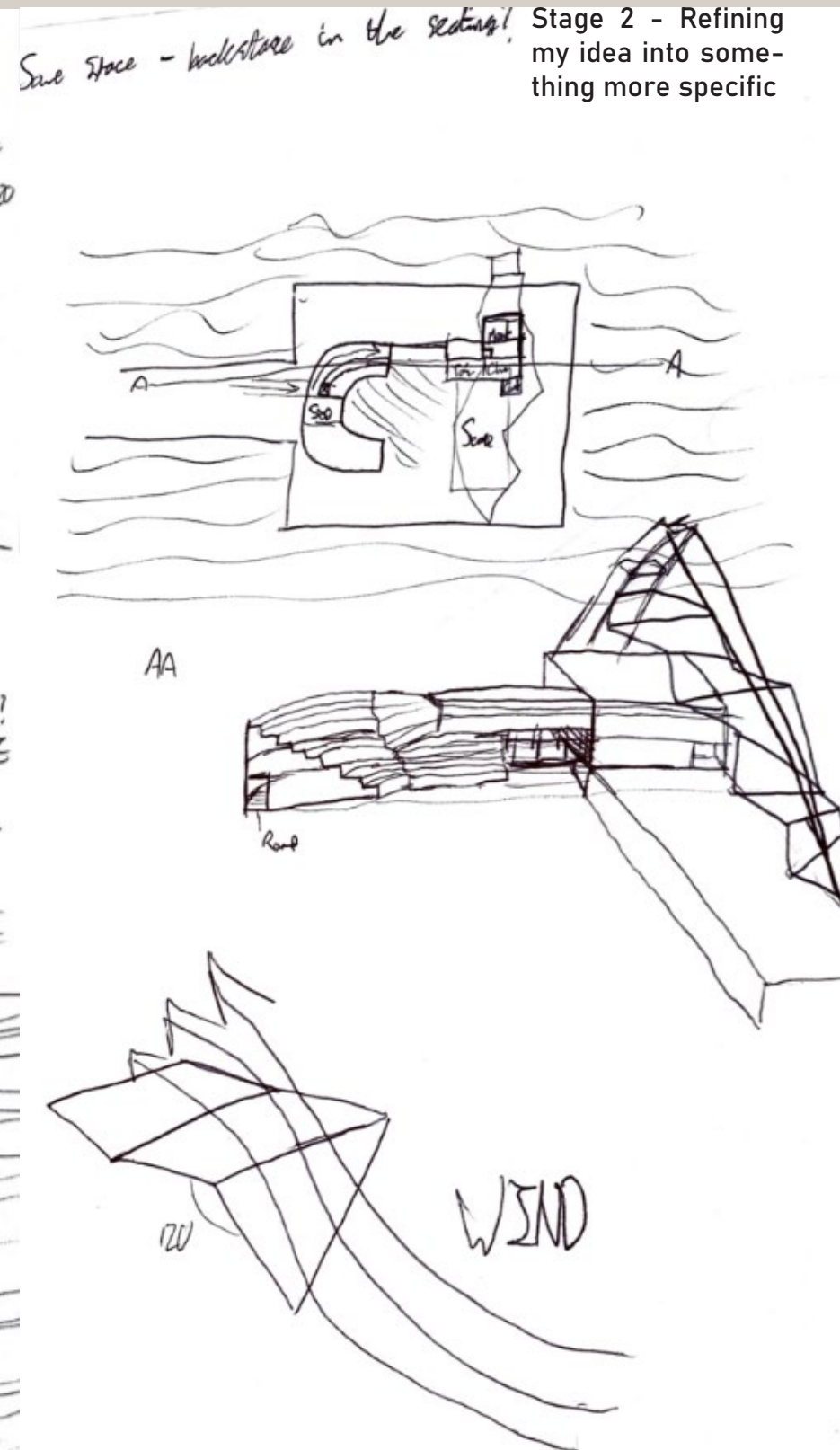
"How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?"

## Initial Concept - Sketches

Initial sketches - forming the general idea of my project and how I will approach it



Stage 2 - Refining my idea into something more specific



Backstage req.:

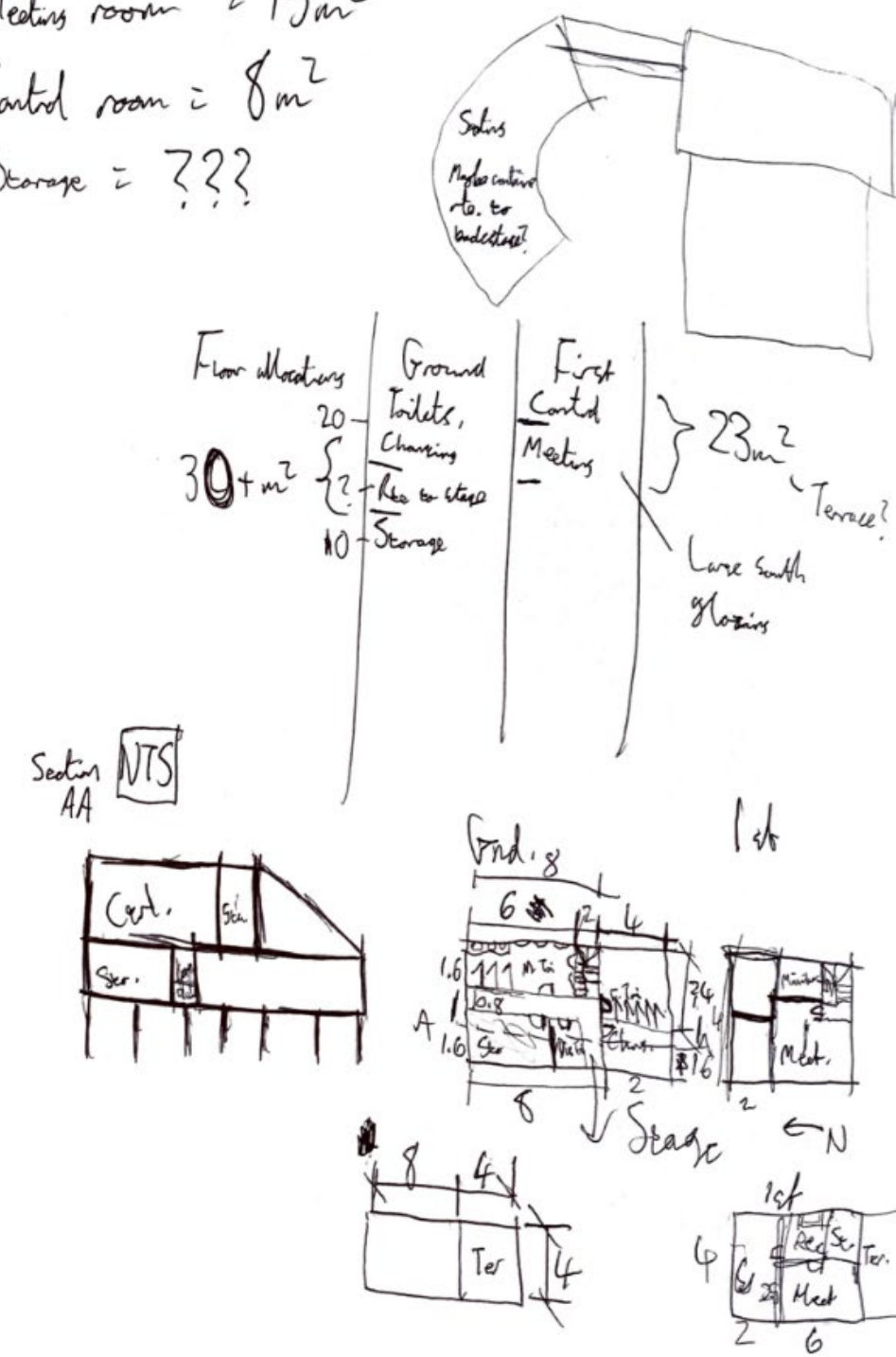
Toilets & Changing = 20m<sup>2</sup>

Meeting room = 15m<sup>2</sup>

Control room = 8m<sup>2</sup>

Storage = ???

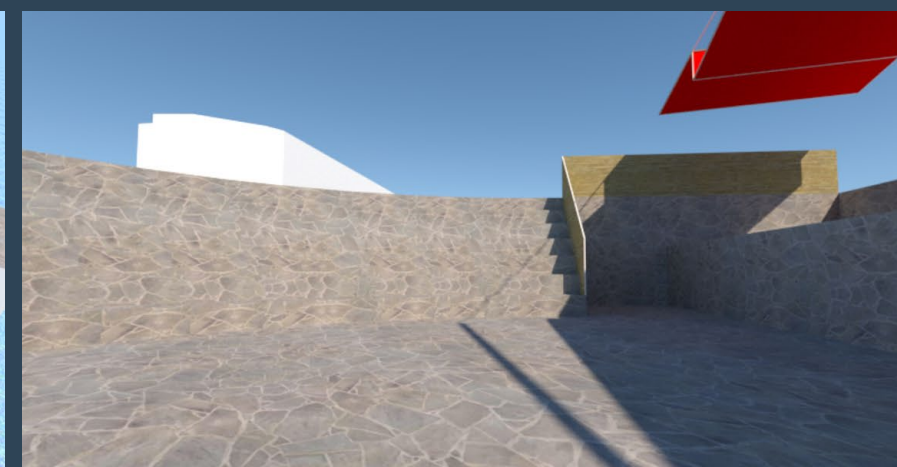
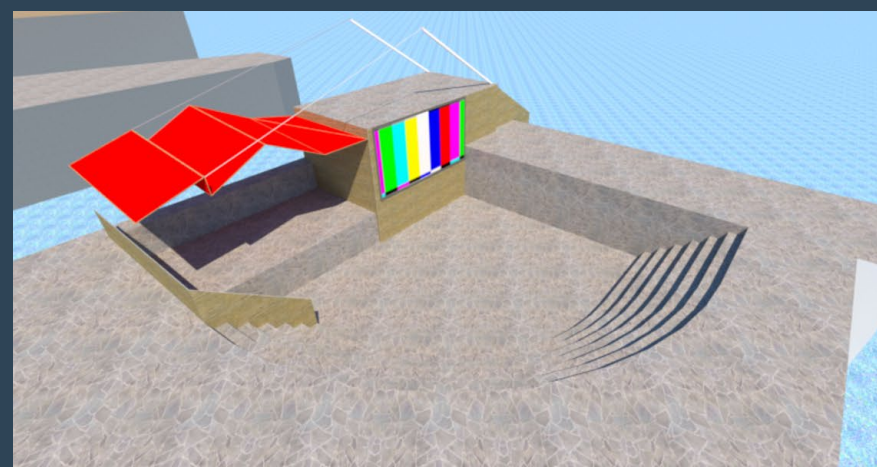
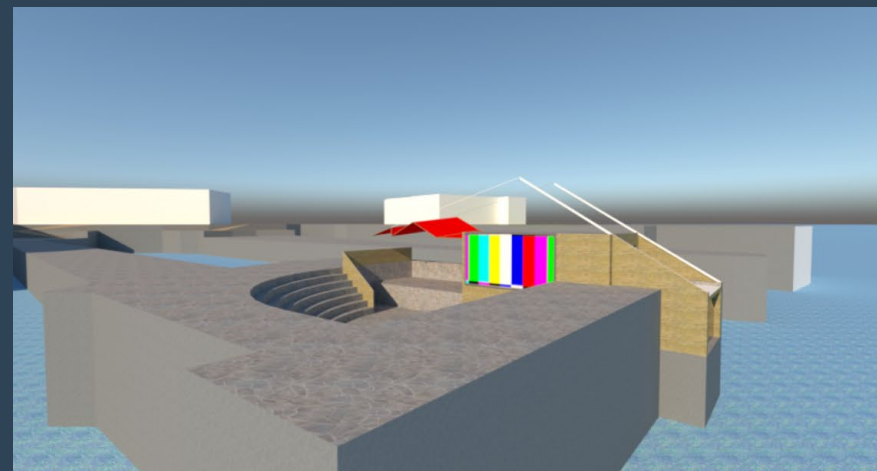
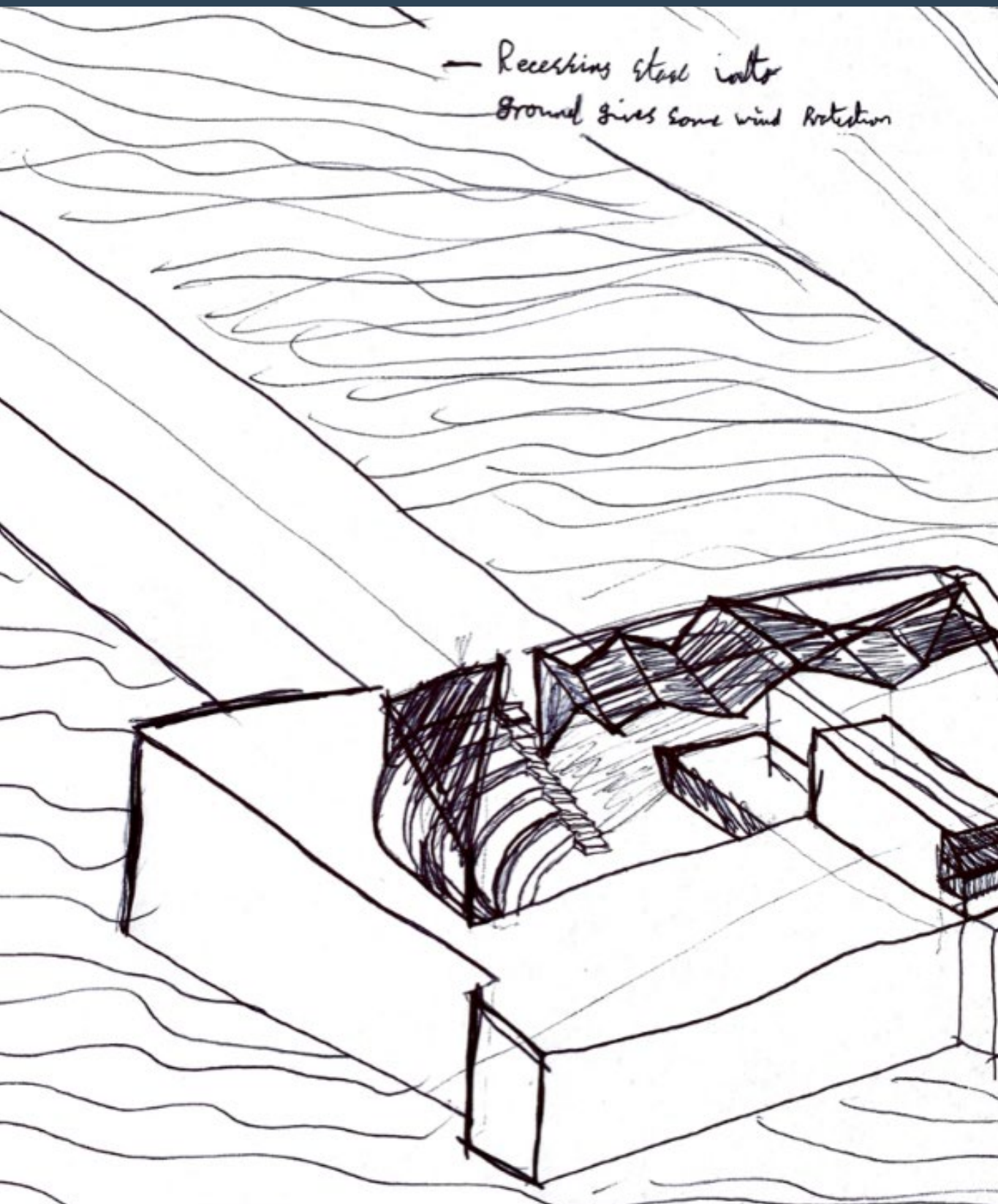
Stage 3 - Introducing constraints and adjusting accordingly



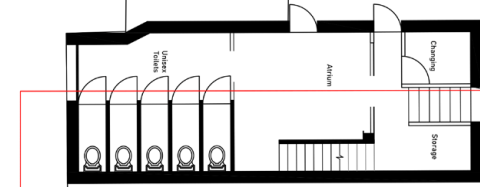


# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

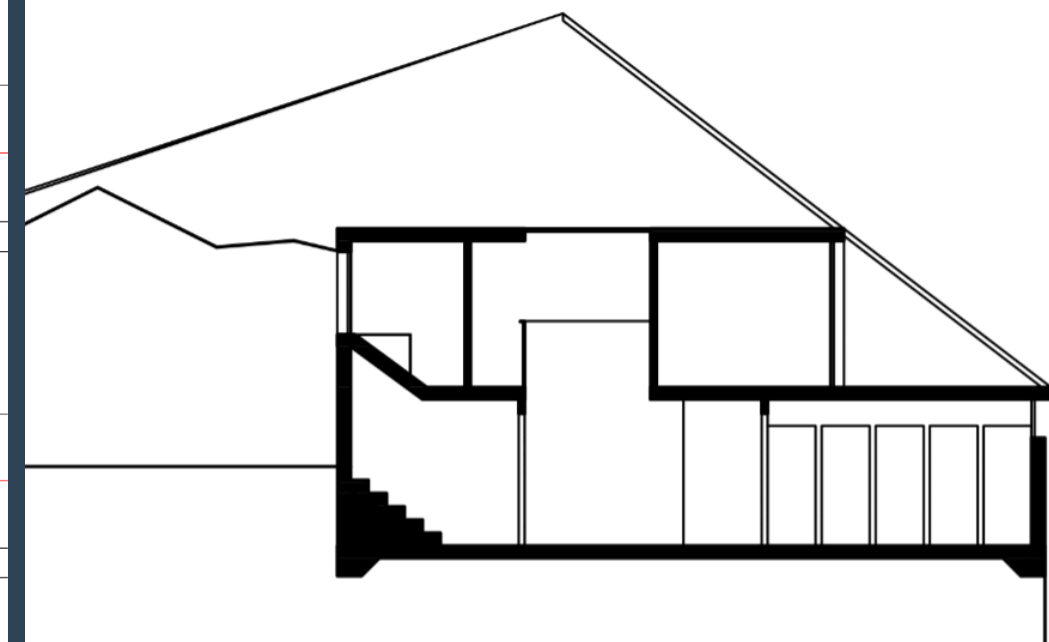
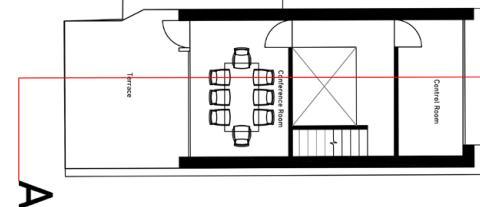
## Initial Concept - Sketches & First Drawings/ Renders



Ground Floor - Initial Plan (Not to scale)



Level 1 - Initial Plan (Not to scale)

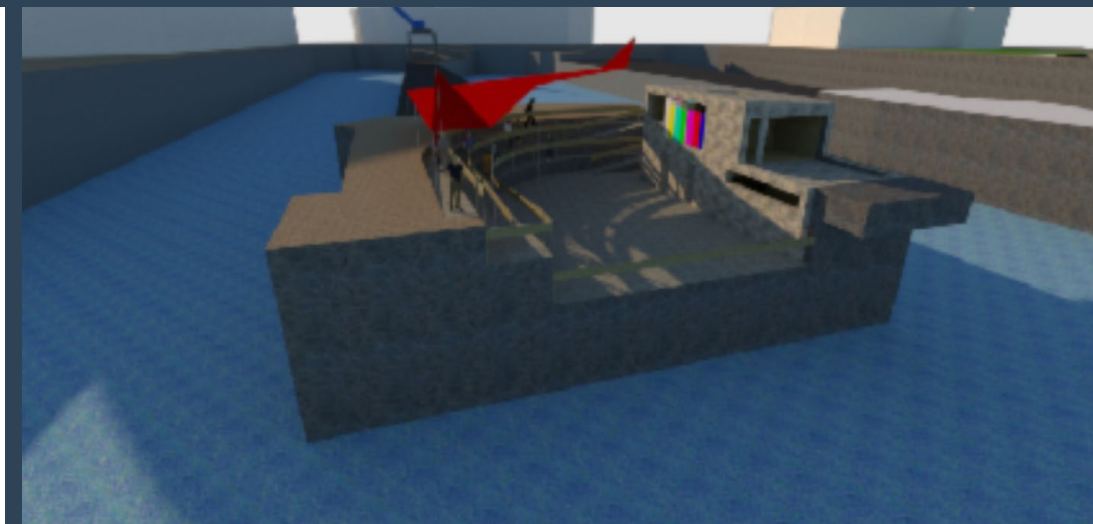
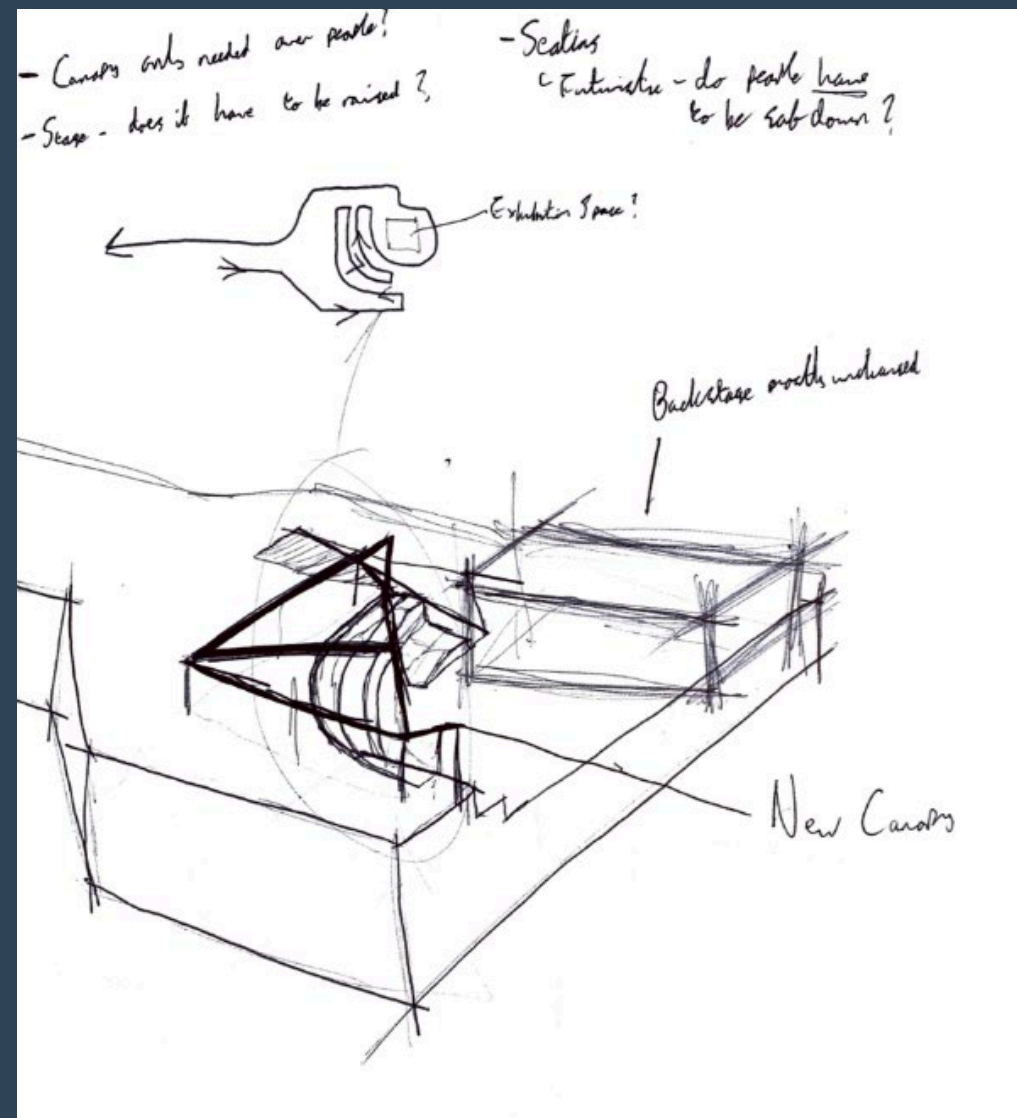




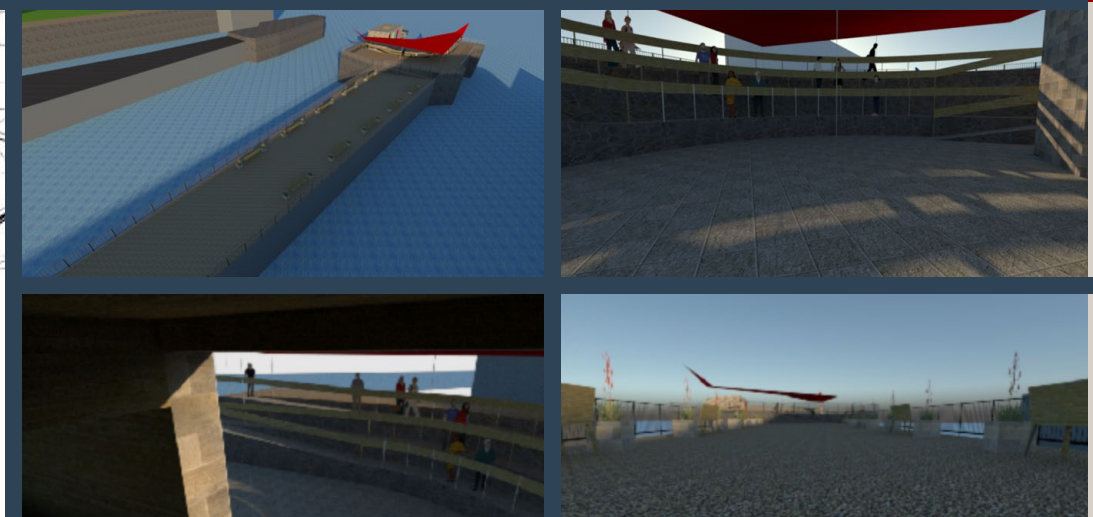
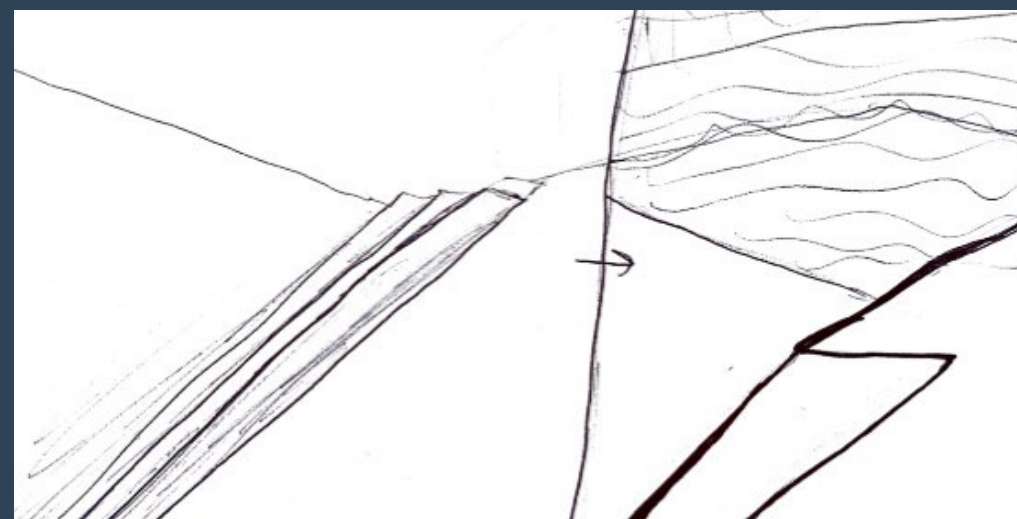
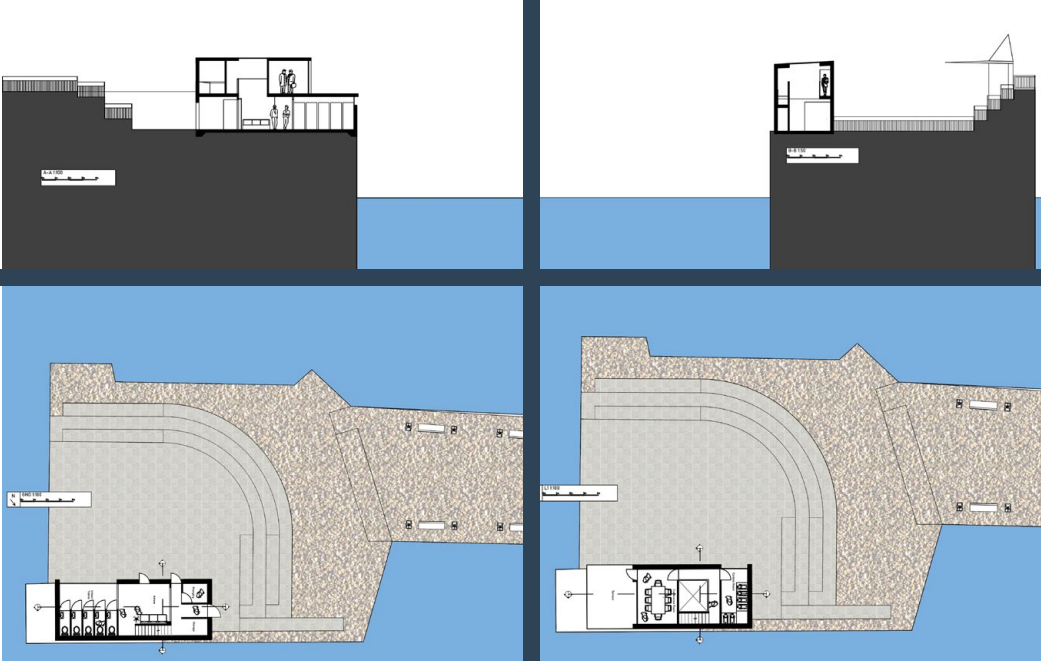
# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

## First Iteration - Sketches and Renders

- Canopy changed to shelter people instead
- Seating design changed - more representative of futuristic theme, based on late modernist exhibition spaces (Precedent C)
- Steps to dock 'head' redeveloped into a ramp for accessibility
- Backstage moved to be in a realistic position after Google Earth observation of site
- Fenestration moved and enlarged to offer control room views of stage (which was moved to a place that emphasised the 'focal point' idea)



Development drawings, Not to Scale



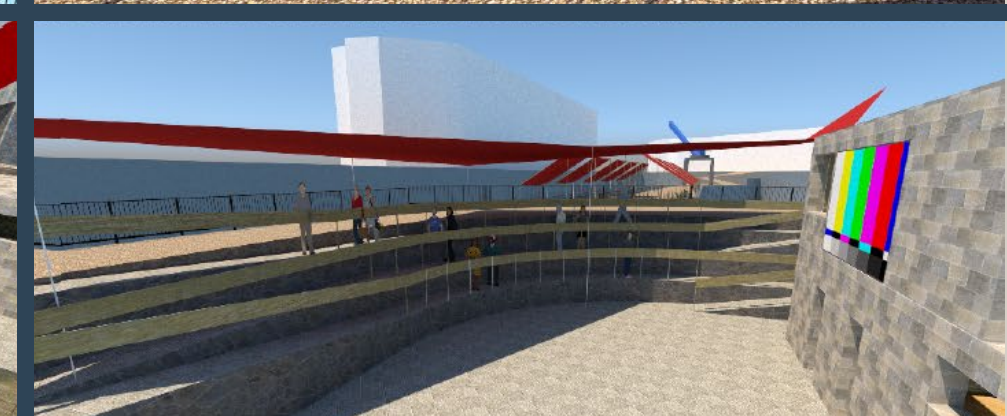
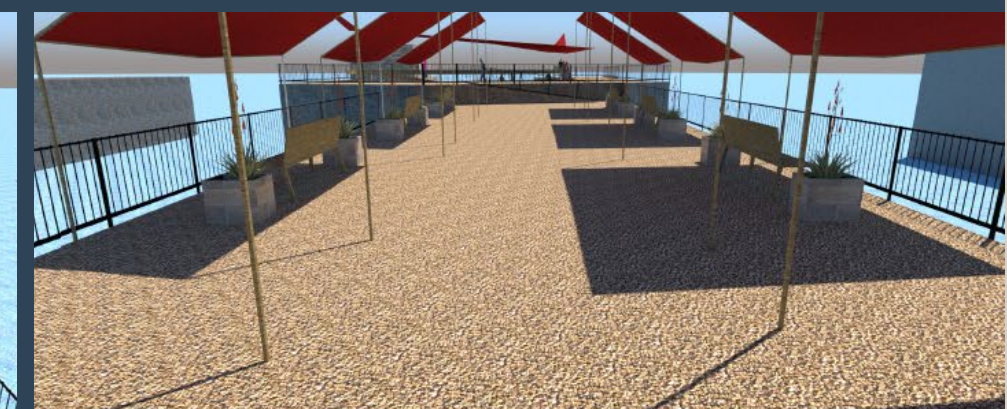
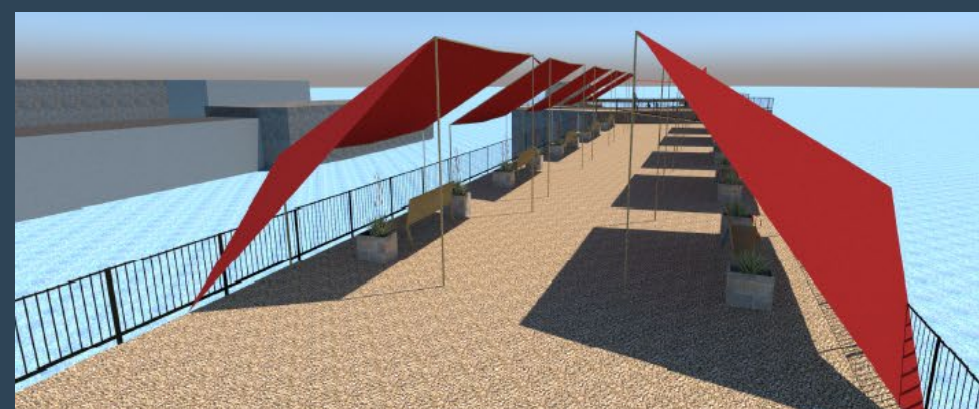
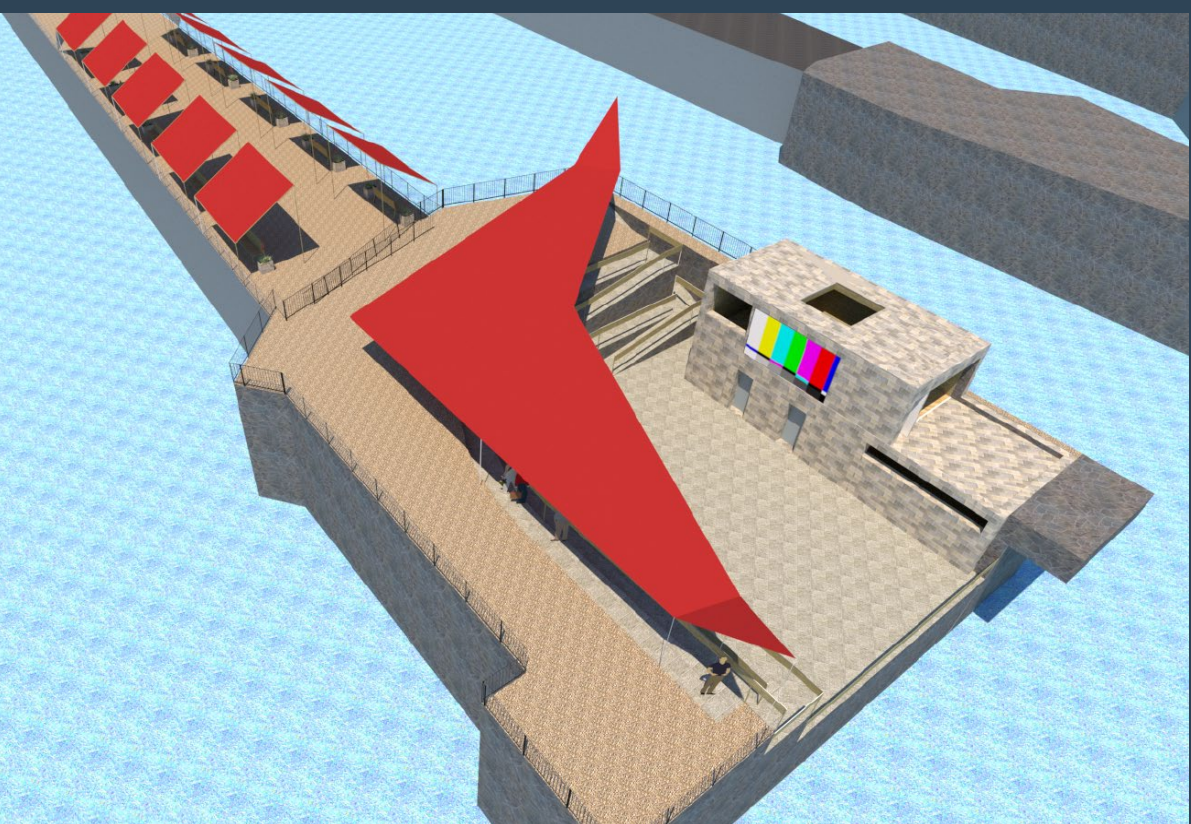
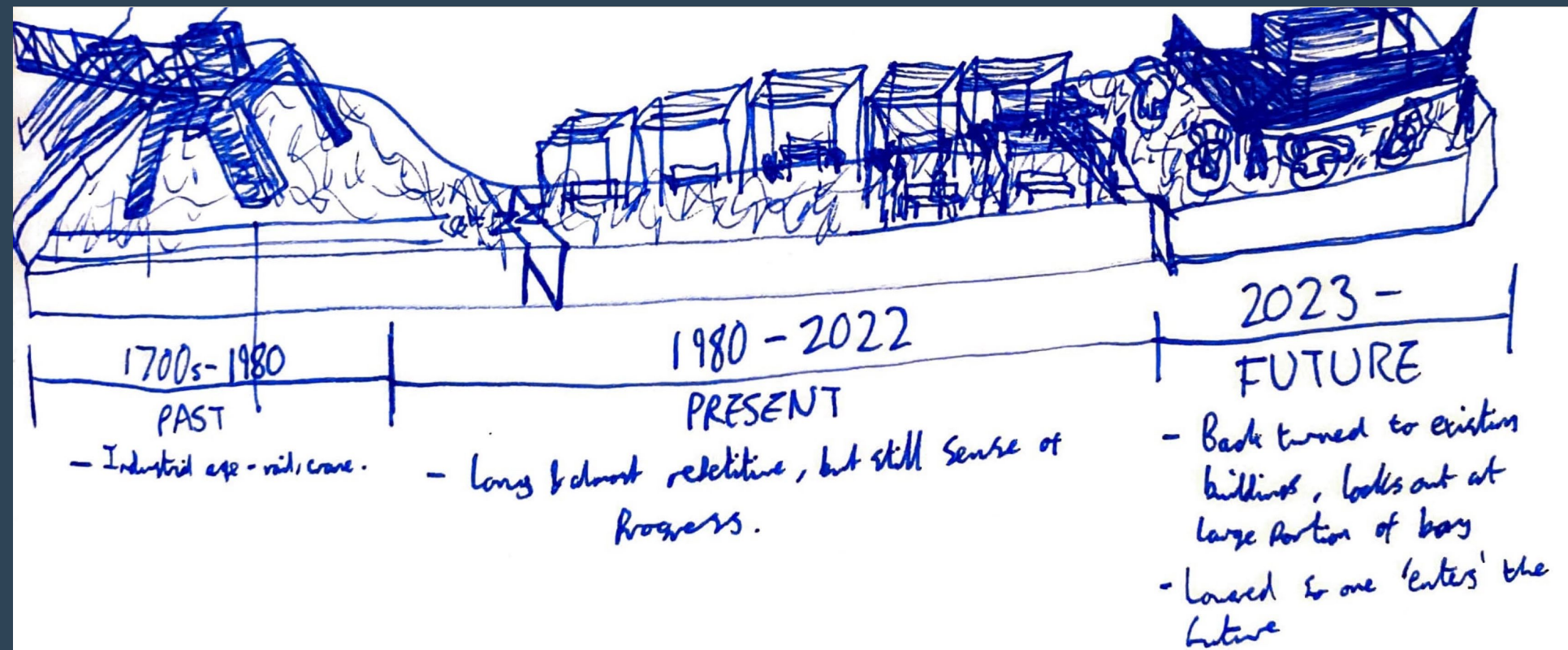


# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

## Second Iteration - Sketches and Renders

-Added benches and canopies over said benches along the walk also, in order to promote gathering and attract more to the stage

-Emphasises the idea of ‘entering’ the future, length of path implies the everyday and the present





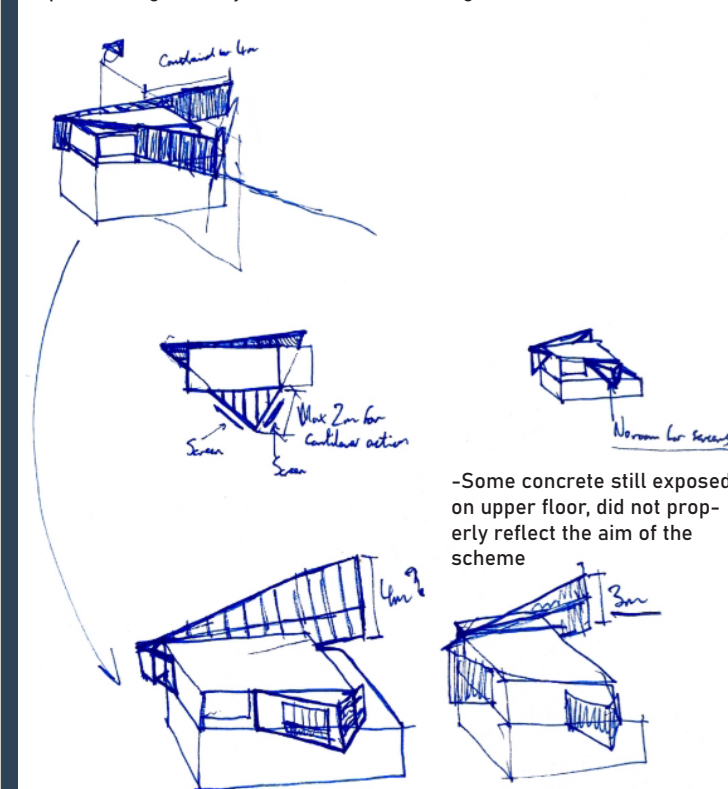
# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

## Third and Post-Crit Iterations - Sketches and Renders

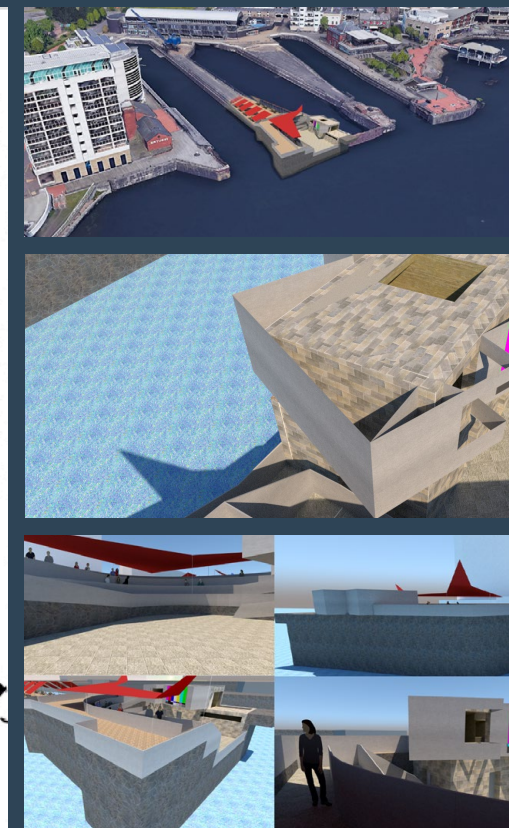
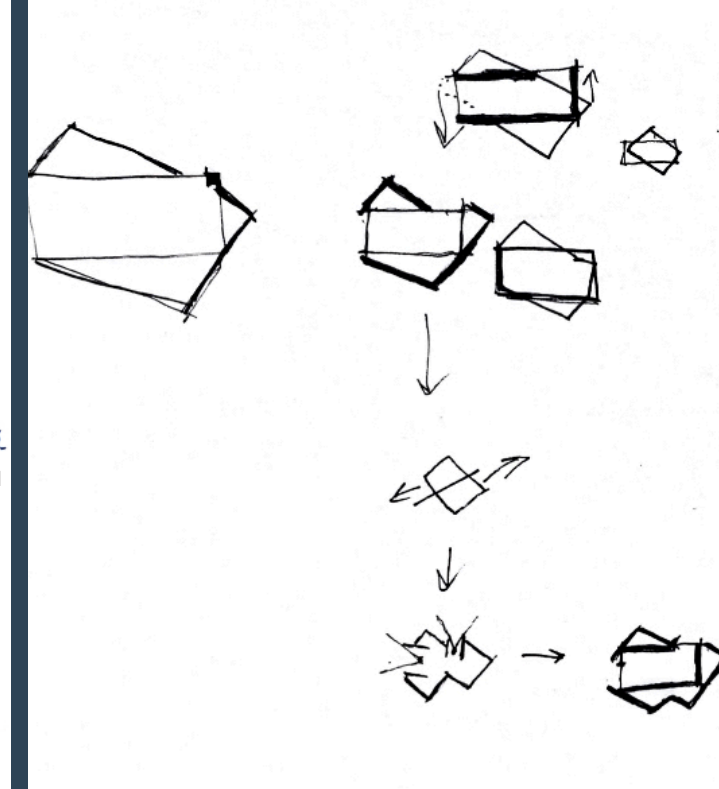
### Third Iteration-

- Altered upper floor design of backstage to better reflect high-tech futuristic statement the scheme is meant to make
- Widened spiral walkways from 1000mm to 1250mm to improve ease of use, and all railings replaced with recycled aluminium.
- Exit ramp from stage opened up to offer water views and improved safety, from being less hidden.

Step 1 - Adding the recycled aluminium cladding

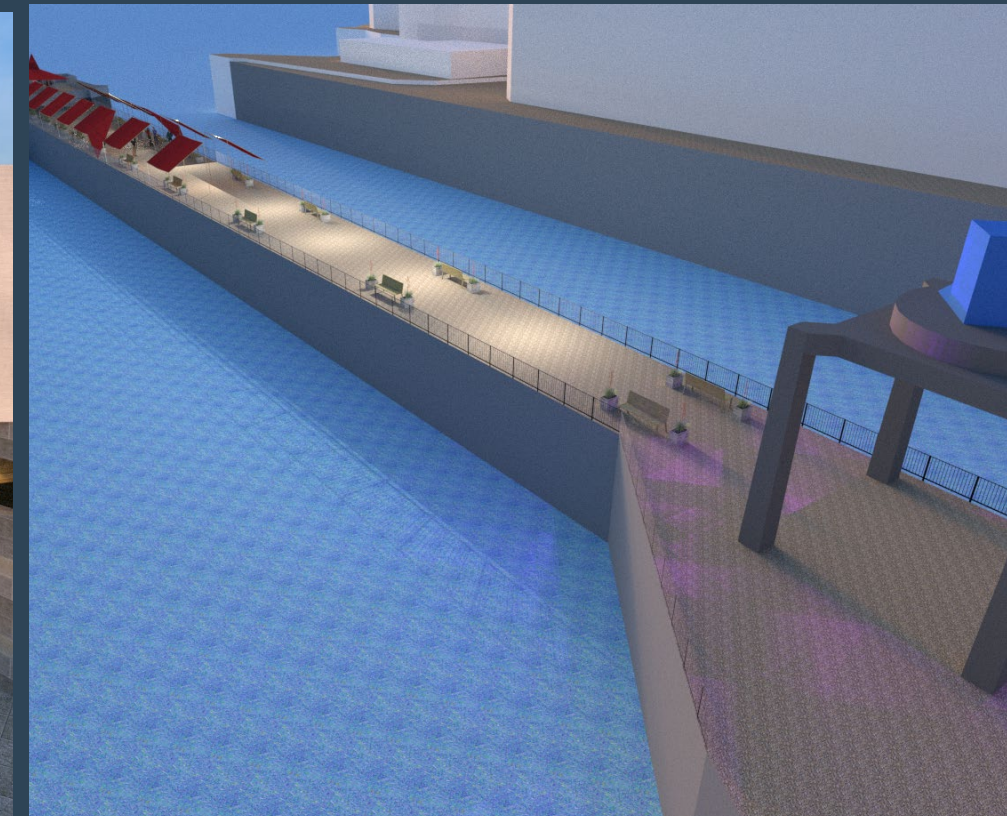


Step 2 - Hiding all upper floor concrete



### Post-Crit Iteration-

- Added beacons around the designated 'stage' or 'exhibition area', in order to enhance the idea of the future as a beacon or object of intrigue.
- Spaced out the benches more to emphasise the idea of coming together, further preserving the spirit of the Eisteddfod festival beyond 2022.

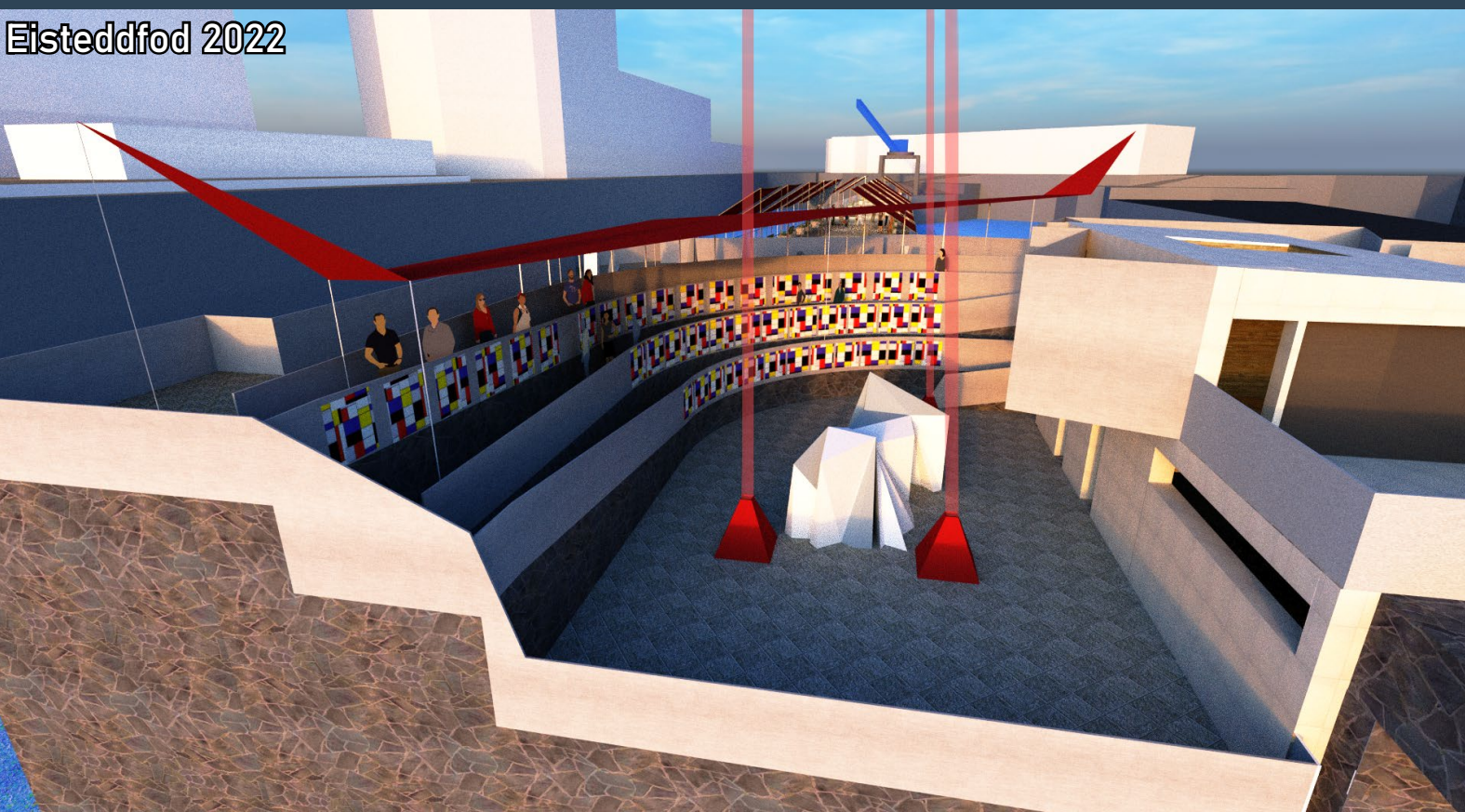




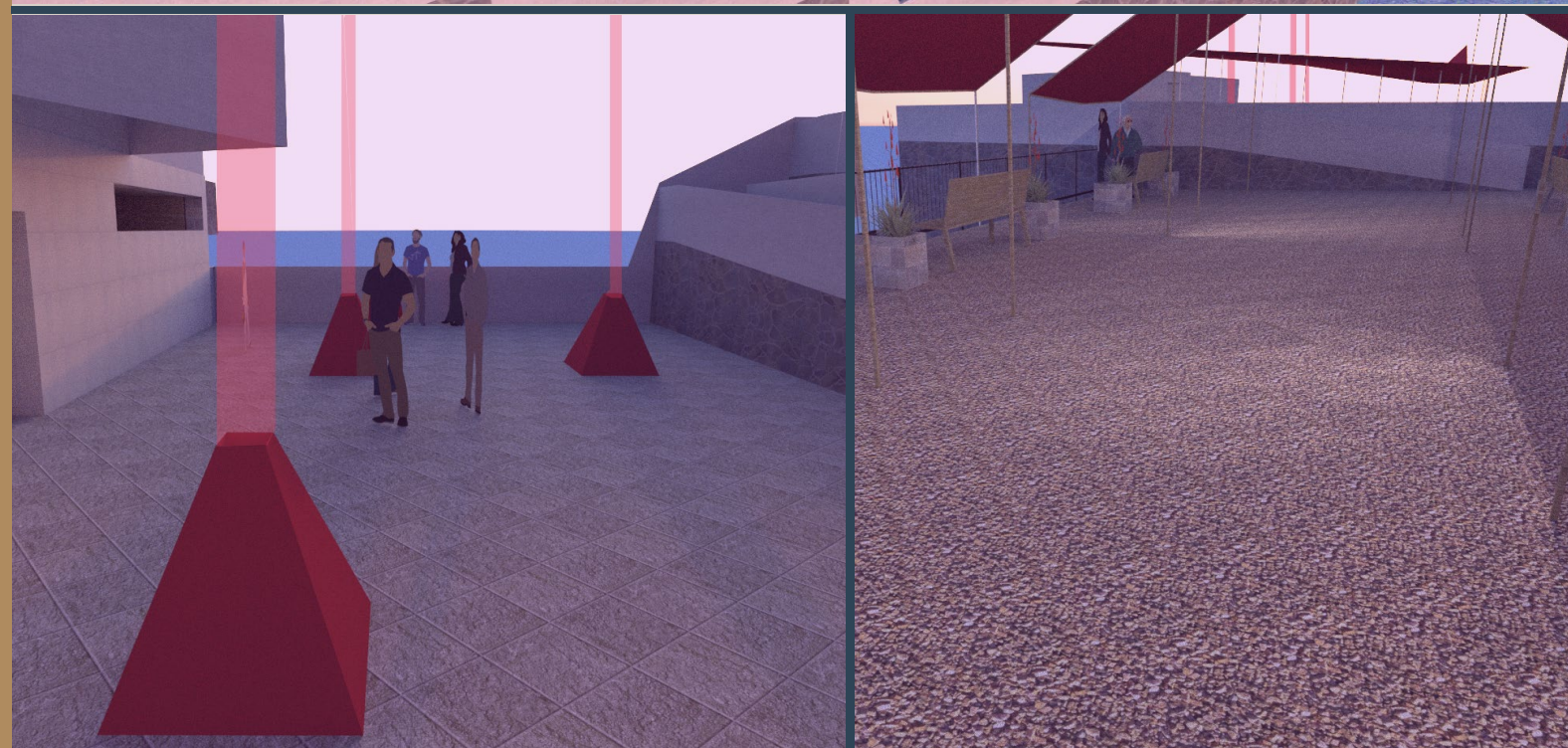
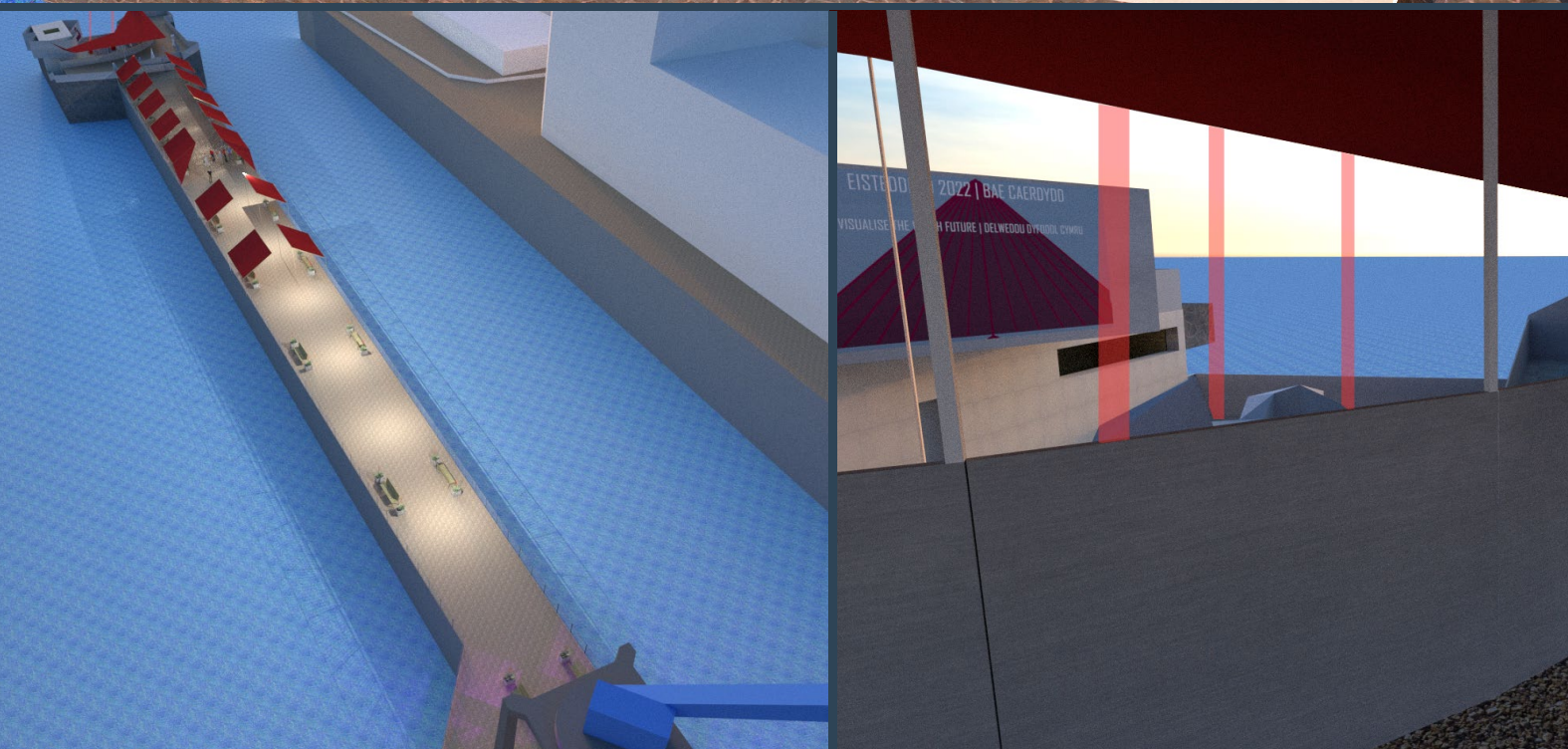
# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

## Final Proposal - Renders

Eisteddfod 2022



Public Square 2077

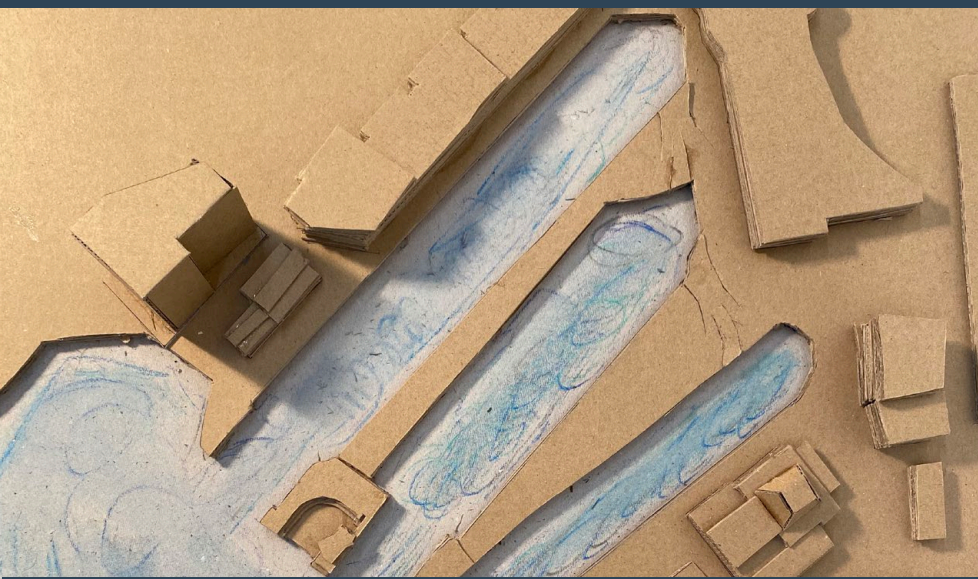




# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

## Final Proposal - Models

MACRO / 1:500 | SITE MODEL



ARCHITECTURAL / 1:100

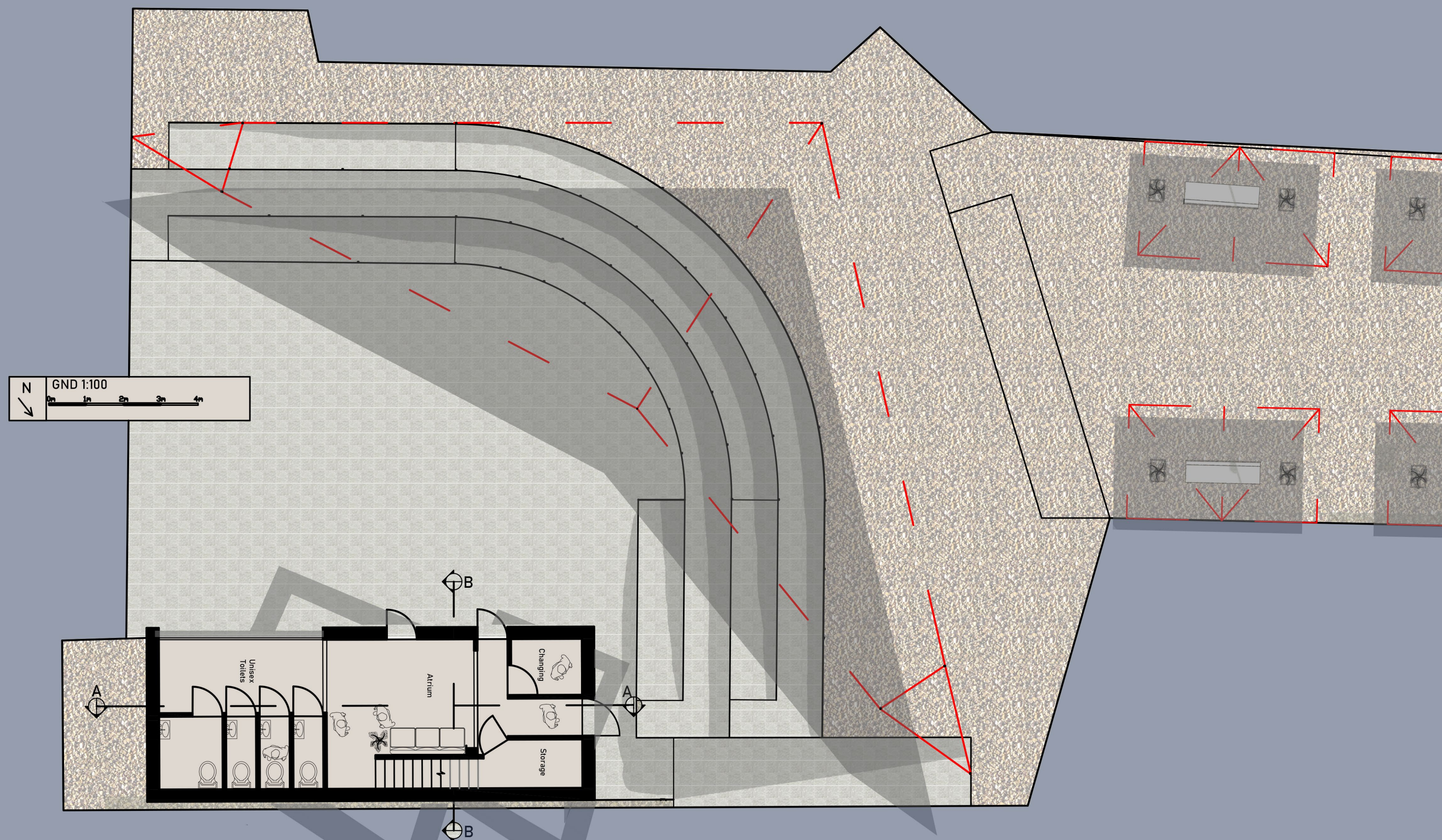


MICRO / 1:10 | TECTONIC MODEL



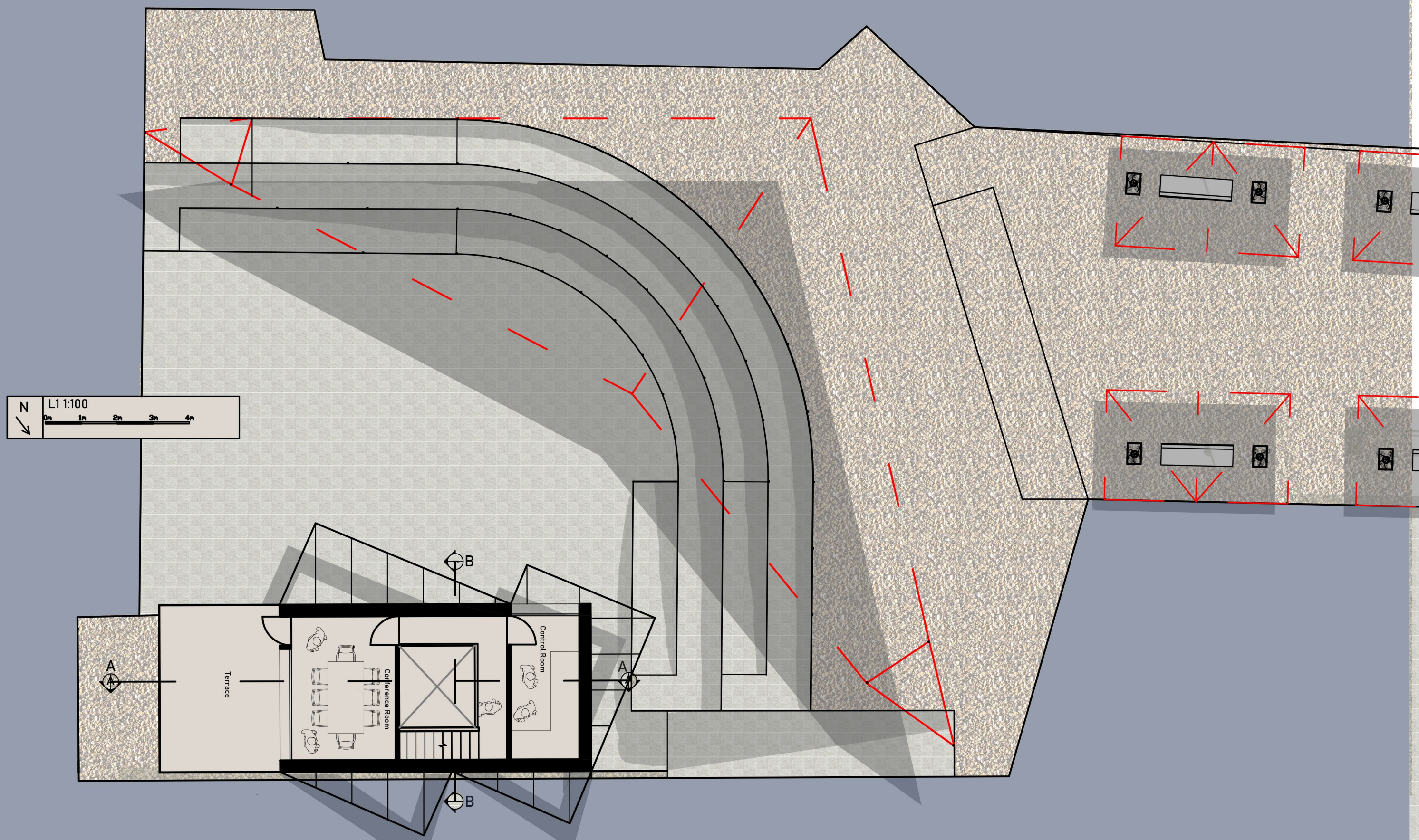


# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”



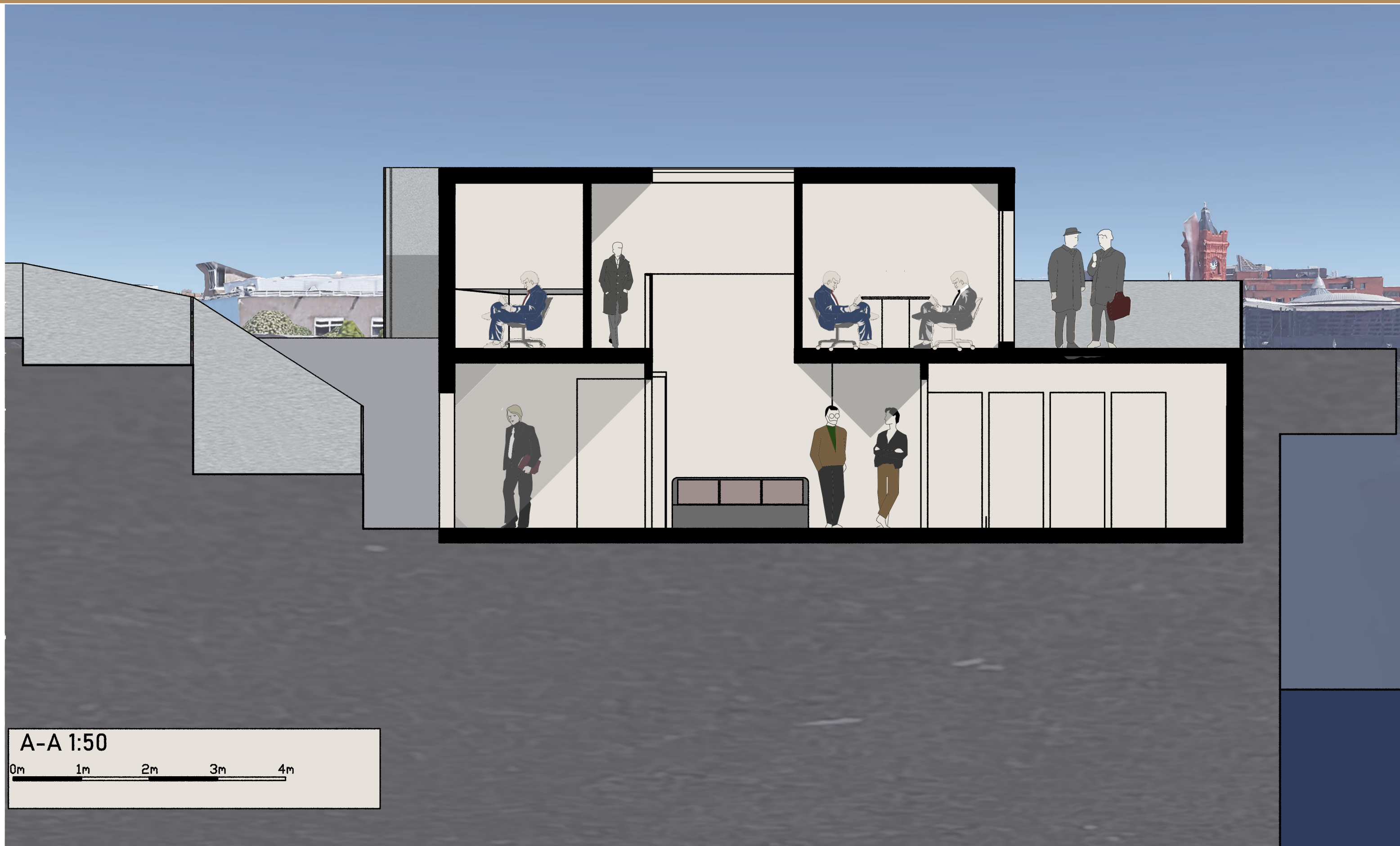


# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

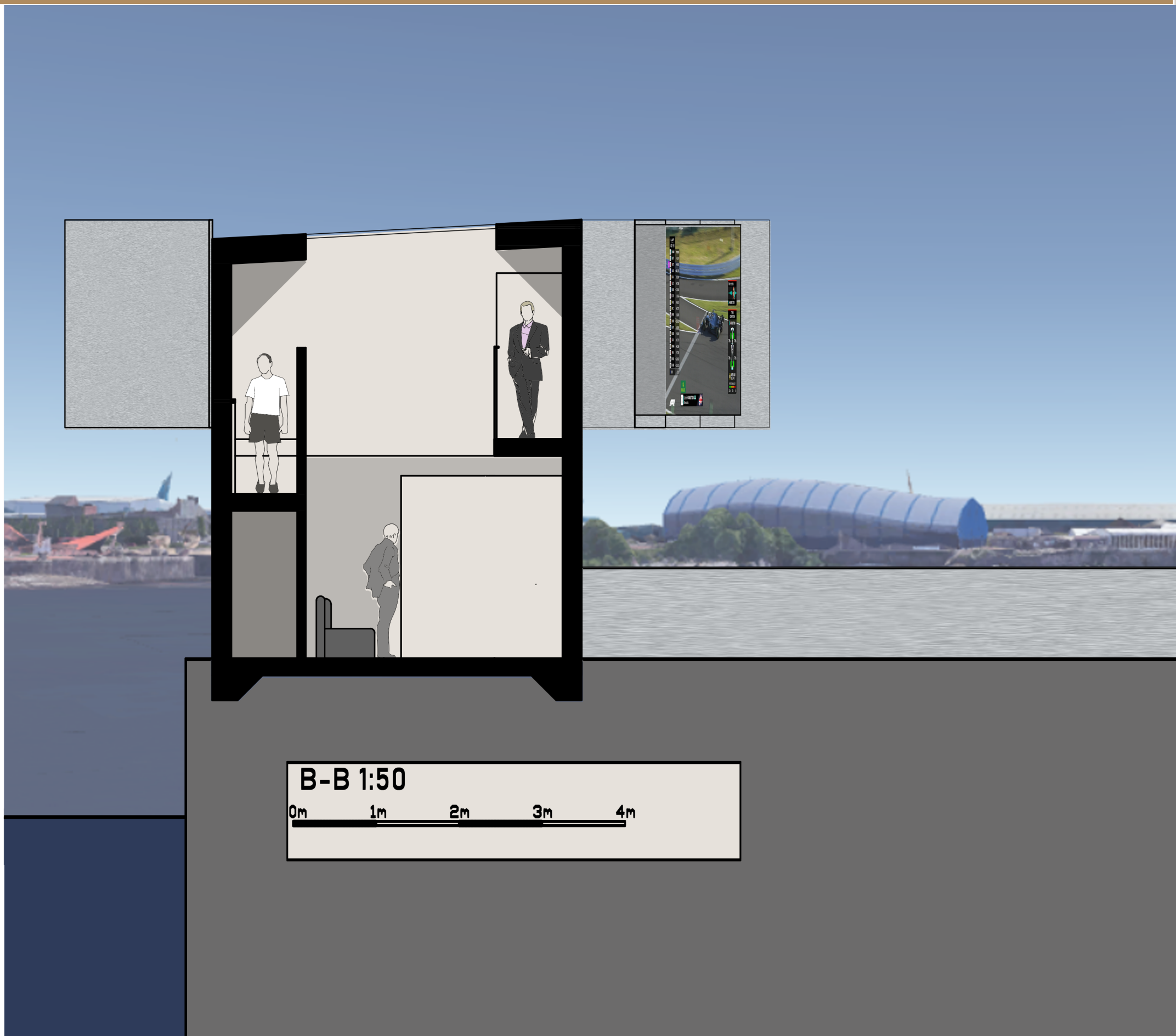
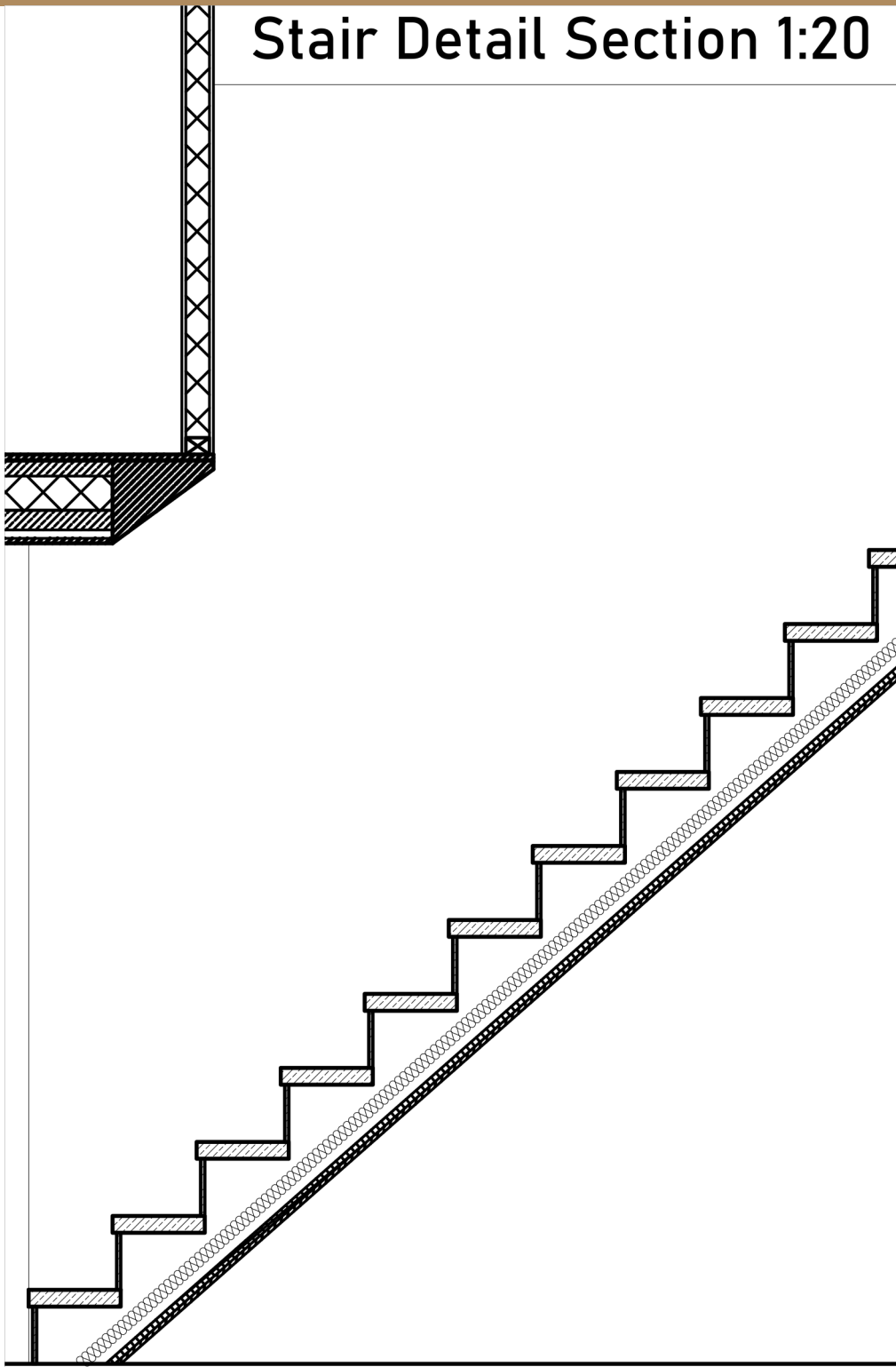




# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”

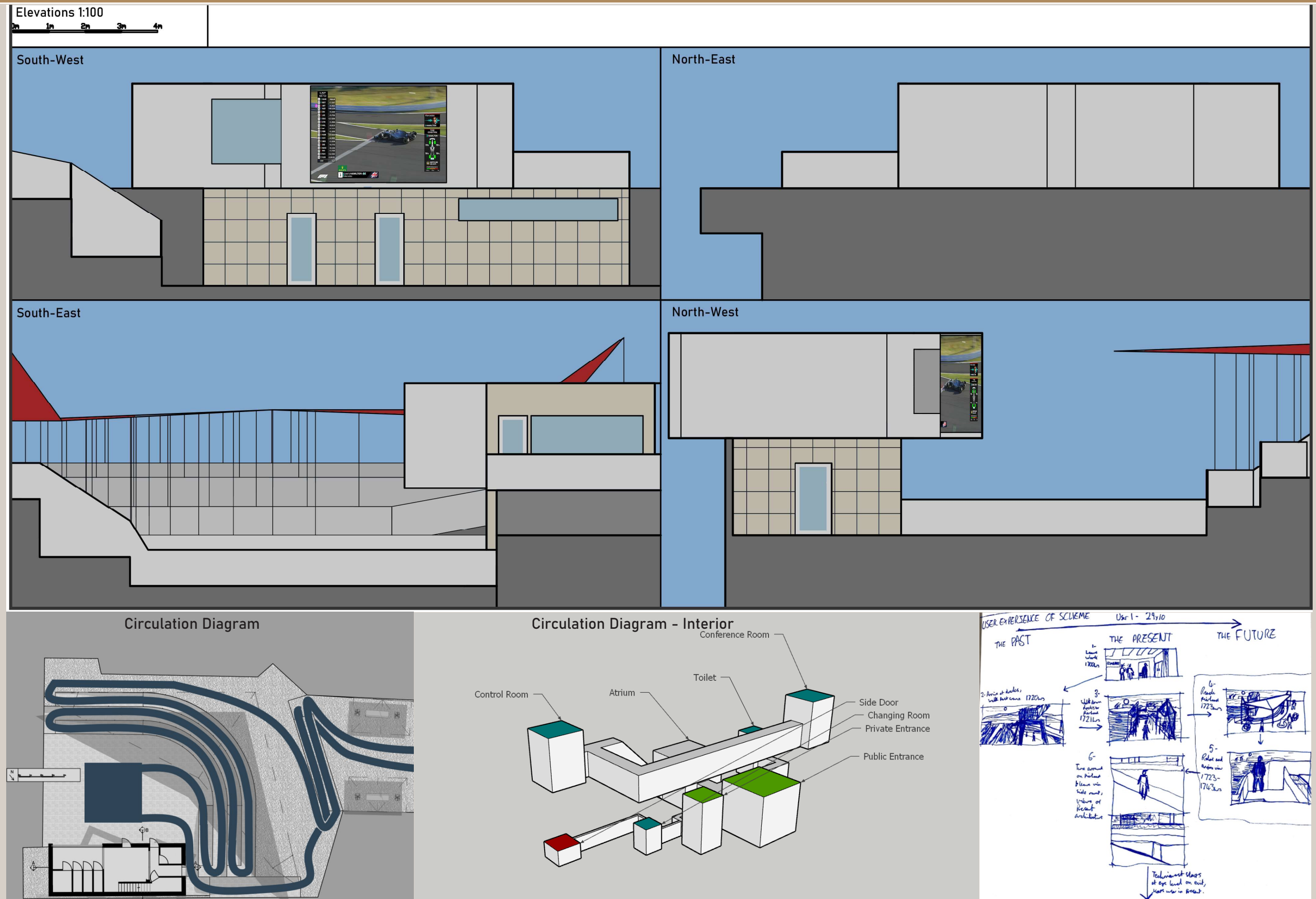








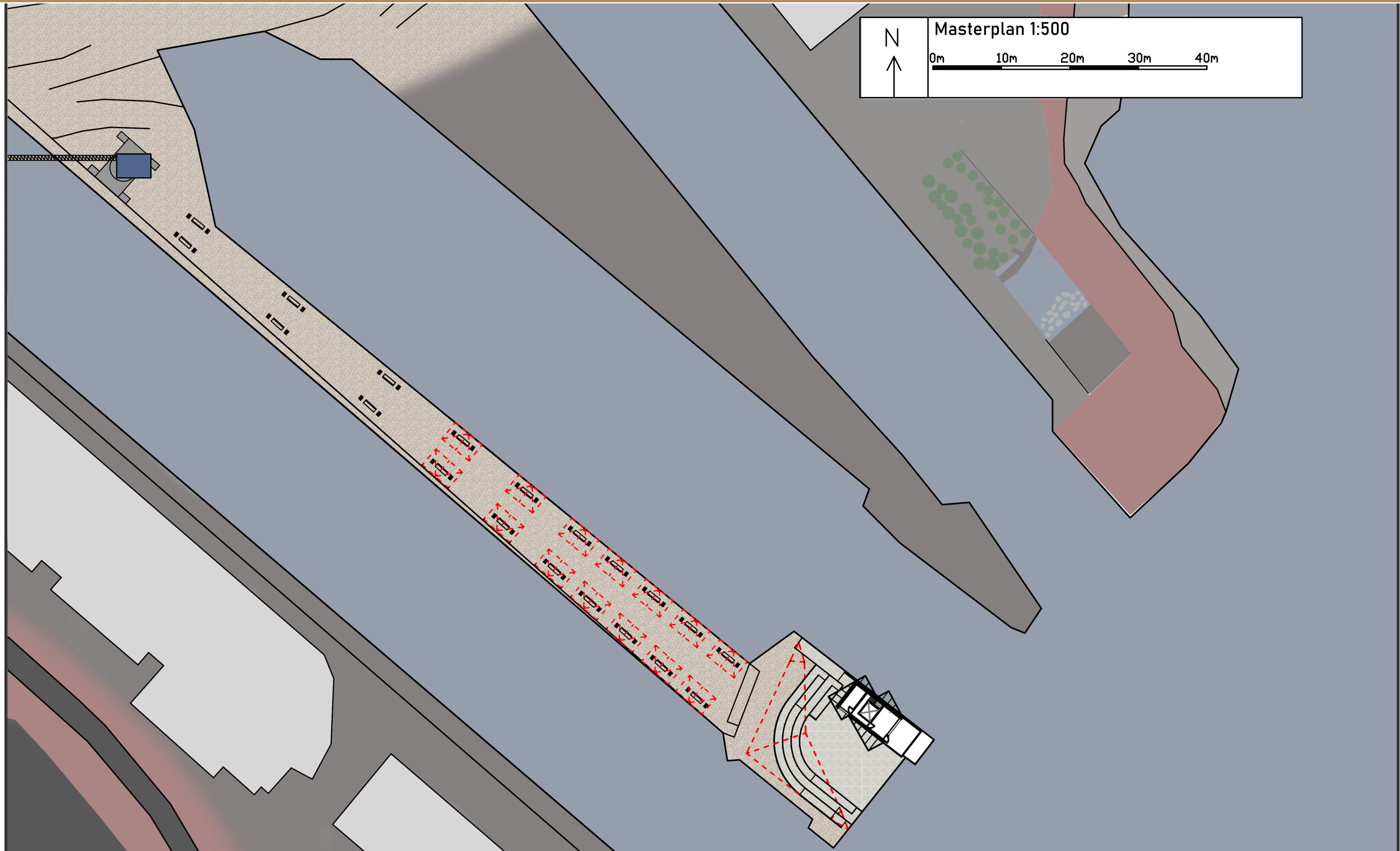
# DP4 Urban Stage | “How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”





# DP4 Urban Stage

“How can Welsh culture be displayed in a futuristic, quixotic and/or future aware way?”





# Technological Submission | Site Analysis [Amenities/Transport]

Design aim - To increase the extent of the public realm in a way that responds to the opportunities of the Bay, and to answer the question of how Welsh culture can be futuristically displayed.

## Local amenities - closest toilets, eatery, coffee and hotel.



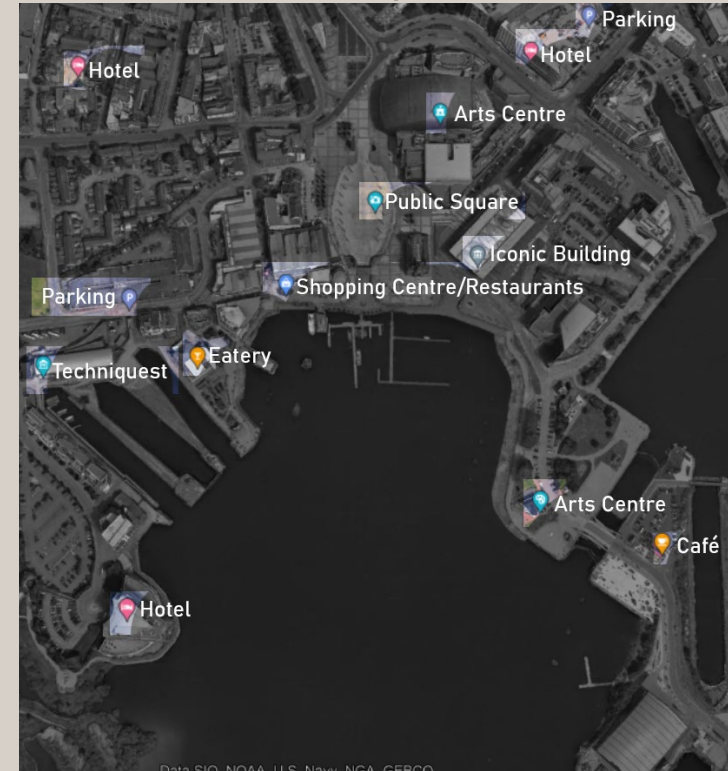
## Local public transport links - closest train station and bus stop.



## Parking opportunities in the relevant area



## Other amenities and places of interest



## What this means for my scheme:

-Toilets are inconveniently far away, so these must be provided.

-The site has good access for pedestrians, and any parking/public transport links are at reasonable distances.

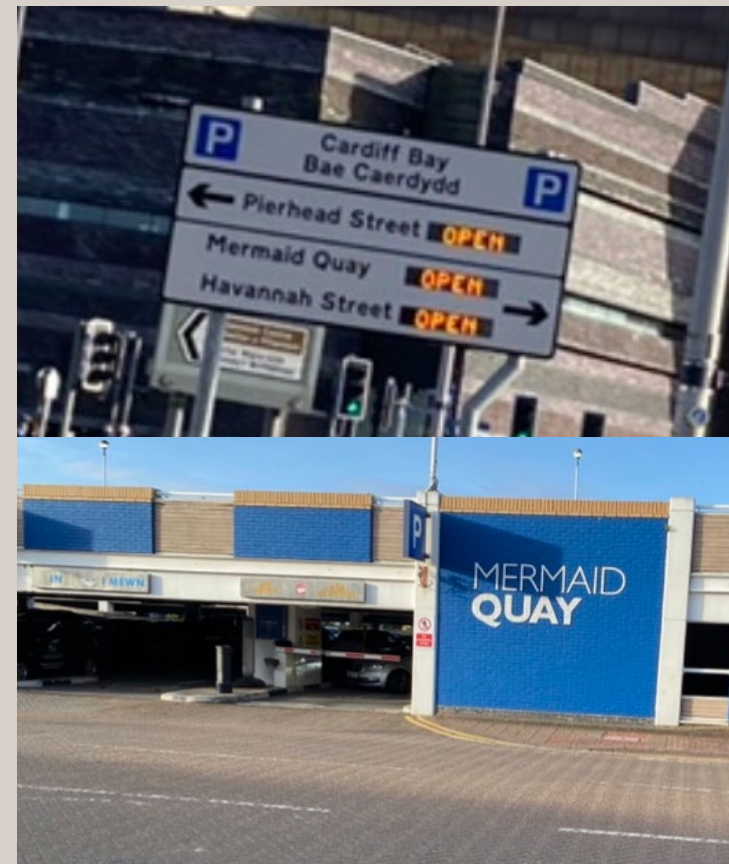
-Q-park Cardiff Bay [Pierhead St.] is likely the most desirable car park. Mermaid Quay is closer but has lower capacity.

## Opportunities on or around my site:

-There are plenty of hotels on or around the site, meaning recurring visitors are likely during the festival.

-The public realm is already well-developed, meaning that an urban stage will fit the area well beyond the Eisteddfod as a public square.

-There are a good range of restaurants nearby, meaning more potential attraction to the site.



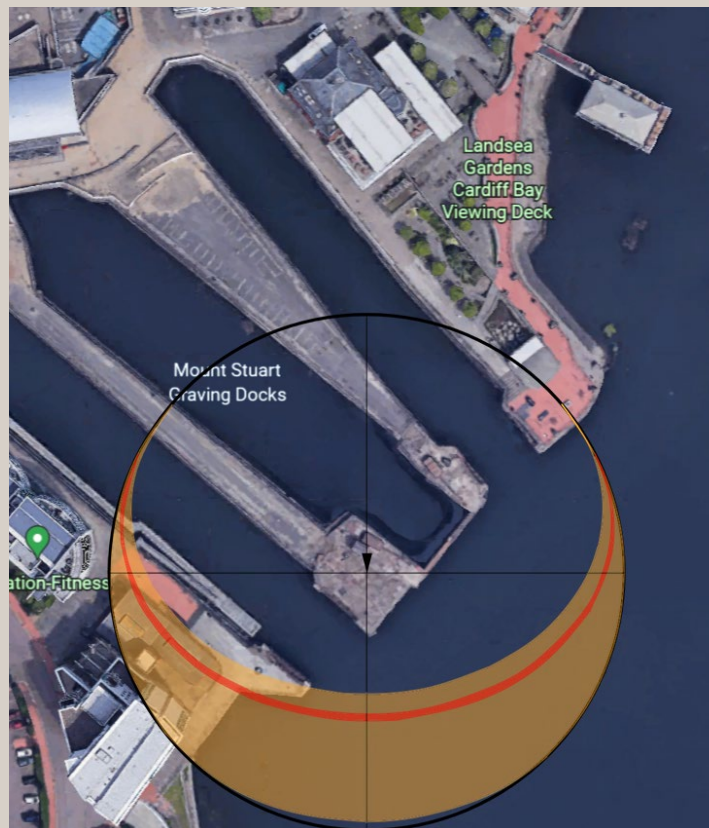


# Technological Submission | Site Analysis [Climatic]

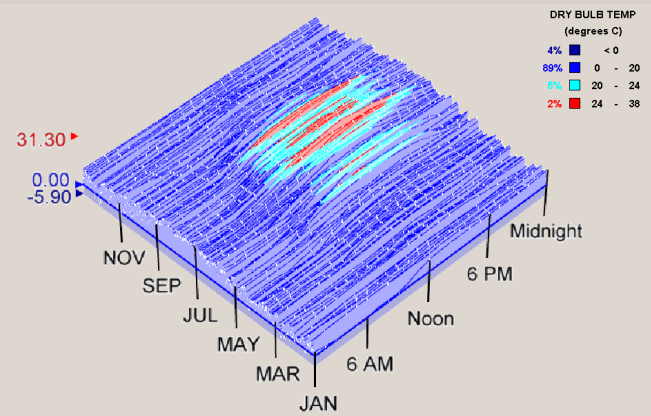
Design aim - To increase the extent of the public realm in a way that responds to the opportunities of the Bay, and to answer the question of how Welsh culture can be futuristically displayed.

## Site Analysis- Climatic

Sun path, with Eisteddfod 2022 dates highlighted in red



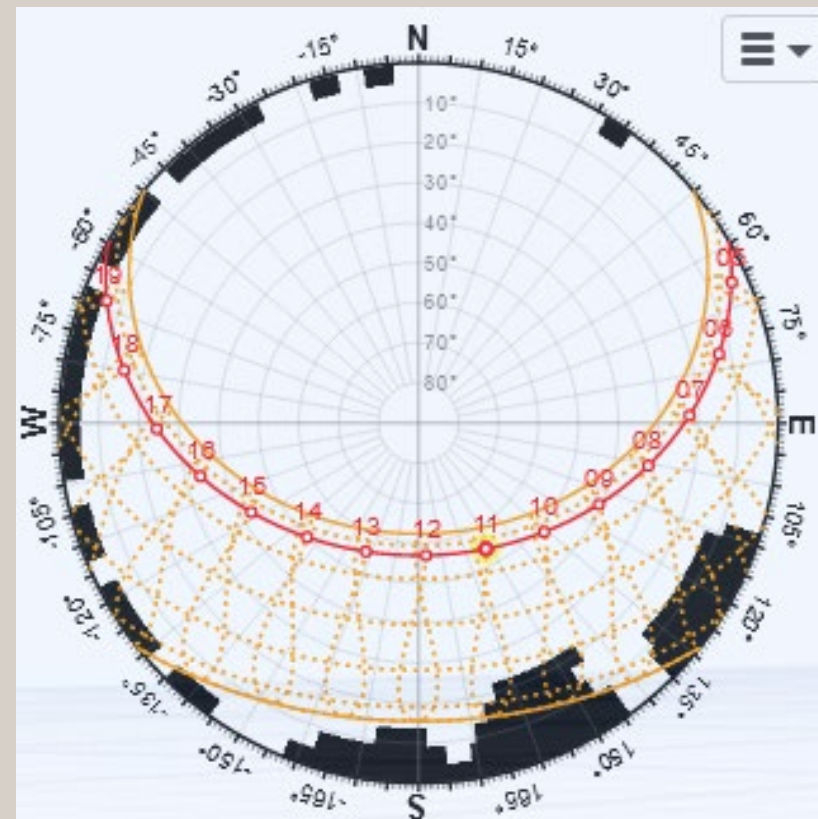
Temperature Graph



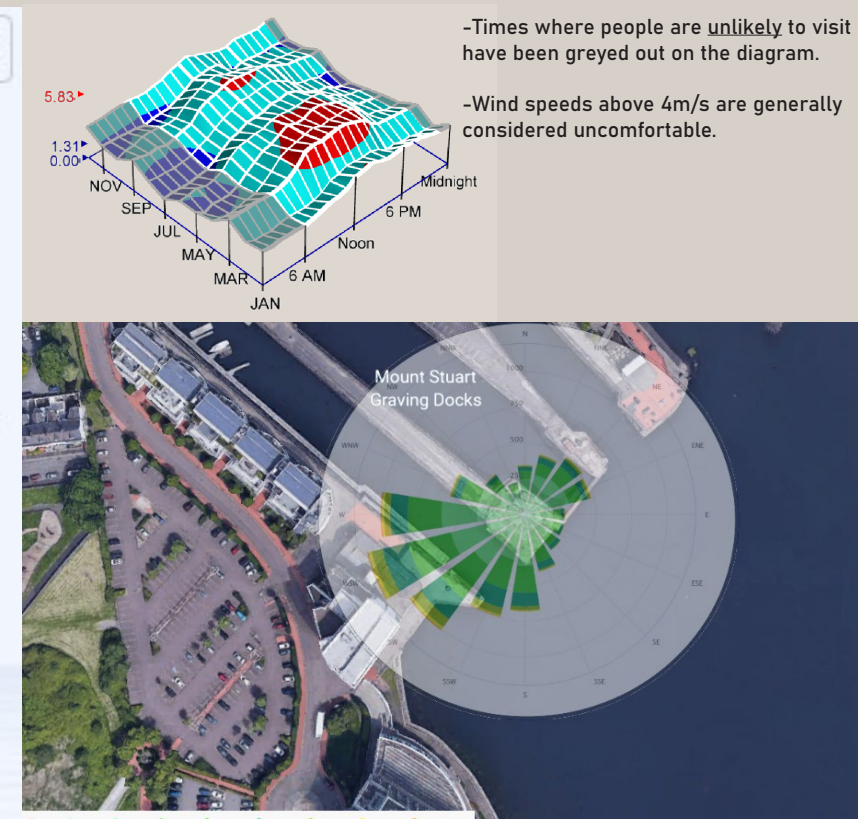
Conclusions from temperature:-

- Cooling will be mostly needed, with temperatures being below 20C 93% of the time. There are few instances in which the temperature is uncomfortable (2% of the time).
- Shading should still be used as a cooling strategy for when temperatures reach uncomfortable levels, so that my scheme is always relatively comfortable to use.

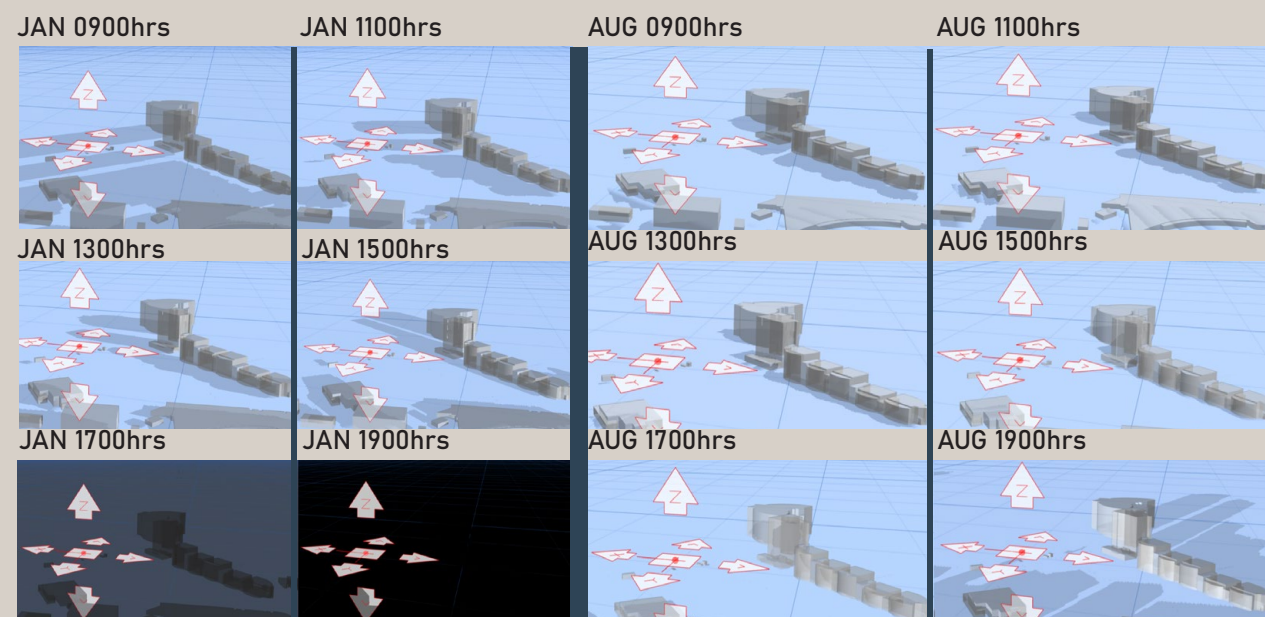
Overshadowing on sun path diagram



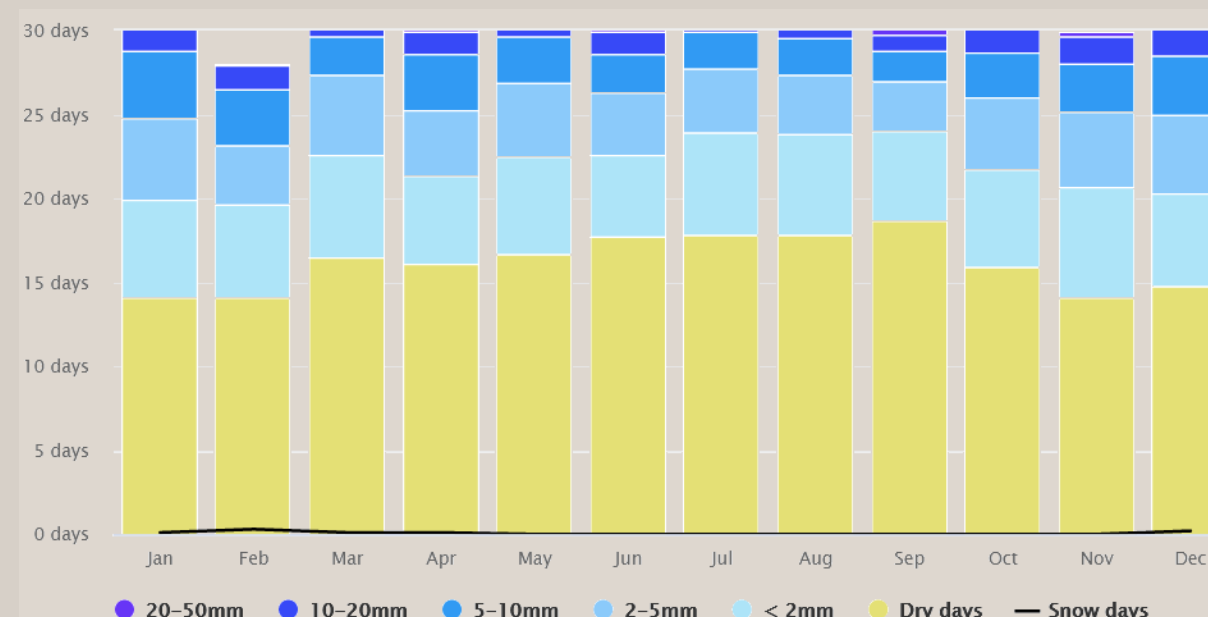
Average Wind Speeds + Modelled Wind Rose



Overshadowing model



Modelled Precipitation Averages



Climatic Site Analysis Conclusions-

- The lowest wind speeds are from the South-East, so people should generally face this direction for maximum comfort.
- The amount of precipitation is considerable, so shelter should be provided.
- Not enough overshadowing is provided during summer months, so shading and the sun's path must be considered in my scheme for the comfort of the audience and the performer.

Sun path, Temperature graph and wind speed 3d graph obtained from Climate Consultant 6.0

Overshadowing model created on <https://drajmarsh.bitbucket.io/shadows3d.html>

Overshadowing on sun path diagram created on <https://drajmarsh.bitbucket.io/shading-box.html>

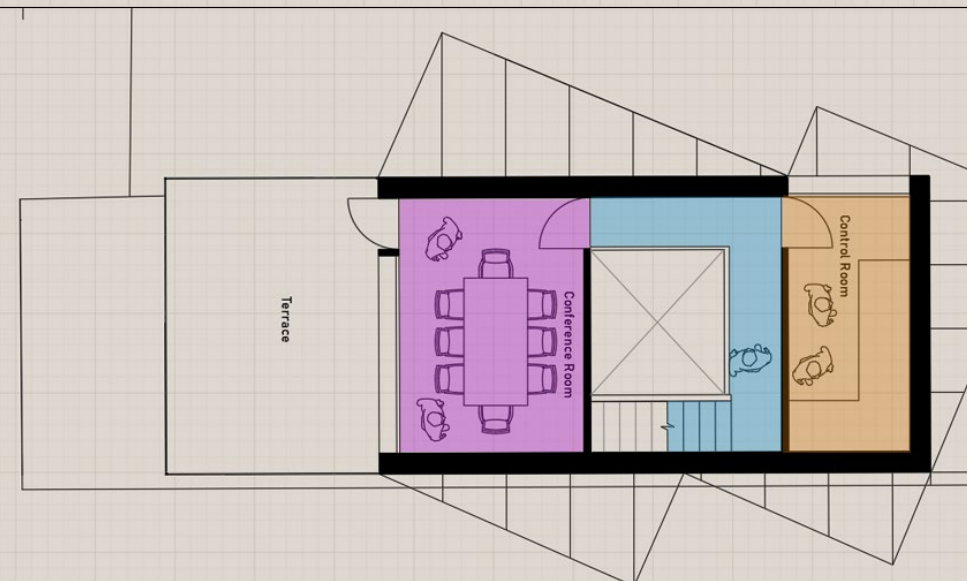
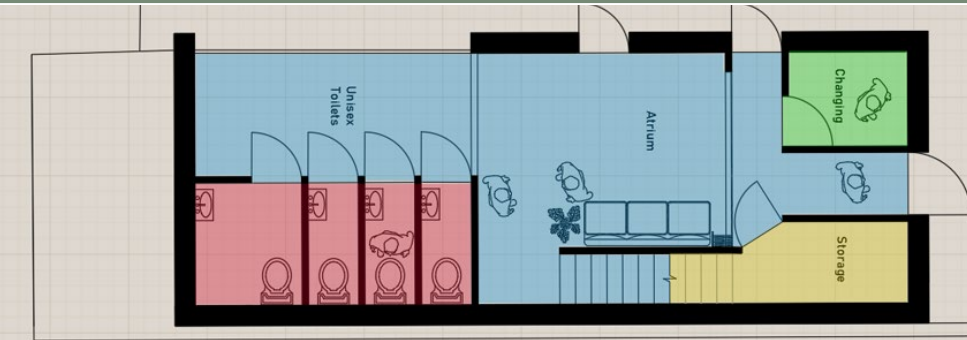
Modelled Wind Rose & Precipitation Averages found on [https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/cardiff-airport\\_united-kingdom\\_3345295](https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/cardiff-airport_united-kingdom_3345295) accessed 2022-04-27



# Technological Submission | Comfort and Ventilation

Thermal Comfort assessment (Data obtained from Climate Consultant & CIBSE Guide A, Table 1.5)

Room	Volume (m3)	Maximum occupancy	WINTER- Average dry bulb temp. (C)	WINTER- Indoor comfort temperature (C)	SUMMER- Average dry bulb temp. (C)	SUMMER- Indoor comfort temperature (C)	Direct Heating – Winter (hours)	Direct Cooling – Winter (hours)	Direct Heating – Summer (hours)	Direct Cooling – Summer (hours)
Changing	6.95	1	4	21-23	13	22-25	3988	0	1458	0
Storage	10.4	3	4	19-21	13	21-25	3903	0	1424	0
Atrium and Hallways	95.2	16	4	13-20	13	21-25	3828	0	1424	0
Toilets (total)	19.52	4	4	19-21	13	21-25	3903	0	1424	0
Conference Room	28.1	8	4	21-23	13	22-25	3988	0	1458	0
Control Room	18.5	2	4	19-21	13	21-25	3903	0	1424	0



Ventilation assessment (Suggested air supply rate highest for each room from CIBSE Guide A Table 1.5 and EN 16798-1 Tables B.11, B.13, B.14.)

Room	Volume (m3)	Maximum occupancy	Suggested air supply rate (L s-1)	Conversion to air changes per hour (ach)	Winter inside/outside temperature difference range (C)	Summer inside/outside temperature difference range (C)	Winter Qv range (Wh)	Summer Qv range (Wh)
Changing [IEQ III]	6.95	1	10	5.18	17-19	9-12	202-225	107-142
Storage [IEQ III]	10.4	3	30	10.4	15-17	8-12	535-607	206-428
Atrium and Hallways [IEQ II]	95.2	16	160	6.05	9-16	8-12	1710-3040	1520-2280
Toilets (1 unit) [IEQ II]	3.81	1	15	14.2	15-17	8-12	(Total) 803-911	(Total) 428-643
Accessible Toilet [IEQ II]	8.09	1	15	6.67	15-17	8-12	267-303	142-214
Conference Room [IEQ II]	28.1	8	80	10.2	17-19	9-12	1610-1780	851-1140
Control Room [IEQ II]	18.5	2	20	3.89	15-17	8-12	356-404	190-285

$Q_v = (NV\delta T)/3$ , where:

N = air changes per hour

V = volume (m3)

$\delta T$  = Temperature delta (Degrees Kelvin)

TOTAL Qv RANGE [Heat Loss] = 3.44-7.27kWh

-I have decided that most rooms in my backstage area should follow IEQ II standards as a higher than usual environment quality (which would command IEQ I specifications) is not expected.

IEQ III is used to classify the storage and changing rooms, as these will not be occupied as often as other spaces, and not for as long - so a lower environment quality is acceptable.

-My assessment of the pollutants within my building lead me to consider it a low-polluting building, as most of the interior elements are timber-based.

The studs are hardwood, which are exposed in the roof and have a very low TVOC emission score and are overall low-polluting.

The OSB sheathing that is exposed in the roof, and the plywood wall cladding, both make use of adhesives within them that likely increase the emission of Formaldehyde, so these would be considered medium polluting.

BALANCE CALCULATION-

$Q_i + Q_s \pm Q_c \pm Q_v \pm Q_{inf} = Q_{mec}$  (1met = 58W/m2)

$Q_i = 5.67\text{kWh}$

$Q_s = 10.2-24.0\text{kWh}$

$Q_c = 0.224-0.314\text{kWh}$

$Q_v = 3.44-7.27\text{kWh}$

$Q_{inf} = 0.282-0.395\text{kWh}$  (N assumed 0.5)

Therefore,  $Q_{mec}$  range = 8.48-26.3kWh

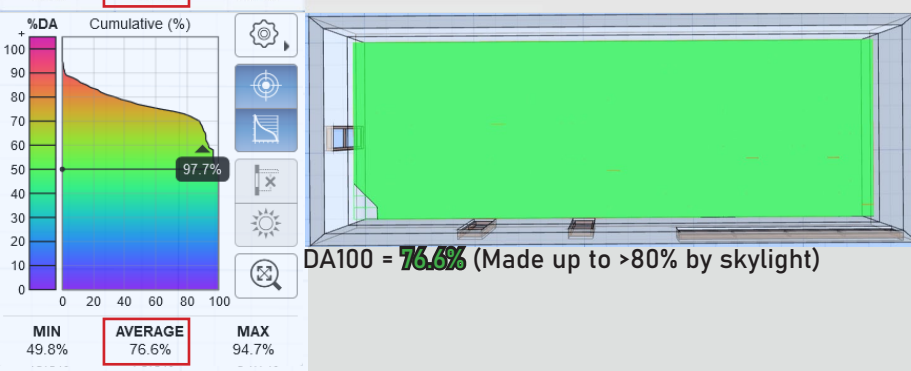
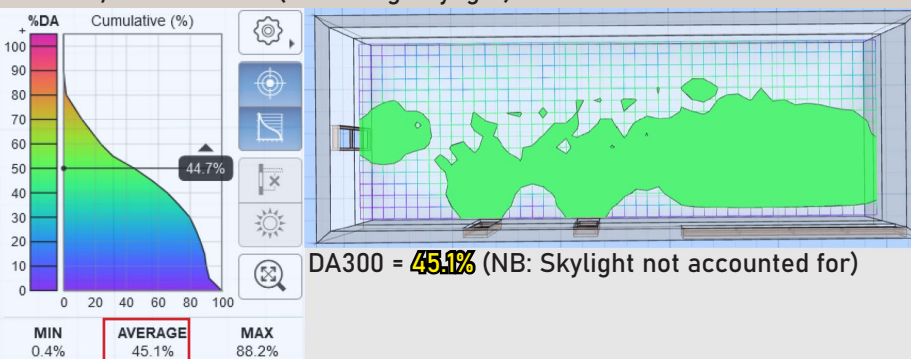


# Technological Submission | Daylight Averages & Irradiation Analysis

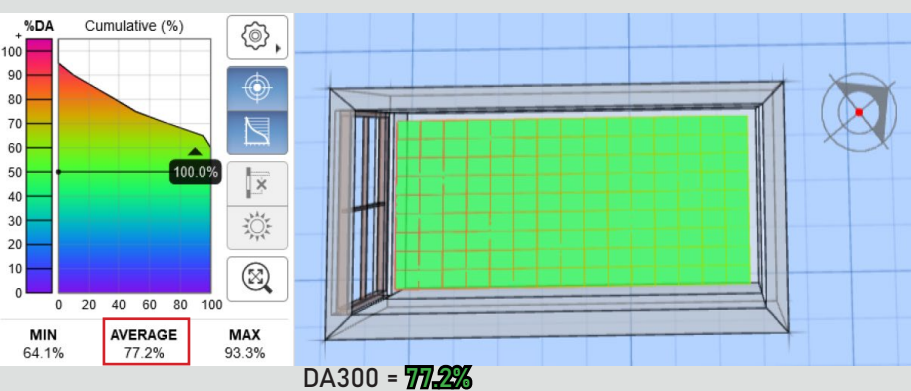
## DA300 ANALYSIS

-CIBSE Guide A Table 1.5 recommends that all of my rooms, for comfort, should have a nominal illuminance of 300lux. Therefore, my design aim is to have a DA300 of at least 75% while being compliant with the UK regulation of DA100 exceeding 80% for each room.

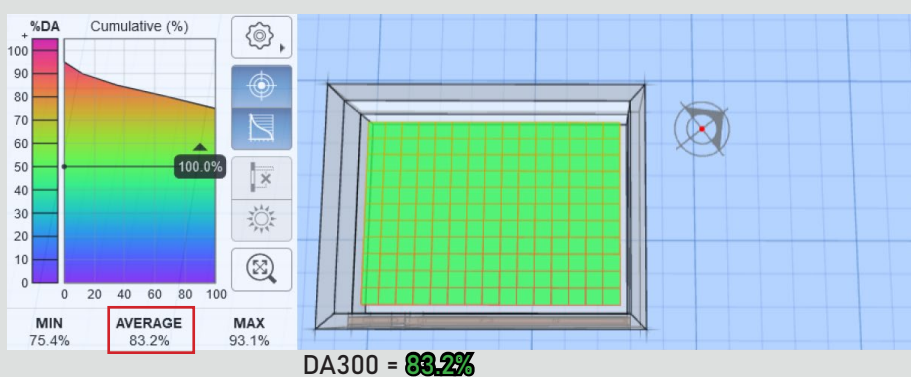
General/Ground Floor (Excluding Skylight)-



Control Room-

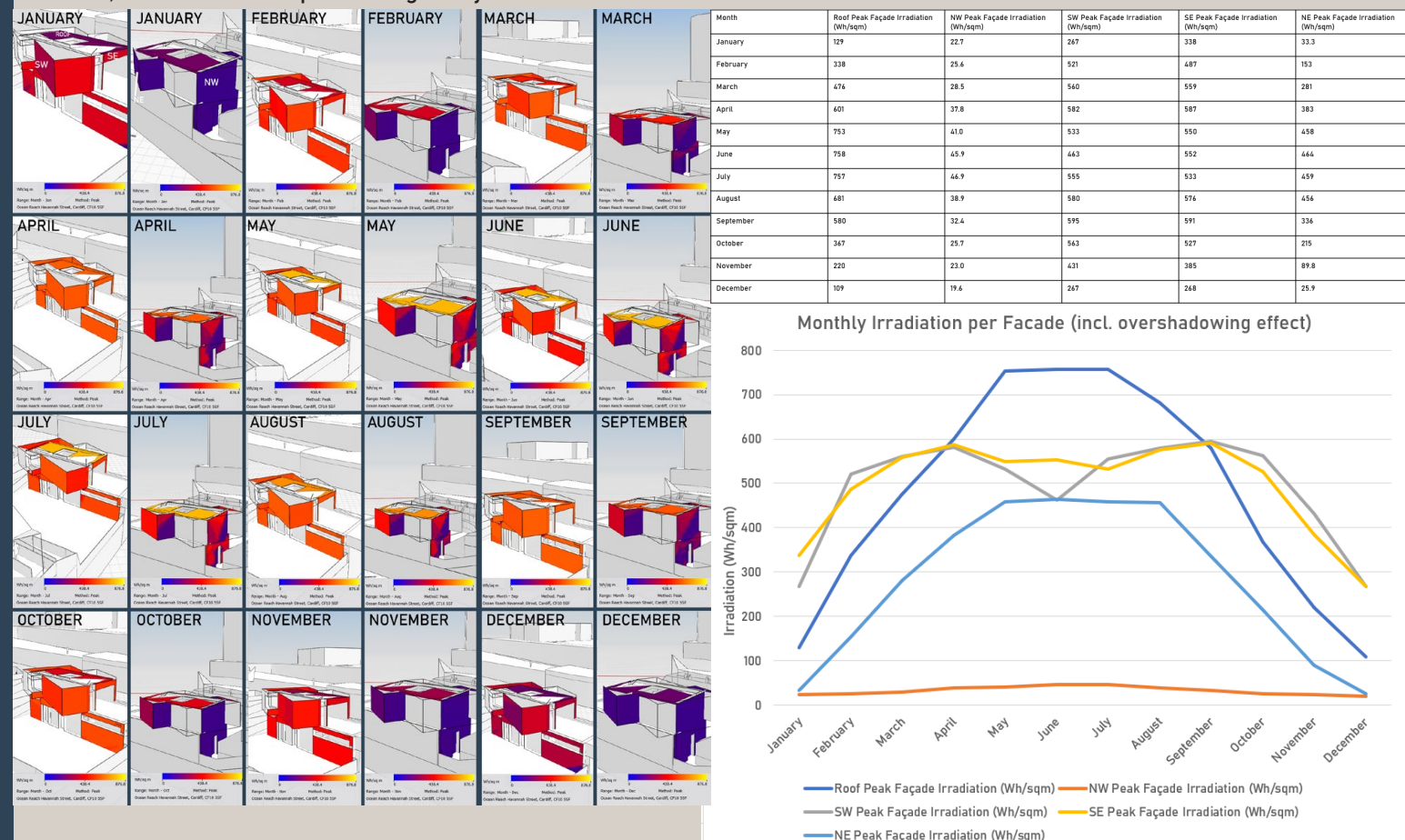


Conference Room-



## IRRADIATION ANALYSIS

What may it mean for my scheme? | Irradiation is the amount of energy incident on a surface by sunlight - and the more irradiation a window is subject to, the more solar gains will occur. I must therefore consider irradiation and its' monthly peaks in my scheme, to decide on the positioning of my windows.



## Conclusions-

-The south-west and south-east (generally south-facing) facades are best for fenestration, as the irradiation drops slightly in the hottest summer months, meaning less solar heat gains occur when they are not needed.

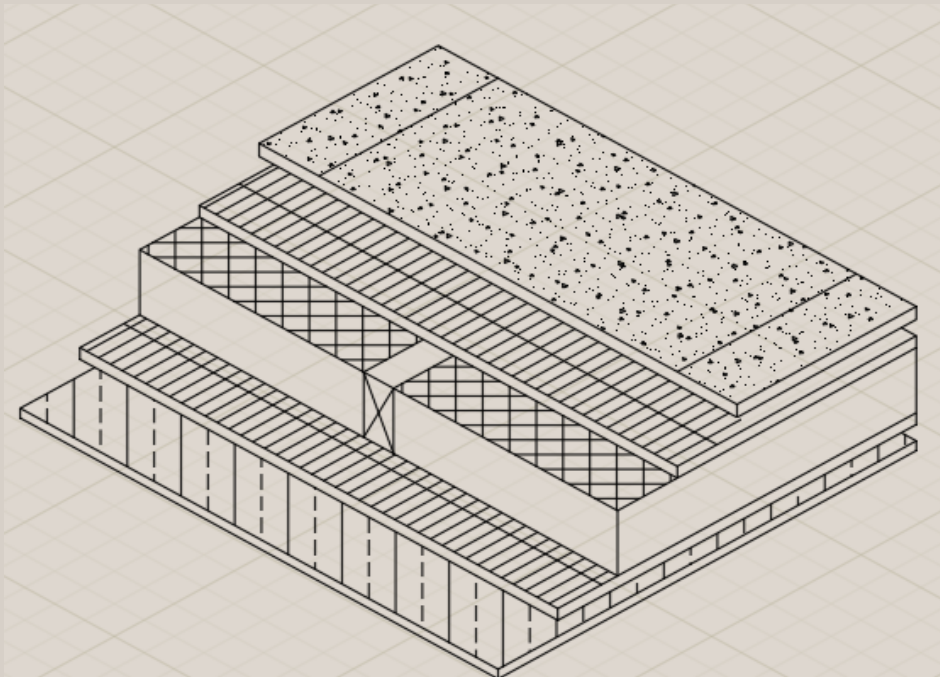
-The skylight is necessary for allowing the general atrium area to satisfy daylighting regulations, so blinds will be needed on to stop solar gains during months where high levels of irradiation are incident on the window. These should be manually controlled to maintain comfort.



# Technological Submission | Wall/Floor/Roof Assemblage & U-values

## WALL

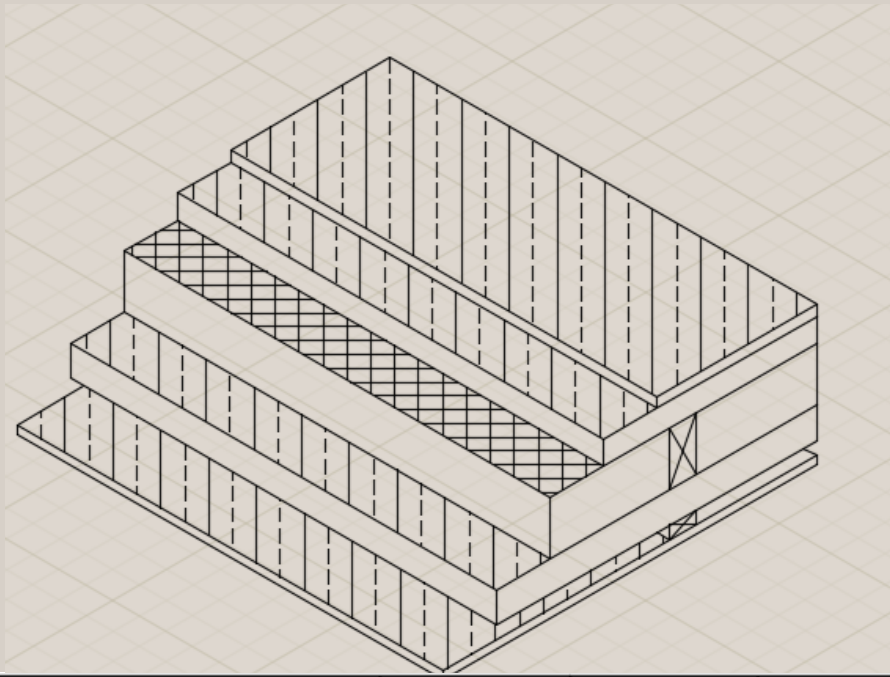
Max. permissible value = 0.30W/m2K (Part L1A Building Regulations)  
Best Practice = 0.13W/m2K



Material (Inside > Out)	R-value (m2K/W)	Thickness (mm)	U-value (W/m2K)
Inside Air Film	0.12	0	8.33
HANSON PLYWOOD LIMITED 12mm Birch Plywood Board	0.536	12	1.87
Battens with 25mmx50mm timber studs	0.192	25	5.21
Lawcris-supplied Norbord 18mm OSB 3, FSC Certified	0.115	18	8.70
100mm Recticel Eurothane GP Rigid Insulation Board (600x2440), between 50x100mm studs	5.09	100	0.196
Lawcris-supplied Norbord 18mm OSB 3, FSC Certified	0.115	18	8.70
Battens with 25mmx50mm timber studs	0.192	25	5.21
Clay Grey Concrete Effect 20mm Exterior Tiles 600x600x20mm	0.012	20	83.3
Outside Air Film	0.12	0	8.33
Total	6.384	218	0.157

## FLOOR

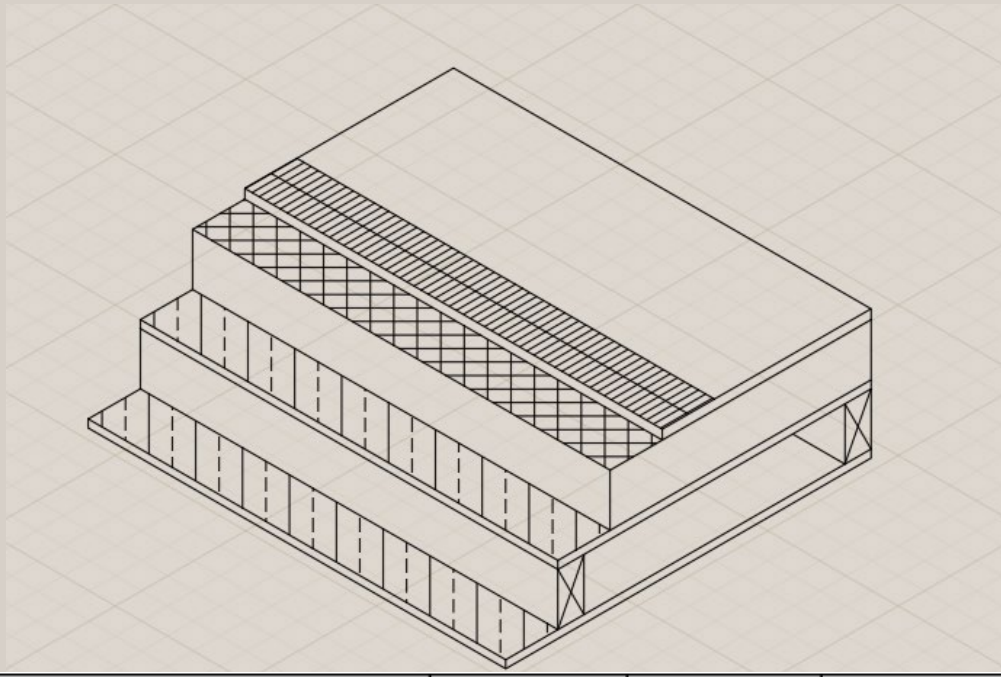
Max. permissible value = 0.25W/m2K (Part L1A Building Regulations)



Material (Lower > Upper)	R-value (m2K/W)	Thickness (mm)	U-value (W/m2K)
Air Film	0.12	0	8.33
HANSON PLYWOOD LIMITED 12mm Birch Plywood Board	0.536	12	1.87
Battens with 25mmx50mm timber studs	0.192	25	5.21
57.5mm solid beech layer (47mm + lintels for electronics, underfloor heating, etc) from Travis Perkins	0.383	57.5	2.61
100mm Recticel Eurothane GP Rigid Insulation Board (600x2440), between 50x100mm studs	5.09	100	0.196
44mm solid beech layer from Travis Perkins	0.293	44	3.41
20mm oak floorboards from "woodandbeyond"	0.133	20	7.52
Air Film	0.12	0	8.33
Total	6.867	235	0.145

## ROOF

Max. permissible value = 0.20W/m2K (Part L1A Building Regulations)



Material (Lower > Upper)	R-value (m2K/W)	Thickness (mm)	U-value (W/m2K)
Air Film	0.12	0	8.33
HANSON PLYWOOD LIMITED 12mm Birch Plywood Board	0.536	12	1.87
Battens with 50x100mm C24 timber joists	0.782	100	
HANSON PLYWOOD LIMITED 12mm Birch Plywood Board	0.536	12	1.87
100mm Recticel Eurothane GP Rigid Insulation Board (600x2440), between 50x100mm studs	5.09	100	0.196
Lawcris-supplied Norbord 18mm OSB 3, FSC-Certified	0.115	18	8.70
GRP Laminate Layer	0	Negligible	0
Air Film	0.12	0	8.33
Total	7.299	242	0.137

R-values obtained from:  
-Opaque 3.0  
-Manufacturer/supplier websites [see p45 table for links]



# Technological Submission | Material Sustainability Appraisal

## Assessment with BRE Green Guide-

Assemblage	Brickwork outer leaf -> Insulation -> Aircrete blockwork w/ Lime Mortar, Plaster, Paint [Blockwork Cavity Wall]	Reclaimed brickwork, plywood [EN636-2] sheathing, timber frame with insulation, vapour ctrl layer, plasterboard on battens, paint [Brickwork on Timber Frame]	UK produced natural slate on timber battens, lightweight solid block outer, insulation, aircrete block inner, plasterboard on battens, paint	Mill finish aluminium composite profiled panel with pentane blown PUR/PIR insulation and steel liner on steel support, structural steel frame, OSB/3 sheathing, light steel frame, vapour control layer, plasterboard on battens, paint	Lime render, insulation, rammed chalk wall (0% cement), sodium silicate treatment	Concrete tiles on timber battens, breather membrane, 2x15mm OSB with 112mm rigid urethane insulation for 142mm SIP system, plasterboard on battens, paint	Timber joists, plywood (temperate EN636-2) decking, vapour control layer, insulation, OSB (18mm), GRP roofing laminate with GRP edge trim	Timber joists, OSB/3 decking, vapour control layer, insulation, Polyester cold applied liquid waterproofing membrane system.
Number	806170061	806190051	806290610	1206360004	1006220013	1106164001	1212540055	1212520010
Summary	A+	A+	A	A+	A+	A+	A+	A+
Climate Change	A	A+	A	A	A+	A+	A+	A+
Ecotoxicity to Freshwater	A+	A+	A+	A+	A+	A+	A	C
Eutrophication	A+	A+	A	A+	A+	A	A+	A
Acidification	A+	A+	A	A	A+	A	A+	A+
Ecotoxicity to Land	A+	A	A+	A	A+	A	A	B
Human Toxicity	A+	A+	A+	A+	A+	A+	A+	B
Fossil Fuel Depletion	A+	A+	A	A	A+	A	A+	A
Waste Disposal	A+	A+	A+	A+	A+	A	A+	A+
Kg CO2 eq [60yrs]	72.0	31.0	85.0	99.0	38.0	56.0	8.1	55.0
Approximate U-value (Thickness)	0.193W/m2K (414mm)	0.217W/m2K (306mm)	Disqualified by Kg CO2 eq	Disqualified by Kg CO2 eq	0.343W/m2K (228mm)	0.157W/m2K (218mm)	0.152W/m2K (244mm)	Disqualified by Ecotoxicity to Freshwater

-To decide on the best assemblages for my scheme based on sustainability, I looked firstly at the BRE Green Guide for their ratings. I only accepted assemblages with ratings of A and above, ideally A+.

-I then looked at the Kg CO2 eq of the shortlisted assemblages, and disqualified those with the two highest values. I then narrowed it down further by calculating a hypothetical U-value for each assemblage, and decided that the assemblage with concrete tiles was preferable - due to the high thermal performance and very good BRE Green Guide ratings.

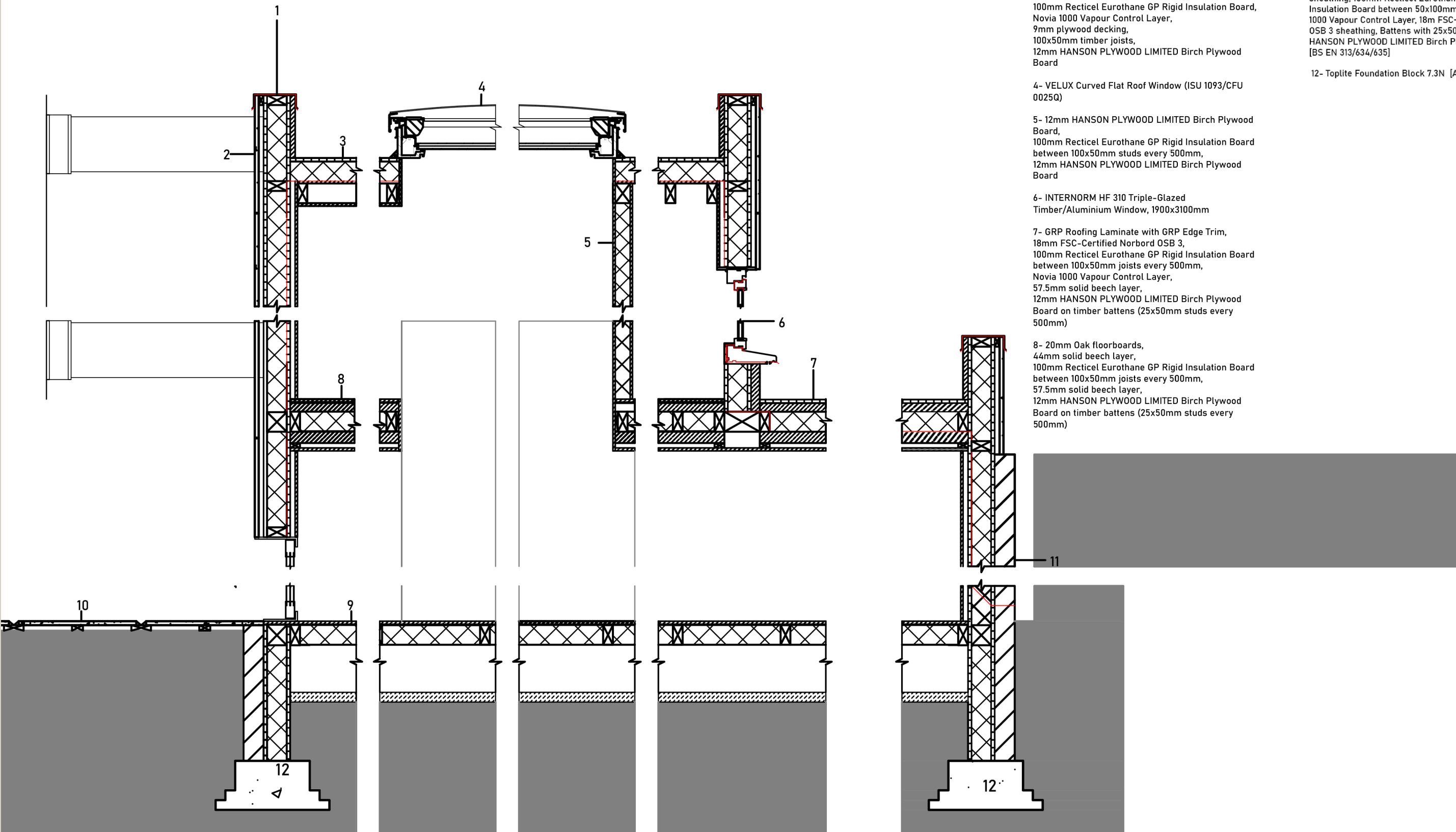
## Sustainability analysis of chosen assemblage-

Material	Manufacture, Distribution and Installation	Use	End of Life
Concrete tiles	Concrete can be cast using sustainable cement/aggregate alternatives, such as blast furnace slag or downcycled concrete. Will be sourced from UK manufacturers.	Over time, concrete will not emit many pollutants and its' CO2 emissions are very low over the life cycle.	The concrete tiles can be broken up and downcycled to create cement or other materials.
C24 Timber studs	Many timber studs in the United Kingdom are from FSC-certified forests, meaning they are logged sustainably. These forests are also carbon sinks.	Rough sawn, raw timber studs will not emit many VOCs or CO2 over time, and can last for a long time if maintained properly.	It can be recycled into synthetic boards such as MDF, OSB and others.
OSB	It uses recycled wood chips, however also makes use of many adhesives to hold these chips together. Many UK-based suppliers and manufacturers exist.	Most of the pollutants are emitted in the manufacture of the board, so in use the adhesives are not so problematic but still should be considered.	It is difficult to recycle and reuse, and is likely to be incinerated at the end of life.
Rigid Insulation	The manufacture of Eurothane Recticel (my chosen insulation) is very energy intensive, but this energy is compensated for due to reasons explained in the use column.	Eurothane Recticel is an extremely effective insulative material, meaning that a building with this type of insulation's energy efficiency will offset the energy required in the manufacture of its' insulation.	The Polyisocyanurate foam can be recovered from the insulation boards and reused in new insulation boards at the end of life.
Plywood	Plywood is manufactured by laminating veneers together, which is likely to be energy intensive and use VOC-emitting contact adhesives.	Much like OSB, few VOCs are emitted during the use of plywood boards - but should still be considered in internal environment quality.	Plywood is more difficult to recycle than raw timber, yet is still recyclable.



# Technological Submission | Construction Detail - 1:20 Section

## A-A 1:20



1- Aluminium coping with flashing (in red)

2- 600/600/20mm concrete slabs on timber battens, 18mm FSC-Certified Norbord OSB 3 sheathing, 100mm Recticel Eurothane GP Rigid Insulation Board (600x2440mm) between 50x100mm studs, Novia 1000 Vapour Control Layer, 18mm FSC-Certified Norbord OSB 3 sheathing, Battens with 25x50mm studs, 12mm HANSON PLYWOOD LIMITED Birch Plywood Board [BS EN 313/634/635]

3- GRP Roofing Laminate with GRP Edge Trim, 18mm FSC-Certified Norbord OSB 3, 100mm Recticel Eurothane GP Rigid Insulation Board, Novia 1000 Vapour Control Layer, 9mm plywood decking, 100x50mm timber joists, 12mm HANSON PLYWOOD LIMITED Birch Plywood Board

4- VELUX Curved Flat Roof Window (ISU 1093/CFU 0025Q)

5- 12mm HANSON PLYWOOD LIMITED Birch Plywood Board, 100mm Recticel Eurothane GP Rigid Insulation Board between 100x50mm studs every 500mm, 12mm HANSON PLYWOOD LIMITED Birch Plywood Board

6- INTERNORM HF 310 Triple-Glazed Timber/Aluminium Window, 1900x3100mm

7- GRP Roofing Laminate with GRP Edge Trim, 18mm FSC-Certified Norbord OSB 3, 100mm Recticel Eurothane GP Rigid Insulation Board between 100x50mm joists every 500mm, Novia 1000 Vapour Control Layer, 57.5mm solid beech layer, 12mm HANSON PLYWOOD LIMITED Birch Plywood Board on timber battens (25x50mm studs every 500mm)

8- 20mm Oak floorboards, 44mm solid beech layer, 100mm Recticel Eurothane GP Rigid Insulation Board between 100x50mm joists every 500mm, 57.5mm solid beech layer, 12mm HANSON PLYWOOD LIMITED Birch Plywood Board on timber battens (25x50mm studs every 500mm)

9- 20/180 mm oak floorboards, oiled 18mm FSC-Certified Norbord OSB 3, Novia 1000 Vapour Control Layer, 100mm Recticel Eurothane GP Rigid Insulation Board between 100x50mm joists every 500mm, 240 mm back ventilation, 50 mm blinding.

10- 600x600x20mm concrete slabs spaced 50mm apart supported in centre by 25x50mm timber studs, 25x100mm timber studs every 500mm connected by grout to slabs.

11- 440x215x100mm Tarmac Toplite GTI 2.9N 'Aircrete' blockwork, 18mm FSC-Certified Norbord OSB 3 sheathing, 100mm Recticel Eurothane GP Rigid Insulation Board between 50x100mm studs, Novia 1000 Vapour Control Layer, 18m FSC-Certified Norbord OSB 3 sheathing, Battens with 25x50m studs, 12mm HANSON PLYWOOD LIMITED Birch Plywood Board [BS EN 313/634/635]

12- Toplite Foundation Block 7.3N [Aircrete]

Precedents taken from Detail Inspiration:

-Löwenbräu Complex in Zurich, CH <https://inspiration.detail.de/loewenbraeu-complex-in-zurich-113606.html> accessed 2022-04-27

-Office Block in Alpnach, CH <https://inspiration.detail.de/office-block-in-alpnach-115181.html> accessed 2022-04-27

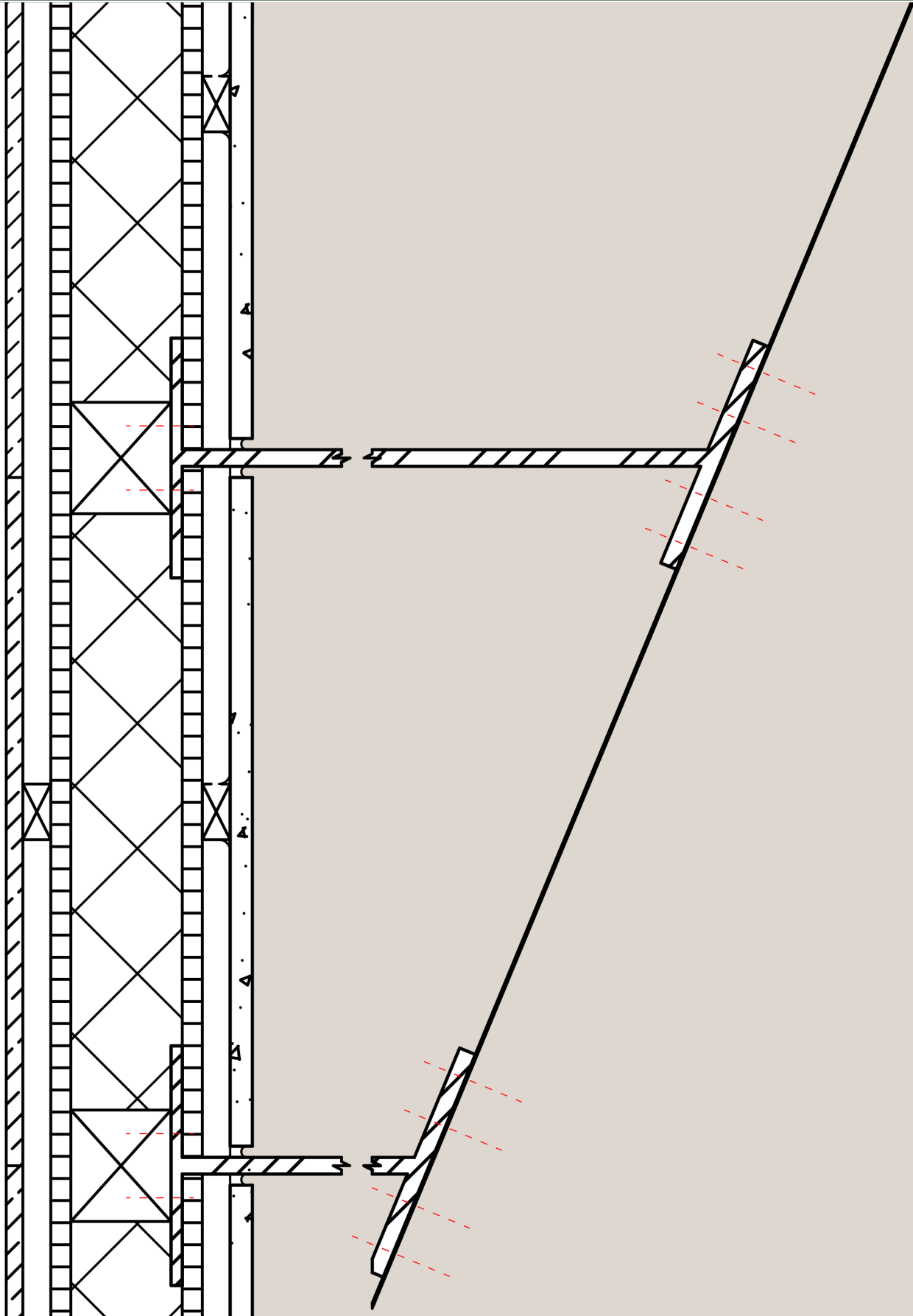
-Overcast House in London, UK <https://inspiration.detail.de/overcast-house-in-london-115199.html> accessed 2022-04-27



Technological Submission

Other Construction Details/Materials and suppliers

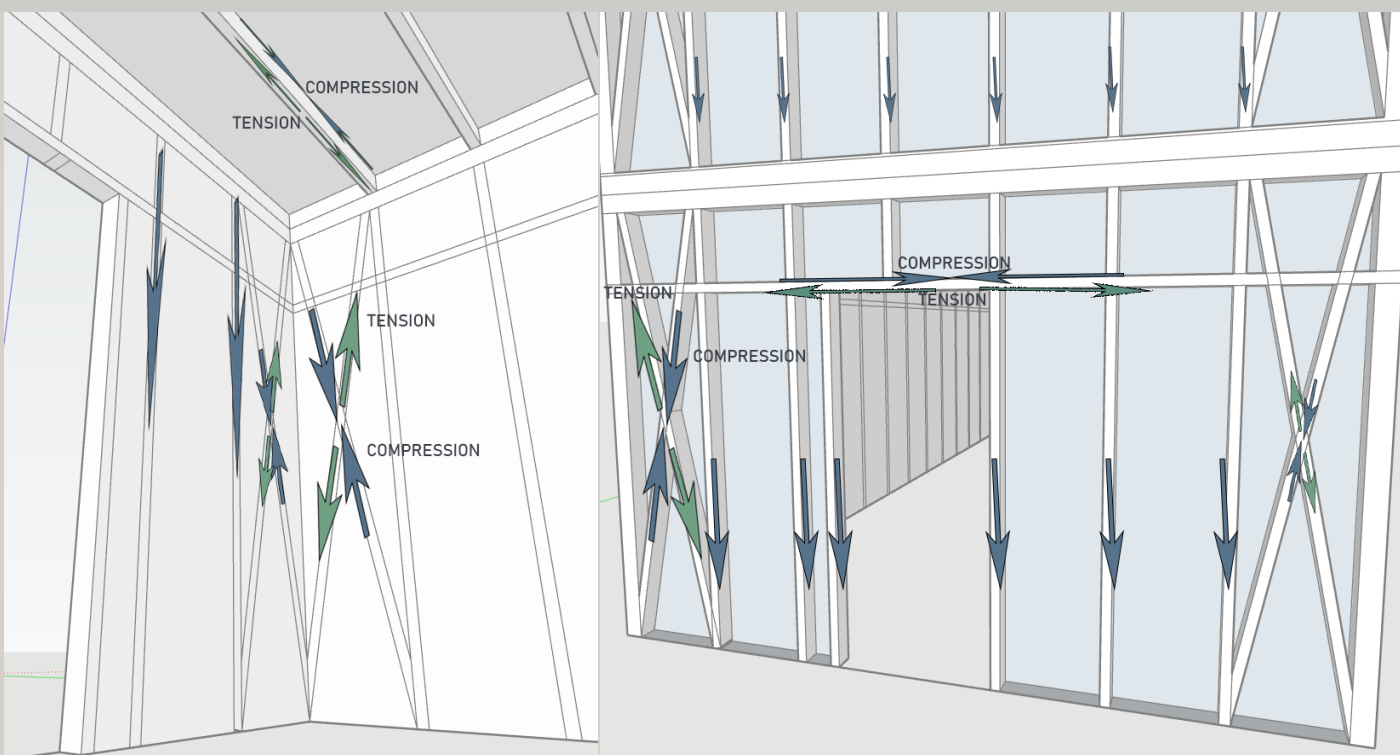
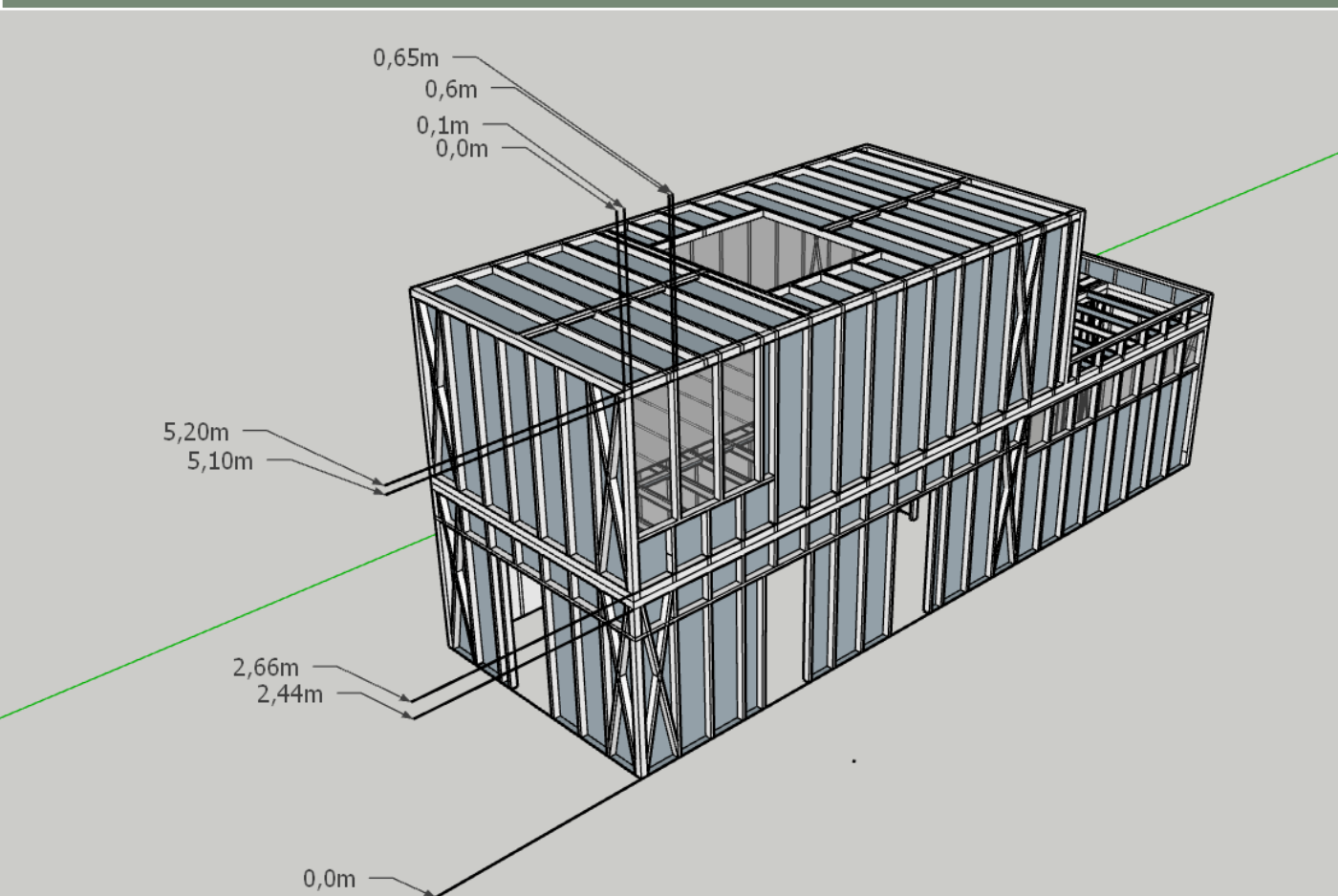
Plan 1:5



Construction Layer	Supplier & link	Purpose	Maintenance
1	<p>Coping - Aluminium Rainflow Ltd <a href="https://www.aluminiumrainflow.co.uk/product-page/210-250mm-wall-coping-3m-length-select-wall-width">https://www.aluminiumrainflow.co.uk/product-page/210-250mm-wall-coping-3m-length-select-wall-width</a></p> <p>Flashing - Corrapol (via B&amp;Q) <a href="https://www.diy.com/departments/corrapol-white-aluminium-corrugated-wall-flashing-l-6m-w-165mm/5060865934334_BQ.prd">https://www.diy.com/departments/corrapol-white-aluminium-corrugated-wall-flashing-l-6m-w-165mm/5060865934334_BQ.prd</a></p>	<p>-Coping protects the internal wall cavity from rain and therefore damp.</p> <p>-Flashing removes any water from areas where it may cause damp, and prevents it from crossing the building envelope from the outside to the inside.</p>	<p>-Assess coping by observation every 5 years, if there are defects, then repair or replace accordingly.</p> <p>-Replace flashing every 30 years.</p>
2	<p>Concrete Slabs - Applebys Tiles <a href="https://applebys-tiles.co.uk/products/clay-grey-concrete-effect-18mm-exterior-tiles">https://applebys-tiles.co.uk/products/clay-grey-concrete-effect-18mm-exterior-tiles</a></p> <p>Grout - Wickes <a href="https://www.wickes.co.uk/Mapei-Fix+Grout-Ceramic+Porcelain-Tile-Adhesive-for-Concrete+Wooden-Floors-15kg/p/114251">https://www.wickes.co.uk/Mapei-Fix+Grout-Ceramic+Porcelain-Tile-Adhesive-for-Concrete+Wooden-Floors-15kg/p/114251</a></p> <p>OSB Sheathing - Wickes OSB 3 <a href="https://www.building-supplies-online.co.uk/sterling-osb-3-board-11mm-x-2440mm-x-1220mm.html">https://www.building-supplies-online.co.uk/sterling-osb-3-board-11mm-x-2440mm-x-1220mm.html</a></p> <p>Insulation - Recticel Eurothane GP PIR 100mm <a href="https://flooringwarehousedirect.co.uk/product/recticel-eurothane-gp-pir-rigid-insulation-board-2-4m-x-1-2m-x-100mm/">https://flooringwarehousedirect.co.uk/product/recticel-eurothane-gp-pir-rigid-insulation-board-2-4m-x-1-2m-x-100mm/</a></p> <p>Vapour Control Layer - Novia <a href="https://www.insulationsuperstore.co.uk/product/polythene-vapour-control-layer-from-novia-1000-gauge-100m2-diy-kit.html">https://www.insulationsuperstore.co.uk/product/polythene-vapour-control-layer-from-novia-1000-gauge-100m2-diy-kit.html</a></p> <p>Plywood - HANSON PLYWOOD LIMITED <a href="https://hanson-plywood.co.uk/products/birch-plywood-wall-panelling/">https://hanson-plywood.co.uk/products/birch-plywood-wall-panelling/</a></p> <p>Timber Studs &amp; Joists - TRAVIS PERKINS C24 ROUGH SAWN <a href="https://www.travisperkins.co.uk/treated-timber/c24-kiln-dried-regularised-sawn-treated-timber-47mm-x-100mm-x-4-8m/p/2069107gclid=CjwKCAjwIcaRBhBYEiwAK34IjU-nMqgbIYMRpCWxDp70-m6kuuKJQQAjGHlUijLeAEiShUsGCWbNhRoCut0QAvD_BwE&amp;gclidsrc=aw.ds">https://www.travisperkins.co.uk/treated-timber/c24-kiln-dried-regularised-sawn-treated-timber-47mm-x-100mm-x-4-8m/p/2069107gclid=CjwKCAjwIcaRBhBYEiwAK34IjU-nMqgbIYMRpCWxDp70-m6kuuKJQQAjGHlUijLeAEiShUsGCWbNhRoCut0QAvD_BwE&amp;gclidsrc=aw.ds</a></p>	<p>-Concrete Slabs act as the building's façade, while also protecting the interior cavity and frame from moisture. The grout connects them together and provides this watertight seal.</p> <p>-OSB Sheathing provides further protection for the insulation itself from damp.</p> <p>-Rigid insulation is simple to install due to coming in board form, and improves the building's thermal performance.</p> <p>-Vapour control layers prevent water vapours from penetrating the building envelope, helping to maintain a constant internal environment and preventing damp.</p> <p>-Plywood internal cladding hides the internal structure of the wall while providing an aesthetically pleasing wall finish.</p> <p>-Timber studs and joists form parts of the structural frame that holds the building up.</p>	<p>-Assess concrete slabs for cracks, and replace as and when necessary. Clean every 6 months with pressure washer.</p> <p>-Remove slabs and assess for wear every 10 years, unless issues arise in the meantime.</p> <p>-According to the manufacturer, maintenance for the insulation is not required. Condition checks should still take place every 20 years.</p> <p>-Vapour control layer should be checked every 10 years for tears and punctures, unless damp issues occur beforehand.</p> <p>-Assess plywood walls for damage, and repair or replace as necessary.</p> <p>-Check frame elements every 10 years for spalling, warping or other degradation and repair/replace accordingly.</p>
3	<p>See Layer 2 with exceptions:</p> <p>GRP Roofing Laminate - Composite Roof Supplies <a href="https://www.fibreglassroofingkits.co.uk/5-square-metre-450g-fibreglass-roof-kit-ral-7045-dark-grey">https://www.fibreglassroofingkits.co.uk/5-square-metre-450g-fibreglass-roof-kit-ral-7045-dark-grey</a></p>	<p>-GRP Roofing Laminate prevents rainwater from percolating into the building envelope or wall and causing damp or rot to elements such as insulation or frame.</p>	<p>-Replace every 30 years</p>
4	<p>VELUX Curved Flat Roof Window - <a href="https://www.velux.co.uk/products/flat-roof-windows/curved-glass-new-generation">https://www.velux.co.uk/products/flat-roof-windows/curved-glass-new-generation</a></p>	<p>-Allows the influx of natural lighting and provides passive heating through solar gains.</p>	<p>-Assess by observation, clean as necessary and repair or replace if leaks, cracks or other defects occur.</p>
5	<p>See Layer 2 for Plywood and Insulation suppliers</p>	<p>-See Layer 2 Plywood/Insulation</p>	<p>-See Layer 2 Plywood/Insulation</p>
6	<p>INTERNORM HF 310 Triple Glazed Glass - <a href="https://spectrumarchitectural.com/internorm-hf-310-studio-timber-aluminium/">https://spectrumarchitectural.com/internorm-hf-310-studio-timber-aluminium/</a></p>	<p>-Allows the influx of natural lighting and provides passive heating through solar gains.</p>	<p>-Assess by observation, clean as necessary and repair or replace if leaks, cracks or other defects occur.</p>
7	<p>GRP Roofing Laminate - See Layer 3</p> <p>Otherwise See Layer 2 with exceptions:</p> <p>Solid Beech Layer - Travis Perkins <a href="https://www.travisperkins.co.uk/treated-timber/c24-kiln-dried-regularised-sawn-treated-timber-47mm-x-150mm-x-4-8m/p/206904">https://www.travisperkins.co.uk/treated-timber/c24-kiln-dried-regularised-sawn-treated-timber-47mm-x-150mm-x-4-8m/p/206904</a></p>	<p>-See Layer 3 for GRP Roofing Laminate, Layer 2 for other materials.</p> <p>-The Solid Beech Layer evenly distributes the imposed load across the frame and allows for the floor to maintain its' structural integrity and behave as a diaphragm with respect to its' loadbearing properties.</p>	<p>-Inspect beech every 10 years for issues such as warping, rot or cracking, or upon noticing issues such as perceived floor instability.</p>
8	<p>Oak Floorboards - "Wood and beyond" <a href="https://www.woodandbeyond.com/real-wood-flooring/solid-wood-flooring.html?gclid=CjwKCAjwsJ6TBhAIEiwaAfI4TWExs6xrwPlwwD632w3R5yUIEqQPc0AGgB4mdrAgdPL773_wo0kX_-RoCSAIQAvD_BwE">https://www.woodandbeyond.com/real-wood-flooring/solid-wood-flooring.html?gclid=CjwKCAjwsJ6TBhAIEiwaAfI4TWExs6xrwPlwwD632w3R5yUIEqQPc0AGgB4mdrAgdPL773_wo0kX_-RoCSAIQAvD_BwE</a></p> <p>Solid beech layers - See Layer 7</p> <p>Insulation and plywood - See Layer 2</p>	<p>-Floorboards offer a hard-wearing and aesthetically pleasing surface on which to walk</p> <p>-See Layer 7 for beech</p> <p>-See Layer 2 for plywood and insulation</p>	<p>-Repair or replace floorboards if cracks or severe wear shows.</p> <p>-See Layer 7 for beech</p> <p>-See Layer 2 for plywood and insulation</p>
9	<p>Oak Floorboards - See Layer 8</p> <p>VCL, OSB and insulation - See Layer 2</p> <p>Blinding - Wickes <a href="https://www.wickes.co.uk/Tarmac-Granular-Sub-Base-Mot-1-1-Jumbo-Bag/p/1318959gclid=CjwKCAjwsJ6TBhAIEiwaAfI4TWPKGgIL3K1oc8sPysC-dyFnrBQ40GrIY0utQqANQJx0IXITubIXj0xoCuySQAyD_BwE&amp;gclidsrc=aw.ds">https://www.wickes.co.uk/Tarmac-Granular-Sub-Base-Mot-1-1-Jumbo-Bag/p/1318959gclid=CjwKCAjwsJ6TBhAIEiwaAfI4TWPKGgIL3K1oc8sPysC-dyFnrBQ40GrIY0utQqANQJx0IXITubIXj0xoCuySQAyD_BwE&amp;gclidsrc=aw.ds</a></p>	<p>-See Layer 8 for oak floorboards</p> <p>-See Layer 2 for VCL, OSB and Insulation</p> <p>-Blinding is used to improve the stability of a foundation.</p>	<p>-Little to no maintenance should be required for blinding.</p>
10	<p>See Layer 2 for Concrete, Grout and Studs</p>	<p>-See Layer 2 for Concrete, Grout and Studs</p>	<p>-See Layer 2 for Concrete, Grout and Studs</p>
11	<p>See Layer 2 with exceptions:</p> <p>Blockwork - Toplite GTI 2.9N <a href="https://lordsbm.co.uk/toplite_gti_2.9n_100mm_block_lct00090/">https://lordsbm.co.uk/toplite_gti_2.9n_100mm_block_lct00090/</a></p>	<p>-See Layer 2 except for concrete and grout</p> <p>-Blockwork protects the interior cavity and frame from moisture, and is an alternative to concrete slabs that is easier to fit in the space given.</p>	<p>-If damp can be seen within the wall structure (as exterior observation is very difficult given the position), replace the blockwork.</p>
12	<p>Foundation Block - TOPLITE FOUNDATION BLOCK 7.3N <a href="https://www.mpmoran.co.uk/100x440x215mm-tarmac-toplite-7-block-100011638">https://www.mpmoran.co.uk/100x440x215mm-tarmac-toplite-7-block-100011638</a></p>	<p>-Distributes the load of the building through the ground to provide it stability.</p>	<p>-If the building begins to tilt, then replace the foundations. Otherwise inspect the foundation blocks every 20 years.</p>



# Technological Submission | Structure Diagrams, Load Paths & Spans

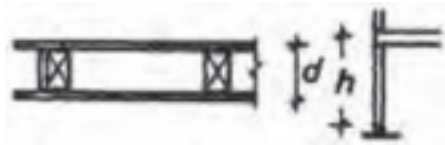


Model created in SketchUp Pro 2021  
Span data obtained from Metric Handbook Sixth Edition, Pages 6-9 through 6-10, Tables VIII through X

## FRAME INFORMATION-

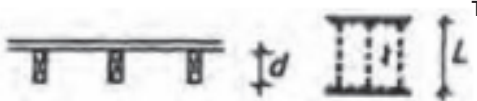
-The structure is a timber frame, as while it is more difficult to recycle once at end of life, its sourcing from FSC-certified forests in Wales means that it is easy to source locally.

-Utilising the Metric Handbook, I decided on the following spans:

Stud frame wall panel		Typical height (m) 2-4	h/d ratio 20-35
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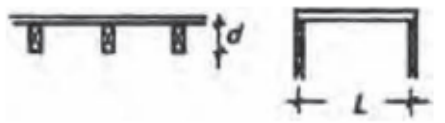
Extract from Table VIII, Page 6-9, Metric Handbook Sixth Edition

h= 2440mm  
d= 100mm  
h/d = 24.4 [SUITABLE]  
-100x50mm studs

Joists with floor board - Softwood - Hardwood		Typical depth (d,mm) 200-300 100-250	Typical span (m) L/d 2-6 2-7	L/d 12-20 22-28
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Extract from Table IX, Page 6-9, Metric Handbook Sixth Edition

d = 100mm  
L = 2000mm  
L/d = 20  
-100x50mm hardwood joists (due to higher ult. load)

Joists with roof deck - Softwood - Hardwood		100-225 100-250	2-6 3-8	20-25 30-35
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Extract from Table X, Page 6-10, Metric Handbook Sixth Edition

d = 100mm  
L = 2000mm  
L/d = 20  
-100x50mm hardwood joists - although L/d is atypical hardwood is more loadbearing and used elsewhere, so for continuity it is preferable.

In the same place (Page 6-9, section 5.2 through 5.8), a spacing of 450-600mm is recommended for timber stud frames. I decided on 500mm spacing in order to deal with the higher ultimate load (from the use of concrete tiles and the terrace) best, and offer the most stability.

I made use of cross-bracing in the corners (or close to the corners) of my frame, as this is where most of the load will be distributed through. As a consequence, for the most stability, cross-bracing is best here.

It is also worth noting that my scheme is sunk into the pierhead rather than built on top of it, so the concrete 'wall' the frame is against will also provide stability.



# Technological Submission | Structure-related Ultimate load calculations

## CALCULATIONS:

Taking g(gravitational constant) as 9.81,

-AREA OF CONCRETE TILES=  
Wall surface area - Fenestration surface area  
(2(5.594x8.647)+(5.594x4.648)+2(3.35x3.025)+(4.648x3.025))-(4.8+2.64+5.89+1.6+2.47)  
=140sqm (3sf), at 43kg/m2 according to manufacturer\*  
=421.83 N/m2  
=0.422kN/m2  
DEAD LOAD = 59.08kN

Party wall avg density = 0.24xPlywood Density + 0.76xInsulation Density  
=(0.24x700)+(0.76x30)  
=191kg/m3 (3sf) at 8.63m3 volume

Inner envelope density =  
Plywood Density(15/151)+Insulation Density(100/151)+OSB Density(36/151)  
= 700(15/151)+30(100/151)+635(36/151)  
= 241kg/m3 (3sf) at 21.1m3

DEAD LOAD = 0.001(9.81((191x8.63)+(241x21.1)))  
=66.1kN

-ROOF AND FLOOR DEAD LOAD  
Insulation volume = 12.0m3, at density 30kg/m3  
Load = 3.53kN

Timber floor density = 720kg/m3 or 7.07kN/m3  
Total floor area = 91m2  
Volume of timber in floors = 10.6m3  
Load = 74.8kN

Roof plywood load = 6.68kN

Window load (assumed 30kg as no info from manufacturer)  
=0.294kN

Aluminium density = 2710kg/m3  
Area of 1.2mm sheet = 70.3m2 (Volume = 0.08436)  
Load = 228.6156kg  
=2.24kN

TOTAL DEAD LOAD = 213kN (3sf)

## LIVE LOADS:

Room Type	Activity Cat.	Area (sqm)	Live Load (kN)
Atrium	C11	13.7	27.4
Hallway	C31	18.2	54.6
Toilet	B2	8	24
Conference Room	B1	12	30
Control Room	E11	7.6	8.55
Changing Room	B2	2.85	8.55
Storage	E13	3.5	16.8
Stairs	C32	2.2	6.6

Activity categories obtained from BS EN 1991-1-1:2002 Table 6.1, imposed loads per metre squared for each category obtained from the same place, table 6.2.

TOTAL IMPOSED/LIVE LOAD = 183kN (3sf)

Wult = (yg\*Gkj) + (yq\*Qkl)  
=(Dead load partial factor (1.35) x Dead Load) + (Live Load partial factor (1.5) x Live Load)

=1.35x213 + 1.5x183

=287.55 + 274.5

ULTIMATE LOAD =562kN (3sf) OR 6.2kN/m2



# Bibliography

## AD1 SUBMISSION-

### ACADEMIC WRITING

1- Jaibee, Shafizan, Abd Khalil Abd Rahim, Fariza Mohamad, Saifulnizan Jamian, Sia Chee Kiong, and Yokoyama Seiji and others, "Review On Current Status Of Waste Electric And Electronic Product In Malaysia", Applied Mechanics And Materials, 773-774 (2015), 898-907 <<https://doi.org/10.4028/www.scientific.net/amm.773-774.898>>

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### PHOTOGRAPHS

Figure 3- C Jill Reid, "Glamorgan Sausage", 2007, [https://commons.wikimedia.org/wiki/File:Glamorgan\\_sausage.jpg](https://commons.wikimedia.org/wiki/File:Glamorgan_sausage.jpg) accessed 2022-02-14

Figure 5- 'Rhyshuwl', "Cawl Cymreig", 2009, [https://commons.wikimedia.org/wiki/File:Cawl\\_Cymreig.jpg](https://commons.wikimedia.org/wiki/File:Cawl_Cymreig.jpg) accessed 2022-02-14

Figure 7- Photographer unknown, image source <https://www.thermofloc.com/en>

Figure 8- 'dave\_7', "Airstream Trailer", 2006, <https://commons.wikimedia.org/wiki/File:AirstreamTrailer.jpg> accessed 2022-02-15

Figure 9- 'Rwendland', "Midland Hotel, Morecambe, in evening sunlight.", 2008, [https://commons.wikimedia.org/wiki/File:Midland\\_Hotel,\\_Morecambe,\\_in\\_evening\\_sunlight.jpg](https://commons.wikimedia.org/wiki/File:Midland_Hotel,_Morecambe,_in_evening_sunlight.jpg)

Figure 10 - Photographer unknown, c. 2018, image source <https://www.napparchitects.com/en/component/k2/7-projects/57-pop-up-container-cafe> accessed 2022-03-29 [Image 3 of 19]

Figure 12 - Taken by William Parris, 2022

Figure 17 source- [https://en.wikipedia.org/wiki/Flag\\_of\\_Wales](https://en.wikipedia.org/wiki/Flag_of_Wales) accessed 2022-03-29

Figure 18- Artist unknown, sourced from <https://www.historic-uk.com/HistoryUK/HistoryofWales/The-National-Eisteddfod-of-Wales/> accessed 2022-03-29

Figure 19- Llywelyn2000, "Prifardd Robin Owain, Welsh poet", 1990, [https://commons.wikimedia.org/wiki/File:Eisteddfod\\_1991.jpg](https://commons.wikimedia.org/wiki/File:Eisteddfod_1991.jpg) accessed 2022-03-29

Figure 20- Sionk, "Y Lle Celf 2018 paintings in the Senedd", 2018, [https://commons.wikimedia.org/wiki/File:Y\\_Lle\\_Celf\\_2018\\_paintings\\_in\\_the\\_Senedd.jpg](https://commons.wikimedia.org/wiki/File:Y_Lle_Celf_2018_paintings_in_the_Senedd.jpg) accessed 2022-04-16

Figure 21 - Photographer unknown, 2020, part of article by Luke Smith on Autosport [<https://www.autosport.com/f1/news/silverstone-renames-pit-straight-to-honour-f1-champion-lewis-hamilton-4976378/4976378/>] accessed 2022-04-16

Figure 22 - Photographer unknown, part of 2019 article by Andrew Jack on Financial Times [<https://www.ft.com/content/46582248-133a-11e9-a581-4ff78404524e>] accessed 2022-04-16

Figure 23 - Photographer unknown, "Pavilhao Bruxelas 5", circa 1958, part of the Bernardes Arquitetura webpage [<https://www.bernardesarq.com.br/en/memoria/de-bruxelas-2/#group-5>] accessed 2022-04-16

Screen image on DP4 Elevations acquired from <https://www.racefans.net/2019/10/30/too-much-information-why-f1-is-adding-yet-more-tv-graphics/>

## AT1 SUBMISSION-

### SOFTWARE USED

Google Earth  
Climate Consultant 6.0  
<https://drajmarsh.bitbucket.io>  
Autodesk Formit Pro for Windows 2023  
Autodesk AutoCAD 2021  
Opaque 3.0  
SketchUp Pro 2021

### RESEARCH LINKS

[https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/cardiff-airport\\_united-kingdom\\_3345295](https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/cardiff-airport_united-kingdom_3345295) accessed 2022-04-27  
<https://www.greenbuildingadvisor.com/article/choosing-triple-glazed-windows> accessed 2022-04-28

### CONSTRUCTION DETAIL PRECEDENTS

-Löwenbräu Complex in Zurich, CH <https://inspiration.detail.de/loewenbraeu-complex-in-zurich-113606.html> accessed 2022-04-27  
-Office Block in Alpnach, CH <https://inspiration.detail.de/office-block-in-alpnach-115181.html> accessed 2022-04-27  
-Overcast House in London, UK <https://inspiration.detail.de/overcast-house-in-london-115199.html> accessed 2022-04-27

### MATERIAL MANUFACTURERS

<https://www.aluminiumrainflow.co.uk/product-page/210-250mm-wall-coping-3m-length-select-wall-width>

[https://www.diy.com/departments/corrapol-white-aluminium-corrugated-wall-flashing-l-6m-w-165mm/5060865934334\\_BQ.prd](https://www.diy.com/departments/corrapol-white-aluminium-corrugated-wall-flashing-l-6m-w-165mm/5060865934334_BQ.prd)

<https://applebys-tiles.co.uk/products/clay-grey-concrete-effect-18mm-exterior-tiles>

<https://www.wickes.co.uk/Mapei-Fix+Grout-Ceramic+Porcelain-Tile-Adhesive-for-Concrete+Wooden-Floors-15kg/p/114251>

<https://www.building-supplies-online.co.uk/sterling-osb-3-board-11mm-x-2440mm-x-1220mm.html>

<https://flooringwarehousedirect.co.uk/product/recticel-eurothane-gp-pir-rigid-insulation-board-2-4m-x-1-2m-x-100mm/>

<https://www.insulationsuperstore.co.uk/product/polythene-vapour-control-layer-from-novia-1000-gauge-100m2-diy-kit.html>

<https://hanson-plywood.co.uk/products/birch-plywood-wall-panelling/>

[https://www.travisperkins.co.uk/treated-timber/c24-kiln-dried-regularised-sawn-treated-timber-47mm-x-100mm-x-4-8m/p/206910?gclid=CjwKCAjwlcaRBhBYEiwAK341jU-nMqgbLYMRpCWXDp70-m6kuuKJQQAjGHIUtlLeAEiShUsGCWbNhRoCut0QAvD\\_BwE&gclsrc=aw.ds](https://www.travisperkins.co.uk/treated-timber/c24-kiln-dried-regularised-sawn-treated-timber-47mm-x-100mm-x-4-8m/p/206910?gclid=CjwKCAjwlcaRBhBYEiwAK341jU-nMqgbLYMRpCWXDp70-m6kuuKJQQAjGHIUtlLeAEiShUsGCWbNhRoCut0QAvD_BwE&gclsrc=aw.ds)

<https://www.fibreglassroofingkits.co.uk/5-square-metre-450g-fibreglass-roof-kit-ral-7045-dark-grey>

<https://www.velux.co.uk/products/flat-roof-windows/curved-glass-new-generation>

<https://spectrumarchitectural.com/internorm-hf-310-studio-timber-aluminium/>

<https://www.travisperkins.co.uk/treated-timber/c24-kiln-dried-regularised-sawn-treated-timber-47mm-x-150mm-x-4-8m/p/206904>

[https://www.woodandbeyond.com/real-wood-flooring/solid-wood-flooring.html?gclid=CjwKCAjwsJ6TBhAIEiwAfl4TWEsX6rwPlwwD-632w3R5yUfEqPcQAQgB4mdrAgGdPL773\\_wo0kX\\_-RoCSAIQAvD\\_BwE](https://www.woodandbeyond.com/real-wood-flooring/solid-wood-flooring.html?gclid=CjwKCAjwsJ6TBhAIEiwAfl4TWEsX6rwPlwwD-632w3R5yUfEqPcQAQgB4mdrAgGdPL773_wo0kX_-RoCSAIQAvD_BwE)

[https://www.wickes.co.uk/Tarmac-Granular-Sub-Base-Mot-1-Jumbo-Bag/p/131895?gclid=CjwKCAjwsJ6TBhAIEiwAfl4TWPKG-g1L3K1oc8sPysC-dyFnrbQ40GrIYOutQqANQJx01XITubIXj0xoCuysQAvD\\_BwE&gclsrc=aw.ds](https://www.wickes.co.uk/Tarmac-Granular-Sub-Base-Mot-1-Jumbo-Bag/p/131895?gclid=CjwKCAjwsJ6TBhAIEiwAfl4TWPKG-g1L3K1oc8sPysC-dyFnrbQ40GrIYOutQqANQJx01XITubIXj0xoCuysQAvD_BwE&gclsrc=aw.ds)

[https://lordsbm.co.uk/toplite\\_gti\\_2.9n\\_100mm\\_block\\_lcf00090/](https://lordsbm.co.uk/toplite_gti_2.9n_100mm_block_lcf00090/)

<https://www.mpmoran.co.uk/100x440x215mm-tarmac-toplite-7-block-100011638>

### STANDARDS & PUBLICATIONS

CIBSE Guide A - Environmental Design (8th Edition)  
EN 16798-1  
EN 1991-1-1 2002  
Pamela Buxton, METRIC HANDBOOK OF PLANNING AND DESIGN DATA, 6th edn (New York: ROUTLEDGE, 2018)

