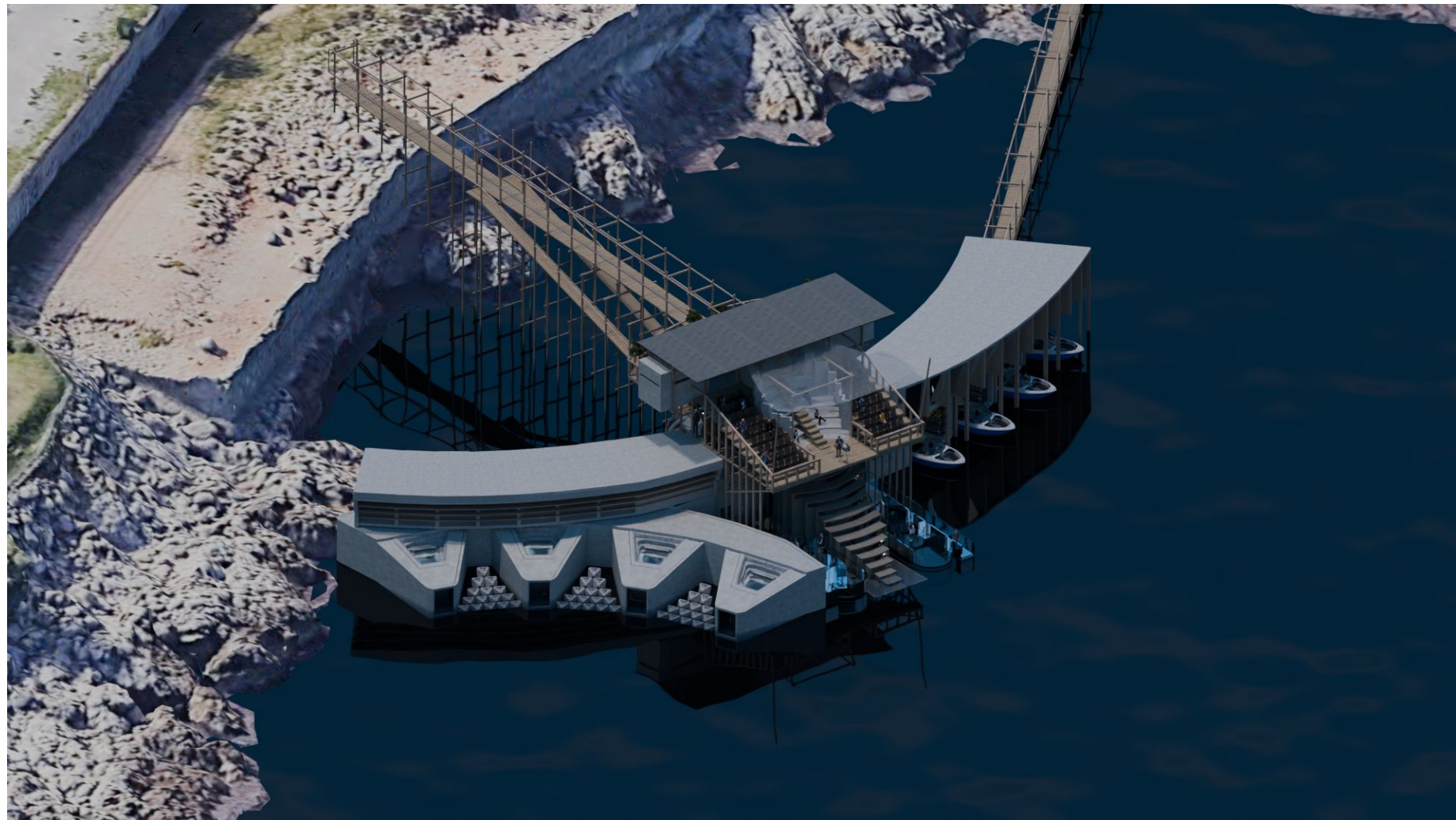
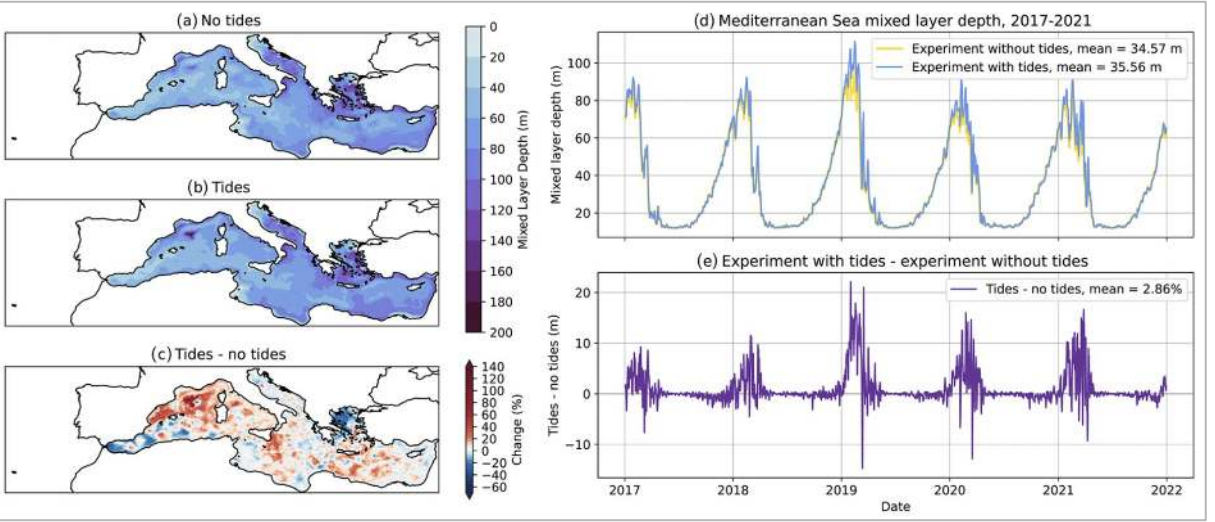
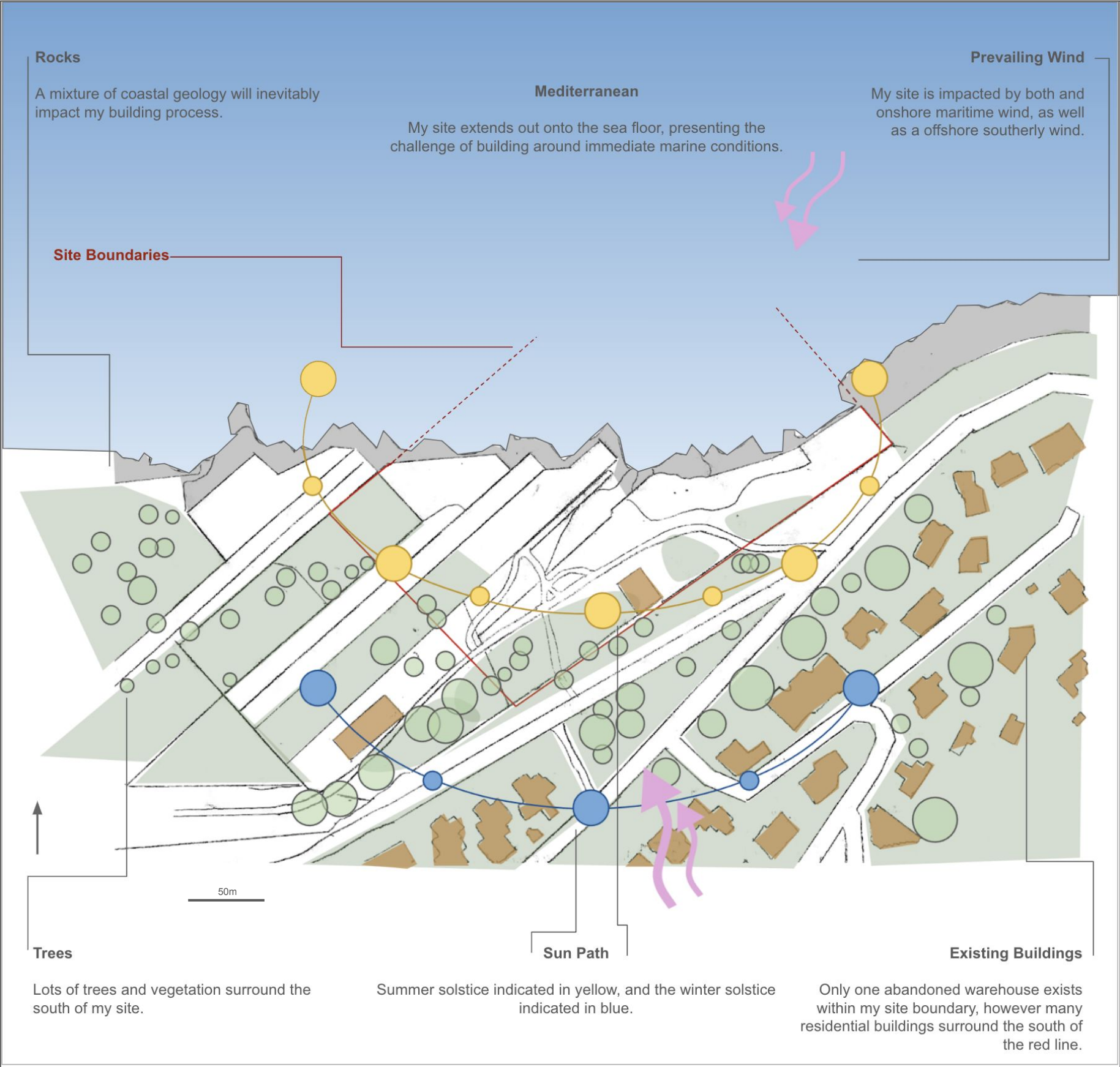


AQUATIC FILM SCHOOL

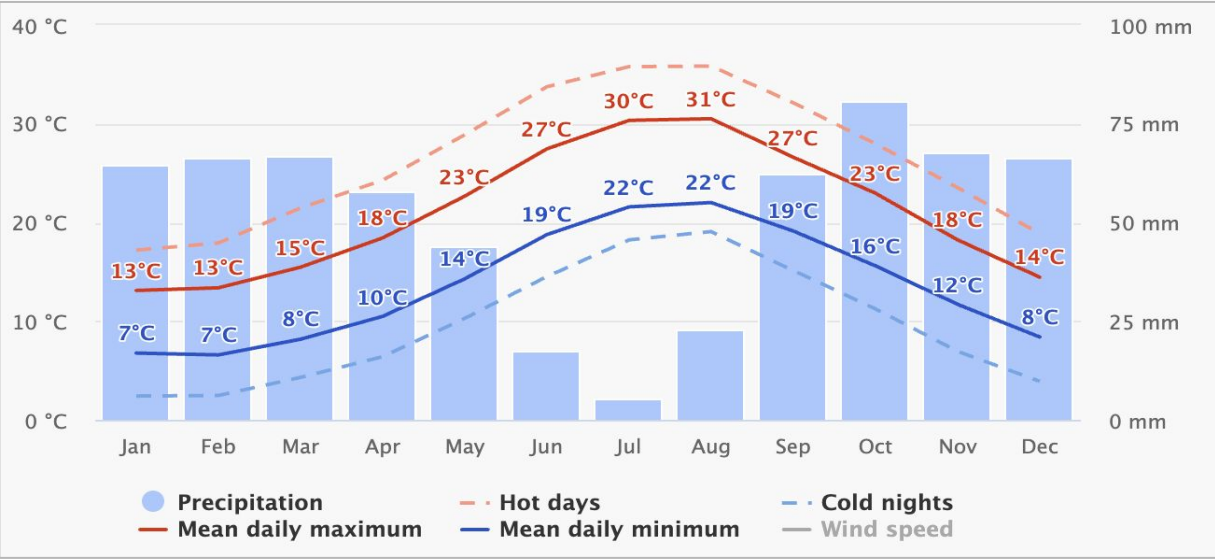
DESIGN AND TECHNOLOGY

Oscar Lakatos, UG5, SN - 23011379





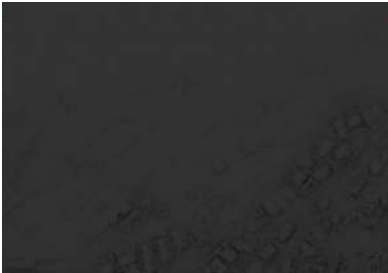
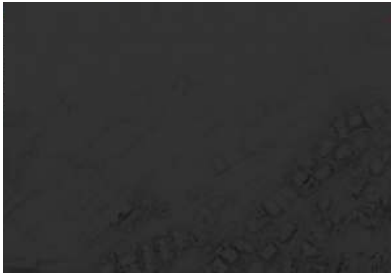
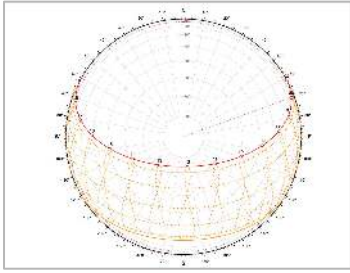
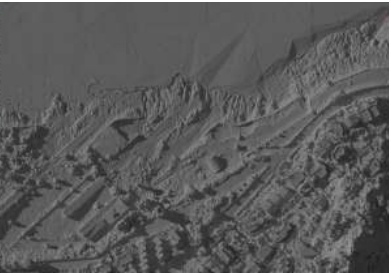
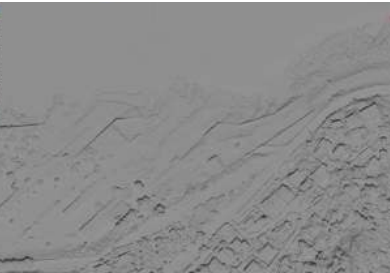
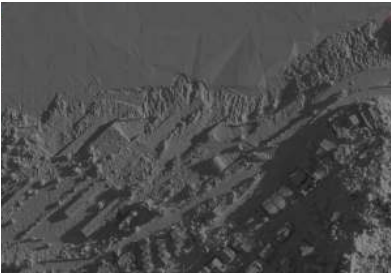
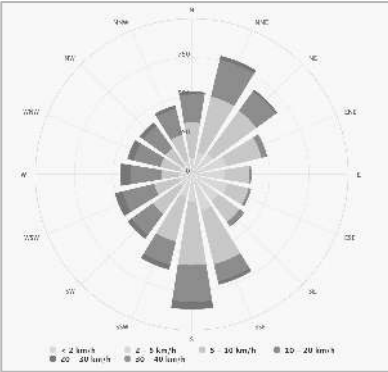
Tides
From the diagram above, you can see that Northern Sicily isn't exposed to significant tidal behaviour, with maximum tide variation of 32cm. There is minimal seasonal change, and a relatively low mixed layer depth.



Climate
This climate graph indicates fairly significant seasonal variations in temperature and precipitation, with very hot and dry summers, and much wetter and cooler winters.

Wind
There are two predominant wind directions in my site coming from a southerly (Sirocco) and north easterly direction (Tramontana and Bora). There's a peak average wind speed in February, 8.6mph and a lowest average in August, with 7.8mph.

Sun
Daylight varies from a maximum of almost 15 hours in the summer and a minimum of 9.5 in the winter. Renders are shown below at 6am, 12pm and 6pm on these two extreme days. During the summer the sun reaches a peak angle of 76°, and in the winter 30°. A large hill behind the site causes extreme shade in the winter.



6am

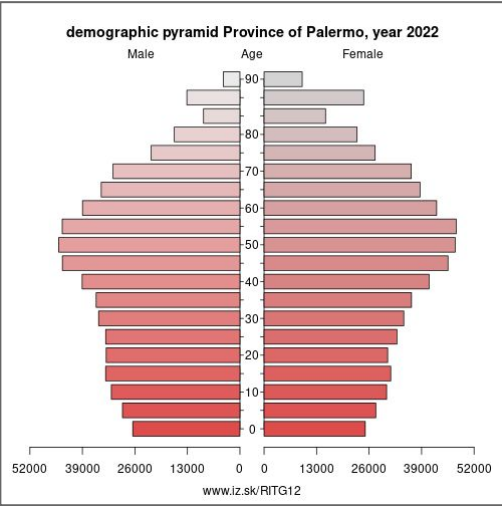
12pm

6pm

6am

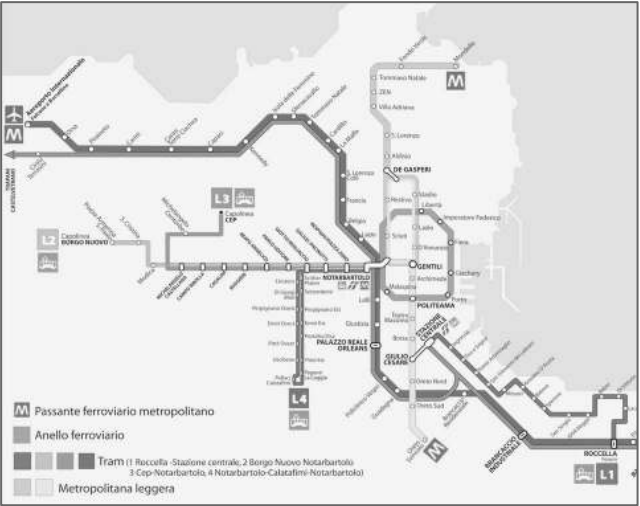
12pm

6pm



Demographic Context

From this population pyramid, it is clear that Palermo is currently home to an ageing population. This is especially true in the town Mondello which neighbours my site. One of my design goals it to provide a community space for this particular demographic.

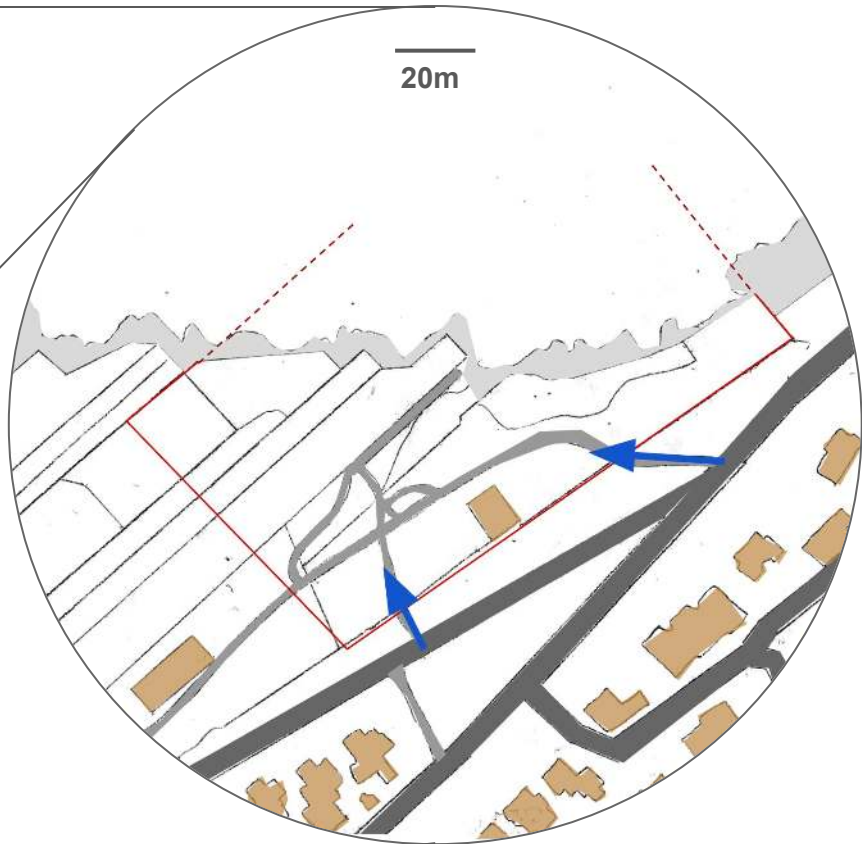


Public Transport

My site is accessible by a series of buses from Palermo's city center, although this is rather inefficient, as buses are infrequent and a change is required. The outreach of my building will be primarily local.

Access Points/Connectivity

It is approximately a 20 minute drive from Palermo's city center to my site, 45 minutes by public transport and a 40 minute cycle. The map below on the left shows these routes. Immediate access points include a footpath from the south and a gravel road from the southeast.



Sea floor Topography

I mapped the seafloor surrounding my site using Garmin Boating data. In my diagram, each horizontal line represents a depth of 0.5 meters. Not far from the coastline, there is a sharp drop off to a depth of 5 meters.

Land Topography

From imagery and measurements, I divided my site's landmass into principle blocks before connecting it to the sea. It consists of parallel linear slopes extending out to the sea, with a more elevated section to the east. The design of my initial massings takes great care in adhering to these formations.

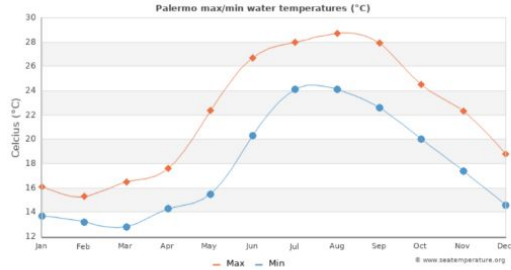
Surrounding Community

Fishing is a primary occupation amongst the immediate population, with many older citizens still working in this field. I intend to incorporate local fishing and spearfishing as a part of the documentary branch of my film school.

Funding

I intend to utilize the european union university funding policies.





Biodiversity

The varying sea temperatures, shown in the graph above, will inevitably result in seasonal variation of aquatic biodiversity, this is something I intend to facilitate for the submerged parts of my building.

Transpiration Cooling

The vegetation on site will naturally result in minor cooling, especially during summer months.

Surface Runoff

This will be more prevalent in winter months, however, facilitating an overflow of rain will not be a major concern due to the immediate coastline.

Sea Breeze

Northerly onshore breeze in the form of the Bora and Tramontana trade winds will result in natural cooling during the summer months, this may also cause wind erosion

Solar

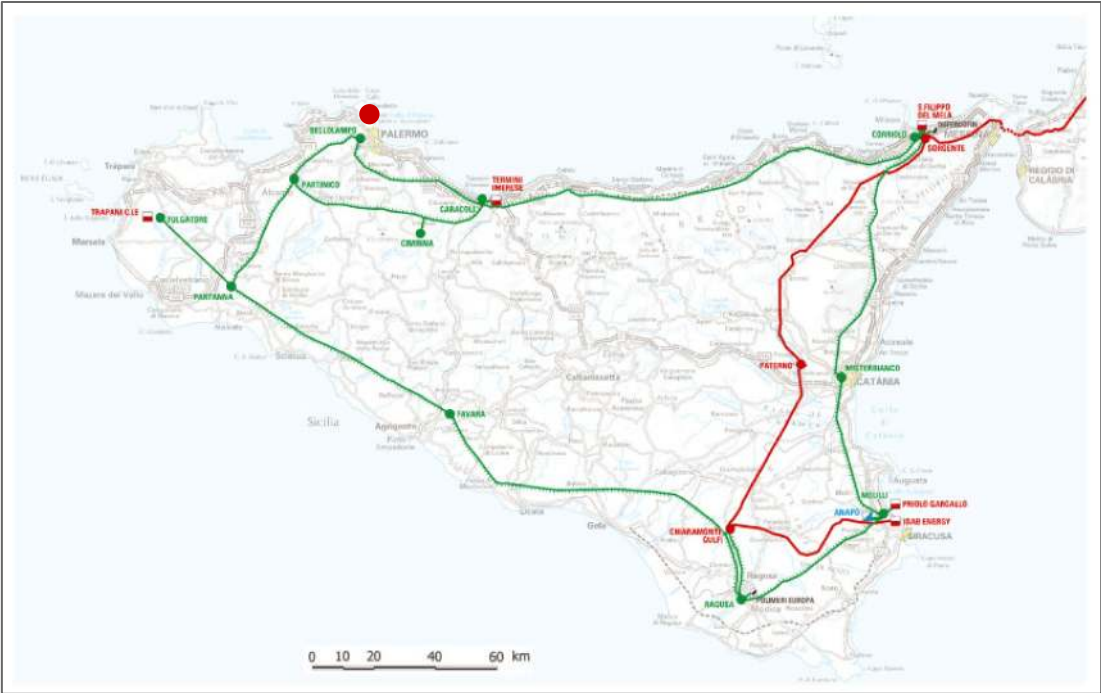
The site also has plenty of potential for solar energy during the summer months. There is an average of 7.4 hours of sunshine per day in Palermo, with this value peaking at 11 hours in July for which the sky is partially cloudy or mostly clear 95% of the time. Solar panels will present a great opportunity for renewable energy.

Energy from Water

Given my site's immediate interaction with the sea, It would be daft not to explore the opportunities for sustainable energy generation via to use of moving water. This is a subject I address in much more detail on my resource strategies page.

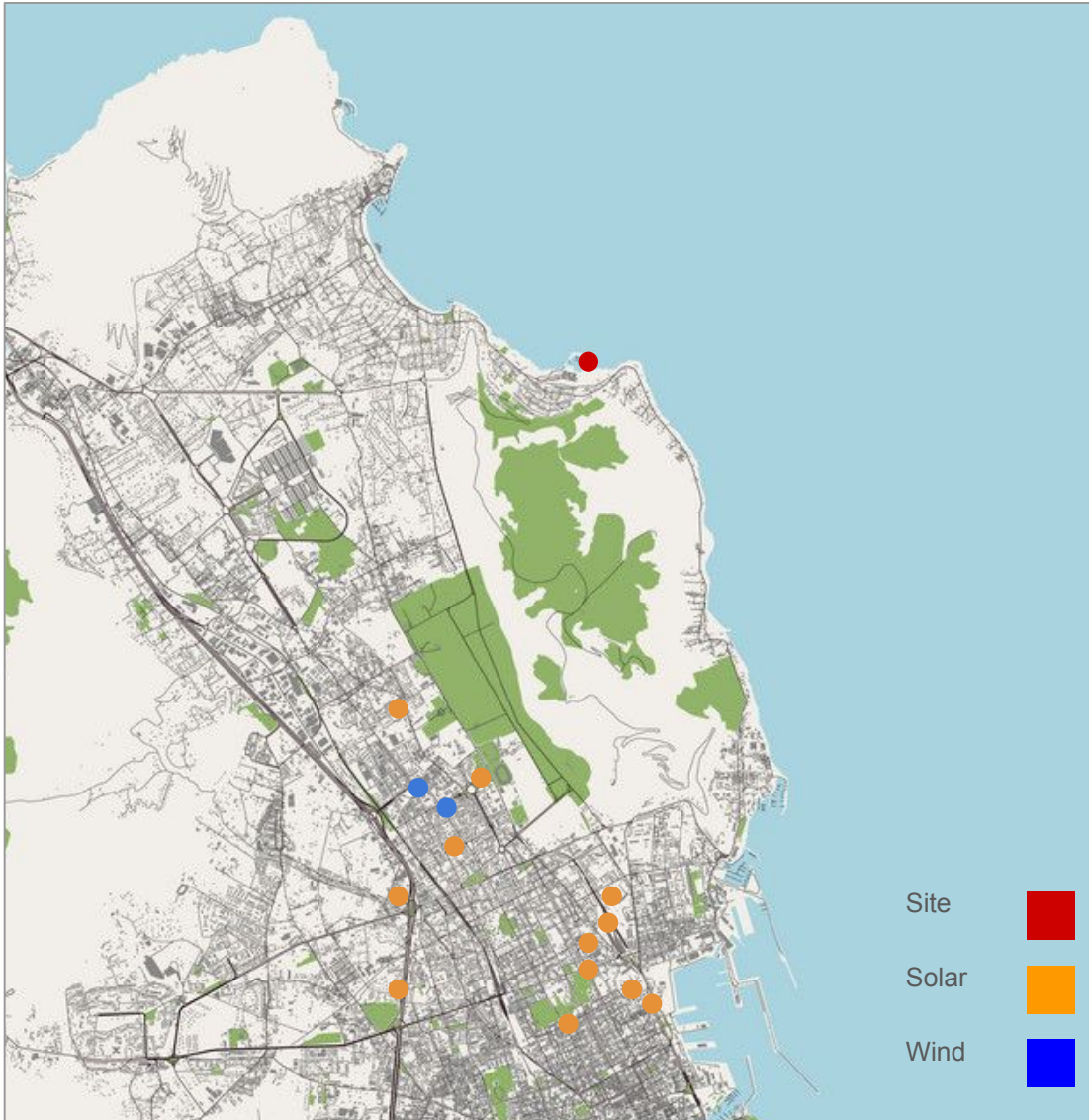
Power Sources

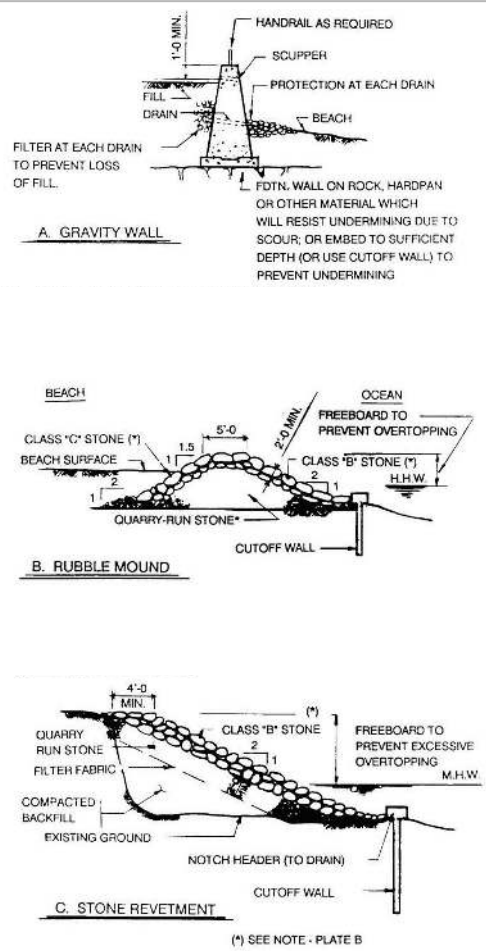
From this map on the right, you can see nearby energy sources in the city of Palermo, including solar (orange) and wind (blue) energy plants. I intend to use both the sun and the sea as sources of renewable energy for my film school.



Electricity Grid and Demands

This map of the electricity grid in Sicily shows that Palermo is well connected to a primary electricity source. Schools on average require 70 kWh/m2/year of electricity, and a further 200 kWh/m2/year of heating energy. A film school may demand more electricity if studio spaces are implemented. Cooling will be required in the summer, however heating is less of a priority due to the moderate winters in Palermo (this may become a requirement if my building is underwater).





Tide Control

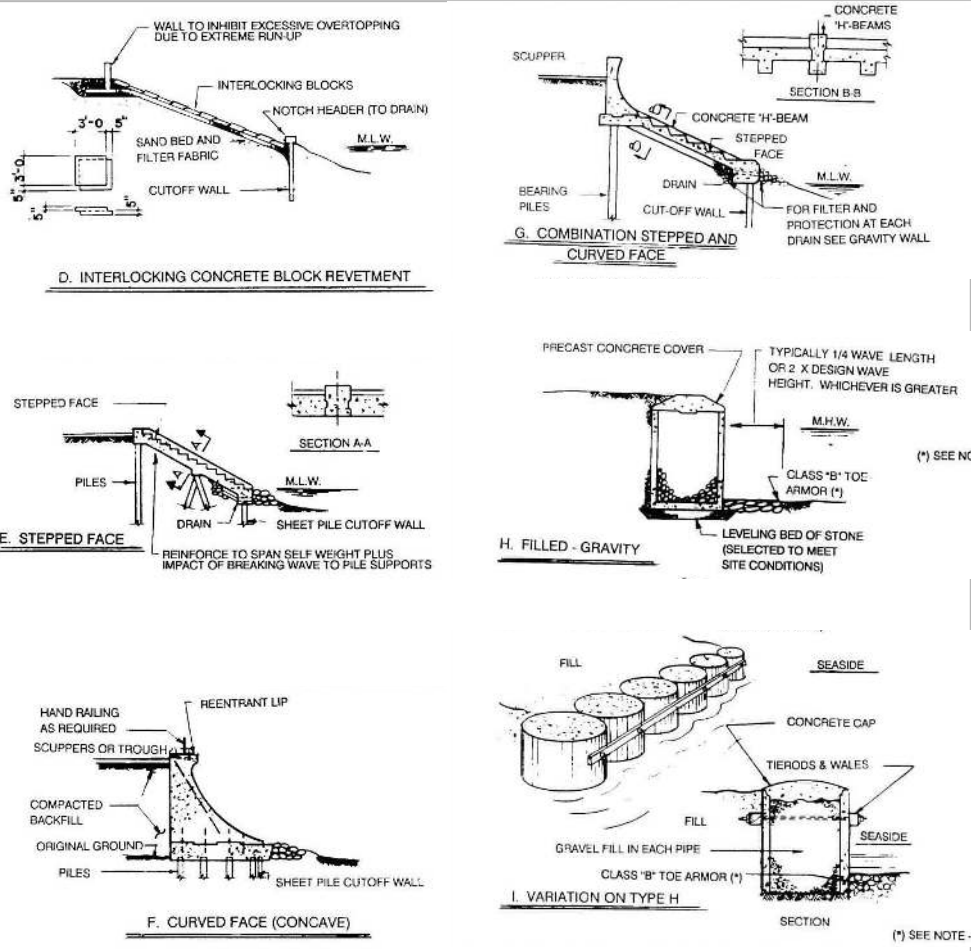
Due to frequent waves around my site it is important to implement a material that can resist subsequent erosion and dissipate the energy of these waves. My design could also incorporate elements of sea walls, primarily used to reduce wave erosion. These are made of either stone (on the left) or concrete (on the right). Both these materials are readily available on the island of Sicily.

Artificial Reefs

Since parts of my building will be submerged underwater, I thought that it would be important to facilitate for aquatic habitats. One way in doing this would be to create facades which encourage marine growth. Artificial reefs have been implemented around Palermo in the past, most of these utilised concrete structures. These can be seen below.

Textured Concrete

Econcrete is a concrete sea wall design which incorporates surface textures, chemical additives and structural forms in order to enhance the growth of aquatic biodiversity. When acting as a sea wall, these blocks generate rock pool environment enhancing local marine habitats whilst dissipating wave energy and reducing erosion. When dealing with my site which can be exposed to waves in excess of 3ft, it is essential to understand sustainable wave dissipation technology such as this. The photos below demonstrate how this technology is implemented



Existing Buildings

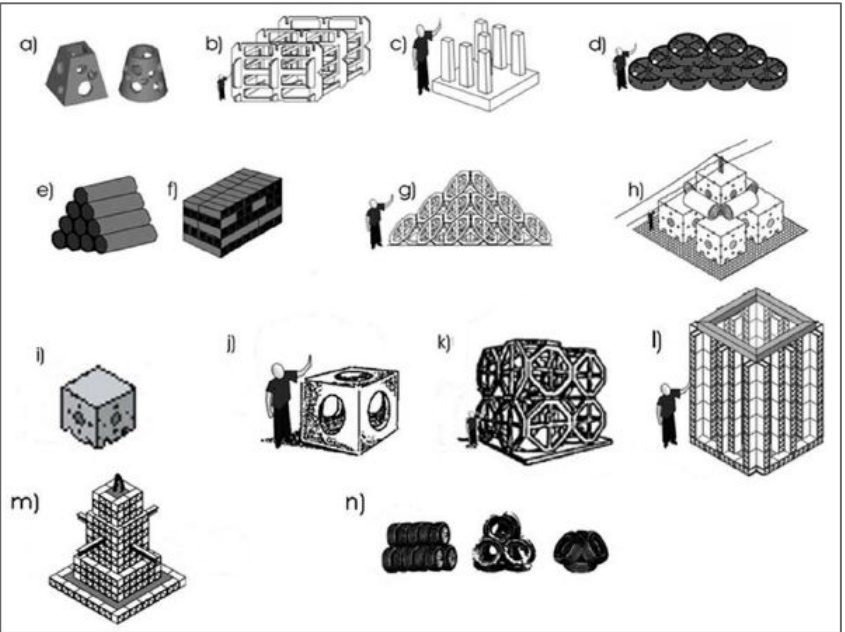
There are currently two existing buildings on my site, both made from a stone material. The larger takes up an area of 200 square meters whilst the smaller building takes 44. Currently my 3d massings don't overlap with these buildings, meaning that no removal will be required, however their materials might be useful for wave dissipation.



Programme Influence

I intend for my film school to include a documentary department. This will inevitably encourage the filming of the surrounding aquatic life. Therefore it is key for a healthy marine environment to be maintained in the immediate surroundings of the building in order to inspire and encourage potential student projects. Below you can see the various structures in which reef marine growth can be encouraged.

Reef Structures



ENVIRONMENTAL - STRATEGIES

Orientation

Above the water level the building will follow preexisting boat slips down towards the sea, facing to the north-east. Once the building submerges below the seafloor its orientation will shift to north. This northern direction will follow the natural direction of striations and rock formations found on the seafloor, reducing the requirement for seafloor reshaping. This angle will minimise the buildings exposure to prominent swells from the Northeast and Northwest.

Site Topography

The natural topography of my site (highlighted in the diagram to the right) consists of a series of tooth-like rocks extending out to sea. This pattern is interrupted as you reach land, due to a series of abandoned north-eastern facing boat slips. I intend to build in accordance to both the natural and man made topography of the site. The ground material, in particular the limestone bedrock underwater, will provide great foundations for concrete piles which will help to support a wave resistant structure.

Disturbance to existing landforms

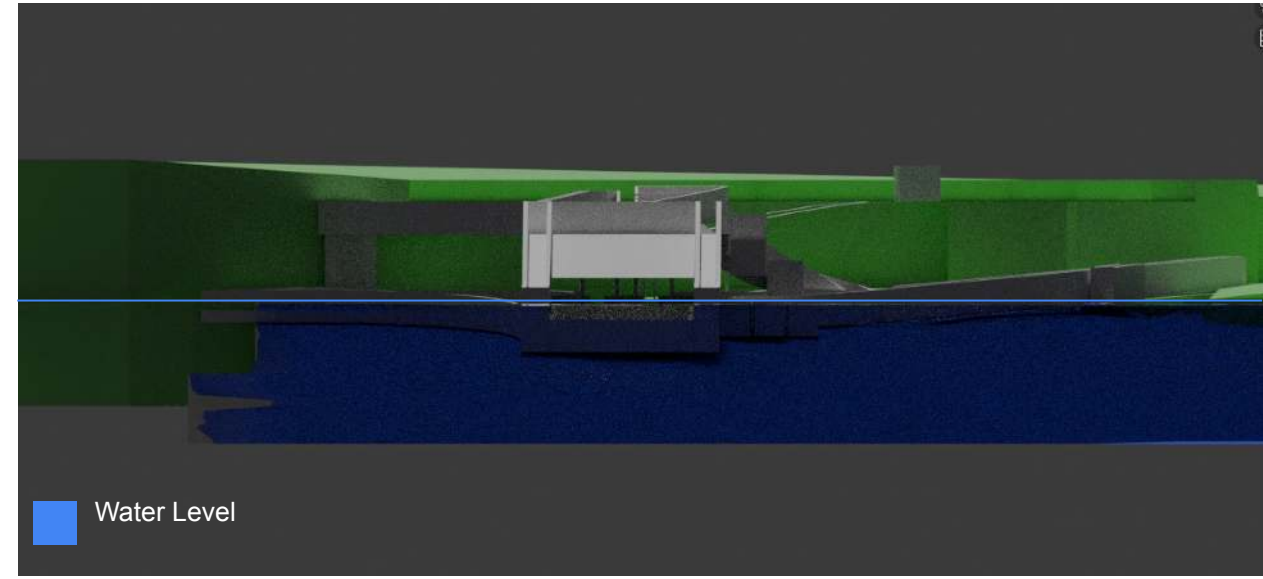
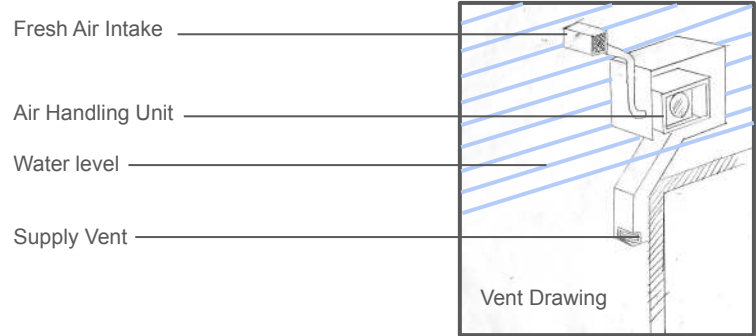
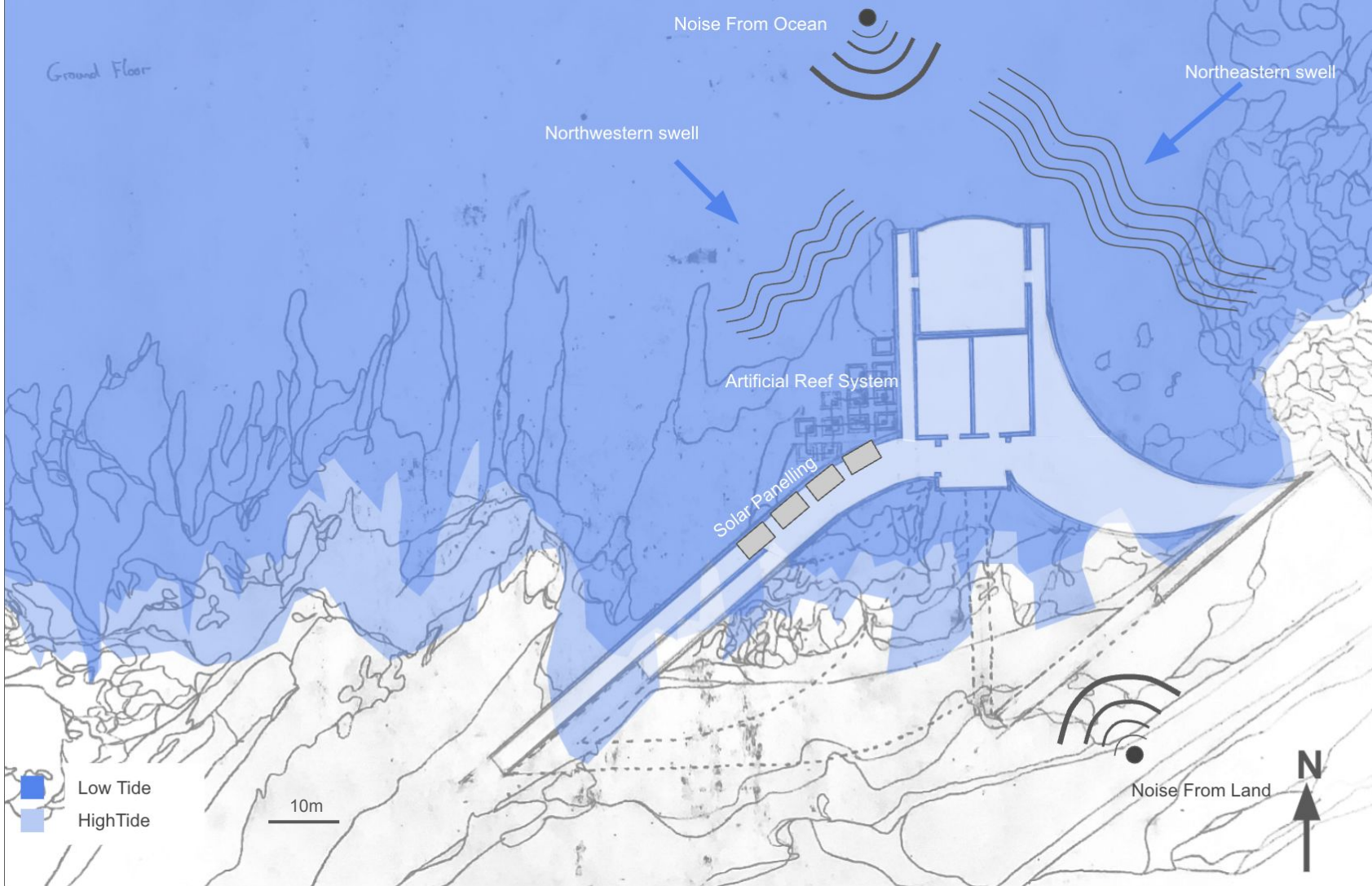
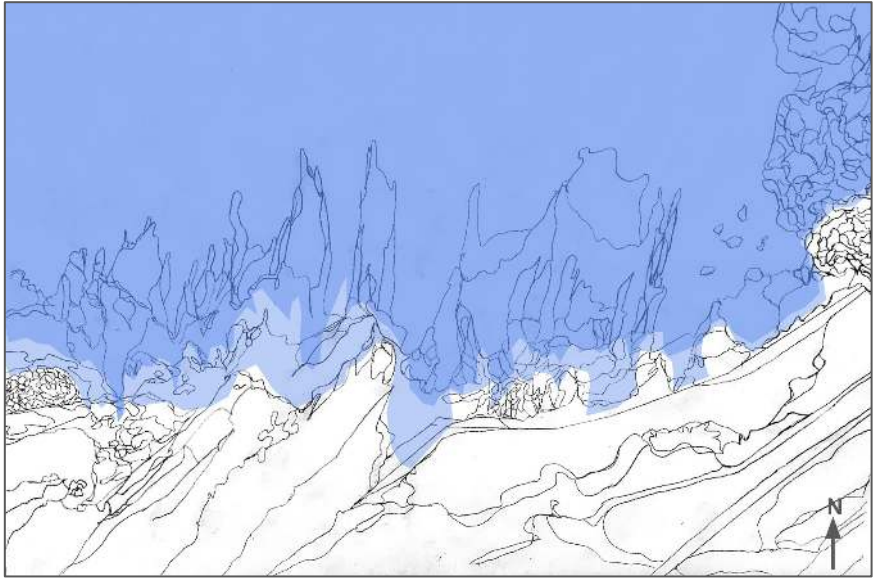
Due to the aquatic topography of my site, most of the construction below water will be done onto exposed bedrock, this will result in little reshaping of the sea floor. The textured concrete material used in construction will also to encourage habitat growth, meaning the small damage done will likely be regenerated post construction. Placing the building onto a series of piles will also reduce landform disturbance.

Noise

My site is mostly secluded from intense congestion, and therefore the majority of the noise experienced will be from the ocean itself. This will be great for immersing film students into the aquatic environment. The wind and waves in the regions can generate noises up to 85 dB

Erosion

Reduced landform disturbance will naturally reduce exposure to erosion. Hydraulic action is the key form of erosion that my building must avoid. Many passive strategies can be implemented in order to achieve this. Encouraging marine growth over the building's surface via the texturing of the concrete will provide bioprotection to oncoming waves, anchoring the building to bedrock with appropriate piles beneath the surface will also prevent shifts as a result of ocean swells. A tapered geometry will also reduce hydraulic pressure on the building when waves hit. My current model (seen above) demonstrates this.



Ventilation

Below the water's surface a mechanical ventilation system will be required in order to reduce condensation and maintain fresh air. This will consist of a fresh air intake above water, an air handling unit within the building, a duct system to distribute air beneath the sea and finally a return duct to remove stale air.

Summer Shading

Although half the building is submerged, I will still aim to incorporate more shade to the elevated parts of my building during the summer months.

Natural Light

Red and orange light will dissipate between 0-5 meters underwater. Therefore underwater views will be enhanced with filtered windows in order to regain this light and to bring more colour into the building.

As my building only extends 3m below the surface, submerged rooms will still receive sunlight.

Thermal Mass and Humidity Control

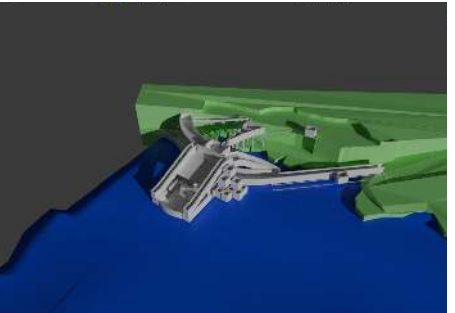
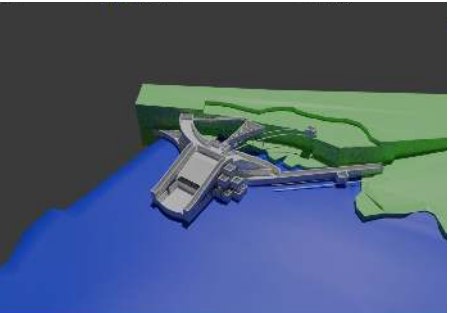
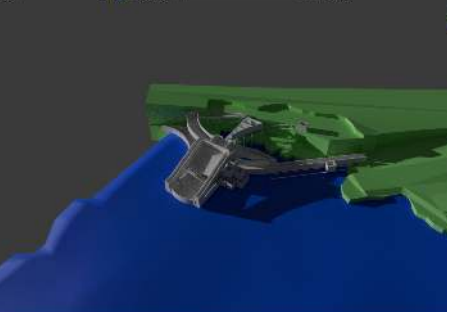
300-500mm thick concrete walls would provide thermal comfort at the depths I am building to (0-3m). High performance insulation will also have to be embedded into the walls to moderate temperature fluctuations. Mould resistant and non porous finished will regulate internal humidity. Silicate mineral paints such as Keim would be a good example as its alkaline, preventing mould growth, and its vapour permeable but water repellent.

Winter Shading

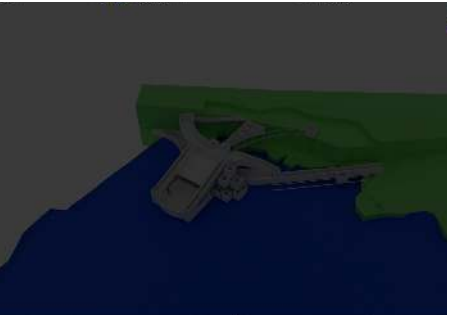
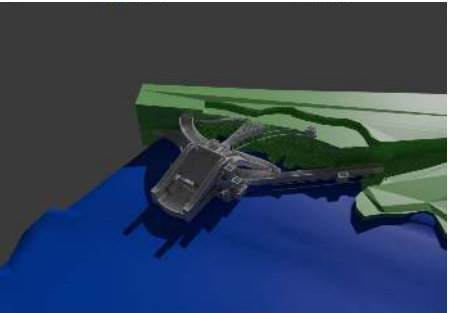
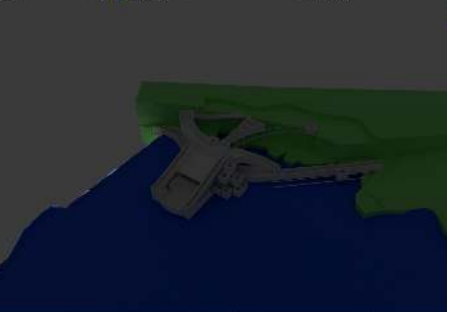
In these renders you can see how my building's orientation causes it to interact with sun and shade in the winter. I aim to get more sun exposure in future iterations in order to avoid the use of artificial heating.

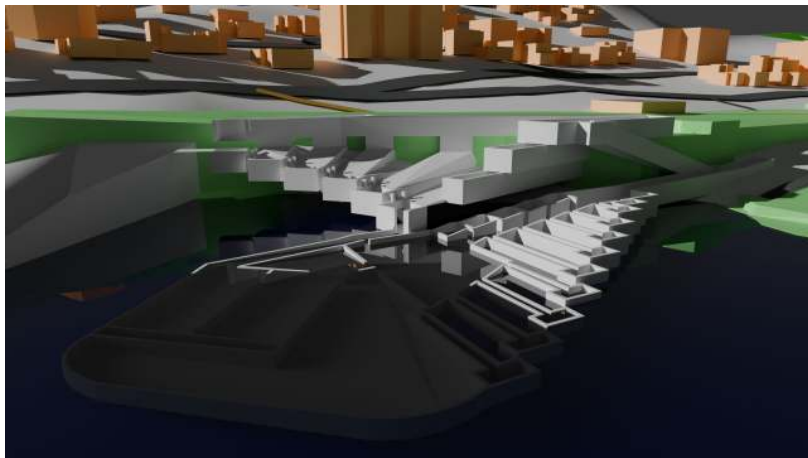
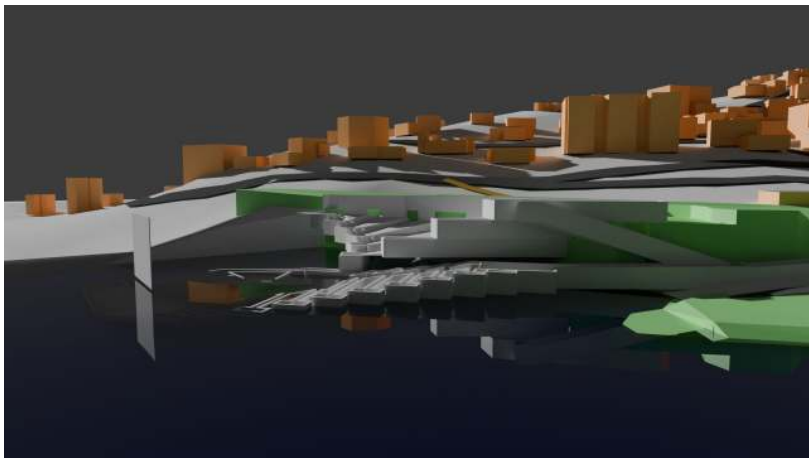
OSCAR LAKATOS - UG5

Summer Solstice Shading (6am, 12pm, 6pm)



Winter Solstice Shading (6am, 12pm, 6pm)





3D Massing

From the massing you can make out the extent to which the current iteration of the school lies under water, as well as its interaction with surrounding buildings. I have design this massing so that resident views are not blocked by my film school, causing minimal visual disruption to the tradition Sicilian coastal context

Community Impact

With my design I intend to mix the elderly population of Mondello with the youth of my film school. My building consists of a public screening space which will accommodate social mixing between these two demographics. Student screenings will also have public viewing, allowing for students to gain feedback as well as gain ideas from local community interaction. A student exhibition space will further encourage this demographic mixing.

Escape Routes

There will be low fire risk due to my material usage as well as the buildings interaction with water, however at the moment there are three principle exits. In future iterations I may implement exits leading directly into the sea in case of severe fires.

Building accessibility

My building will consist of many sweeping ramps, with very few stairs, making it wheelchair friendly. Heavy reliance on underwater spaces increase the risk of flooding, therefore in future iterations I will reduce the number of rooms below the water's surface in order to address this issue. I also aim to increase building circulation.

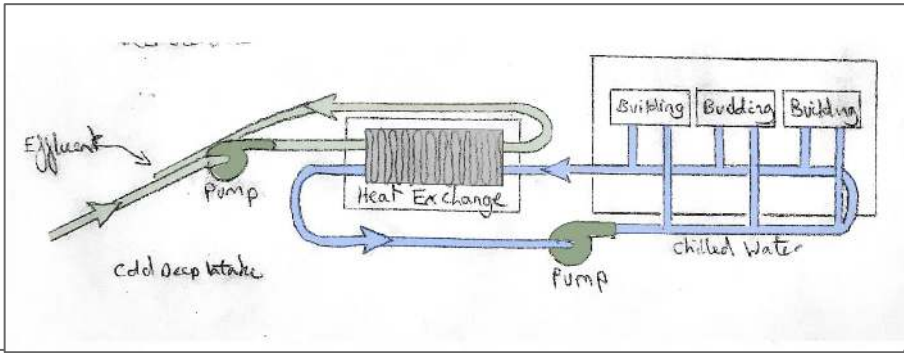
Building Flow Chart

The building users will consist of students, staff and the public. The public. The submerged parts of the building will only be accessible to students, whilst the elevated public viewing and exhibition space will be open to the public. However this spatial organisation is likely to vary in later iterations, meaning that mixing could be incorporated in further parts of the building.



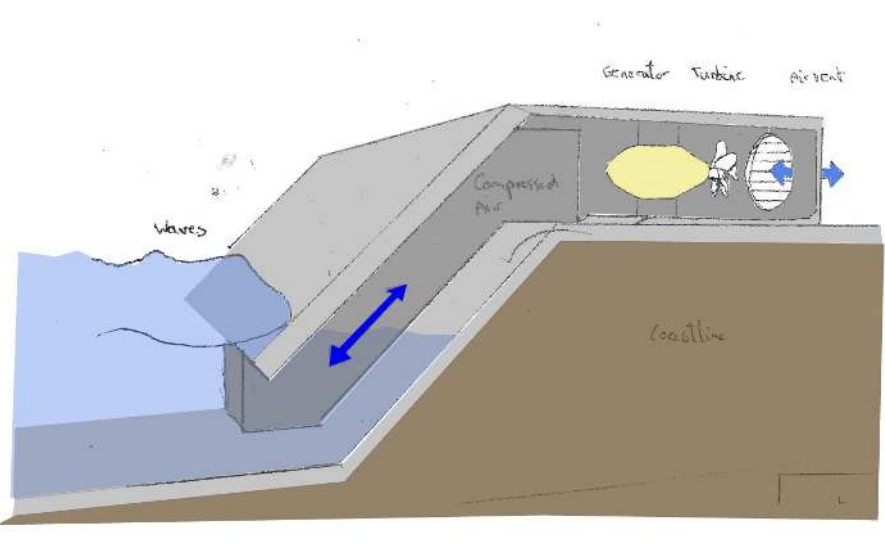
Seawater Air Conditioning

Cold water, is drawn from deep ocean sources, is pumped through a heat exchanger, where it absorbs heat from the building's air or water system. This cooled water is then circulated through the facility, providing air conditioning without the need for traditional refrigeration. SWAC significantly reduces energy consumption, offering an environmentally friendly alternative to conventional cooling methods.



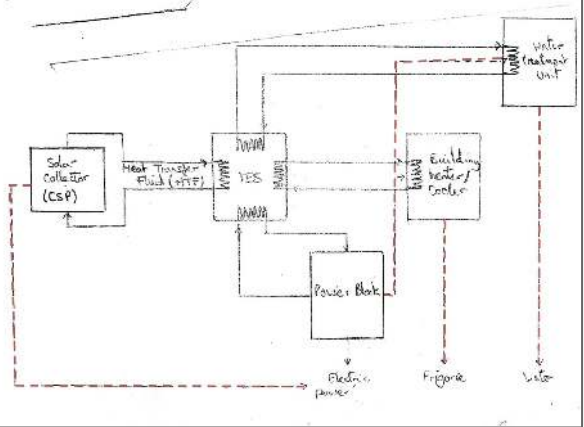
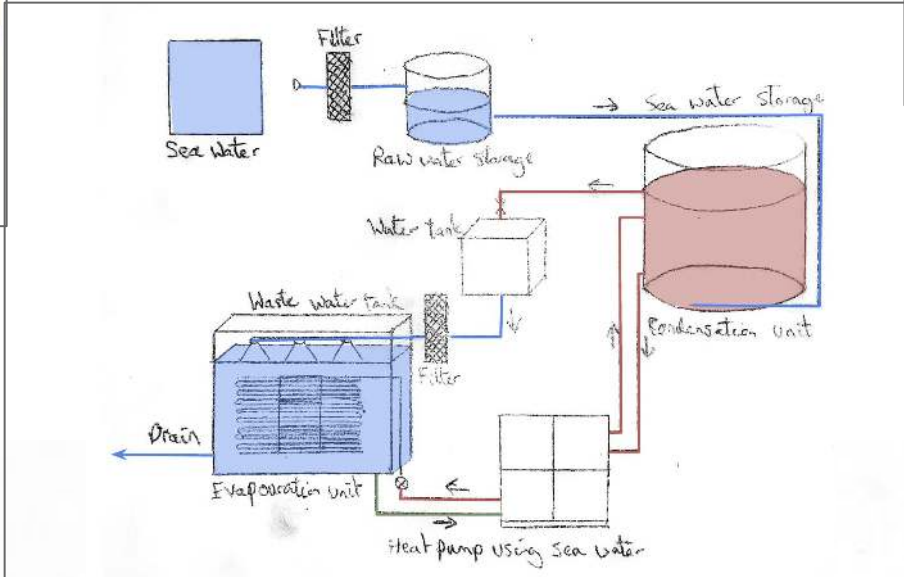
CSP Harvesting

Concentrated heat is used to generate steam, which drives a turbine connected to a generator, producing electricity. CSP systems can store energy by using the heat to melt salts, which retain the heat and can continue generating power even when the sun isn't shining. This method of solar energy harvesting is highly efficient and suitable for large-scale power generation. This system is utilized on a small scale in the nearby University of Palermo. Installing this technology into my building would therefore be easier seeing as it has been done recently using local building facilities. The diagram below explain this process in more detail. There would be space to install this system at the rear of my site.



Seawater Heating

Warm water, usually sourced from shallow coastal areas, is pumped through a heat exchanger. The heat from the seawater is transferred to the building's water system, providing space heating or hot water. This process is energy-efficient and environmentally friendly, as it utilizes naturally occurring heat from the ocean, reducing the reliance on traditional heating systems and lowering energy consumption. Wastewater can also be implemented into this process.

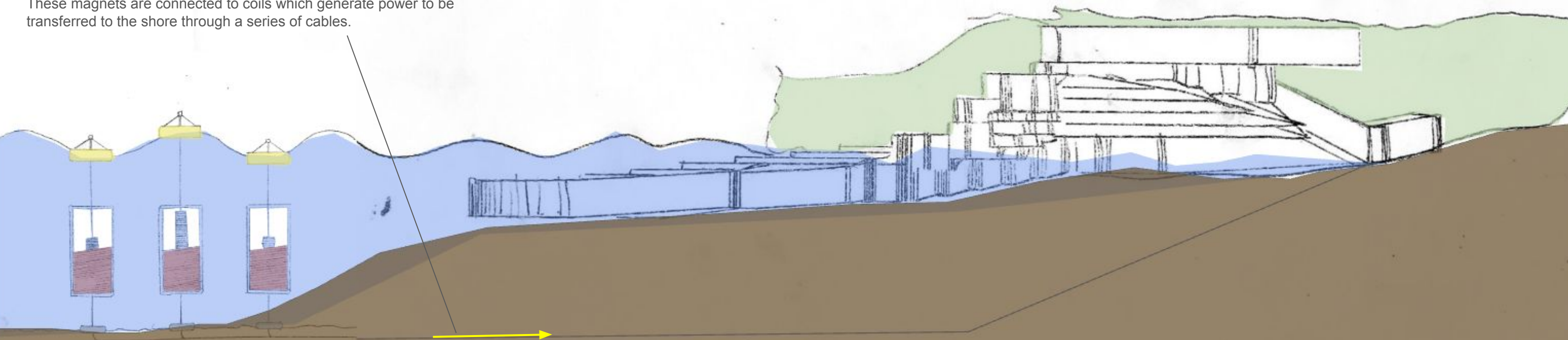


Wave Harvesting

Due to frequent ocean swells in and around my site, I thought using wave harvesting technology would be extremely useful in generating energy for my building. I have illustrated two ways in which this can be implemented. The first (above) includes a concrete structure which directs the waves into a chamber, where they compress air, resulting in generated wind to flow past and turbine, The second (below) includes a series of buoys which power a column of magnets as a result of fluctuating waves. These magnets are connected to coils which generate power to be transferred to the shore through a series of cables.

Impact on Biodiversity and Efficiency of Various Systems

Each of these strategies will inevitably impact biodiversity in one way or another. The SWAC will have a low impact, with slight thermal pollution (as it discharges colder water back into the sea and the possible suction of small marine organisms into the intake pipe). The 'Seawater Heating' would have a similar effect, with the discharge of warm water (this can be avoided if the wastewater is reused within the building). The CSP would have a higher impact on biodiversity as it would contribute to Palermo's urban heat island. The wave Harvesting would have the highest immediate effect on wildlife, as it can potentially disrupt, fish migration, sea floor habitats and surf zone ecosystems. Saying this, if utilised at a small scale, the wave harvesting techniques would generate the most energy (up to 50 MWh/yr), with the CSP equivalent generating roughly 10-15 MWh/yr. At a small scale, the SWAC would save 2-3 MWh/yr and the Seawater Heating equivalent would save 5-8 MWh/yr. These strategies seem to be inversely proportional in regards to biodiversity harm vs efficiency.

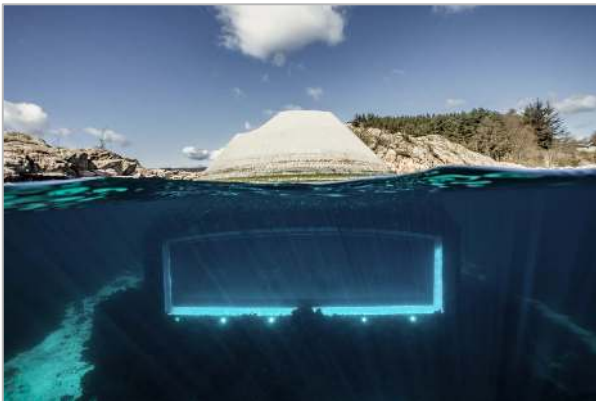


Encouraging Biodiversity

Encouraging marine biodiversity will be a key element in my building's design. Snohetta demonstrates an innovative way in doing this through the concrete facade of their 'Underwater Restaurant'. This facade consists of an uneven and inconsistent surface on which local marine habitats are encouraged to grow. From the images below you can see just how successful this has been, with marine plants completely engulfing the submerged face of the building. This has inspired me to move forward with concrete as a principle material in my building's design (especially in the submerged regions). The implementation of Econcrete technology will also be essential for the encouragement of rockpool biodiversity paralleled with wave dissipation to prevent structural erosion. Econcrete forms are displayed at the bottom of this slide.



Snohetta Underwater Restaurant

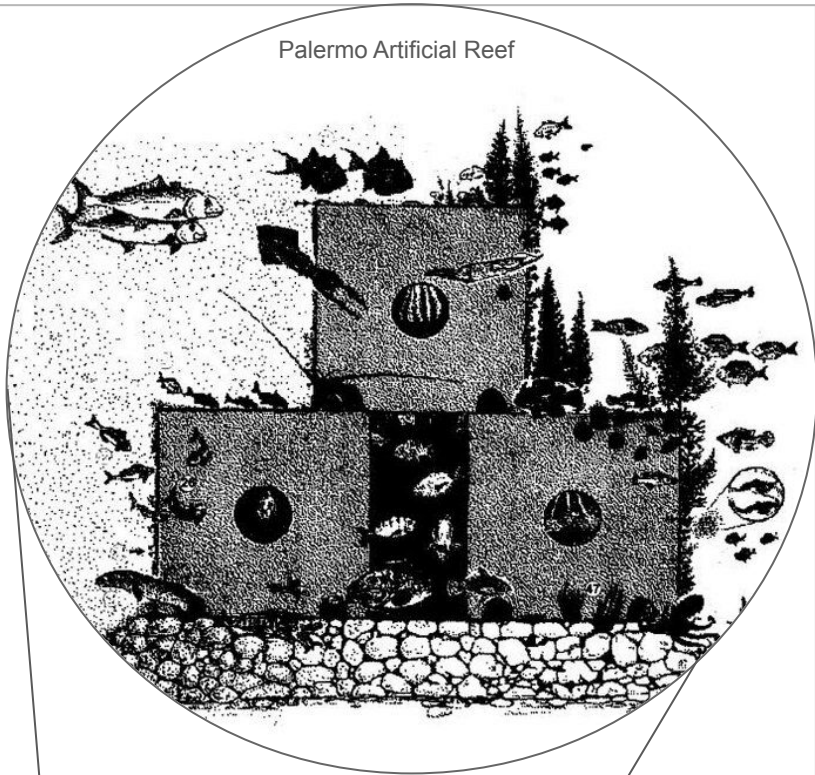
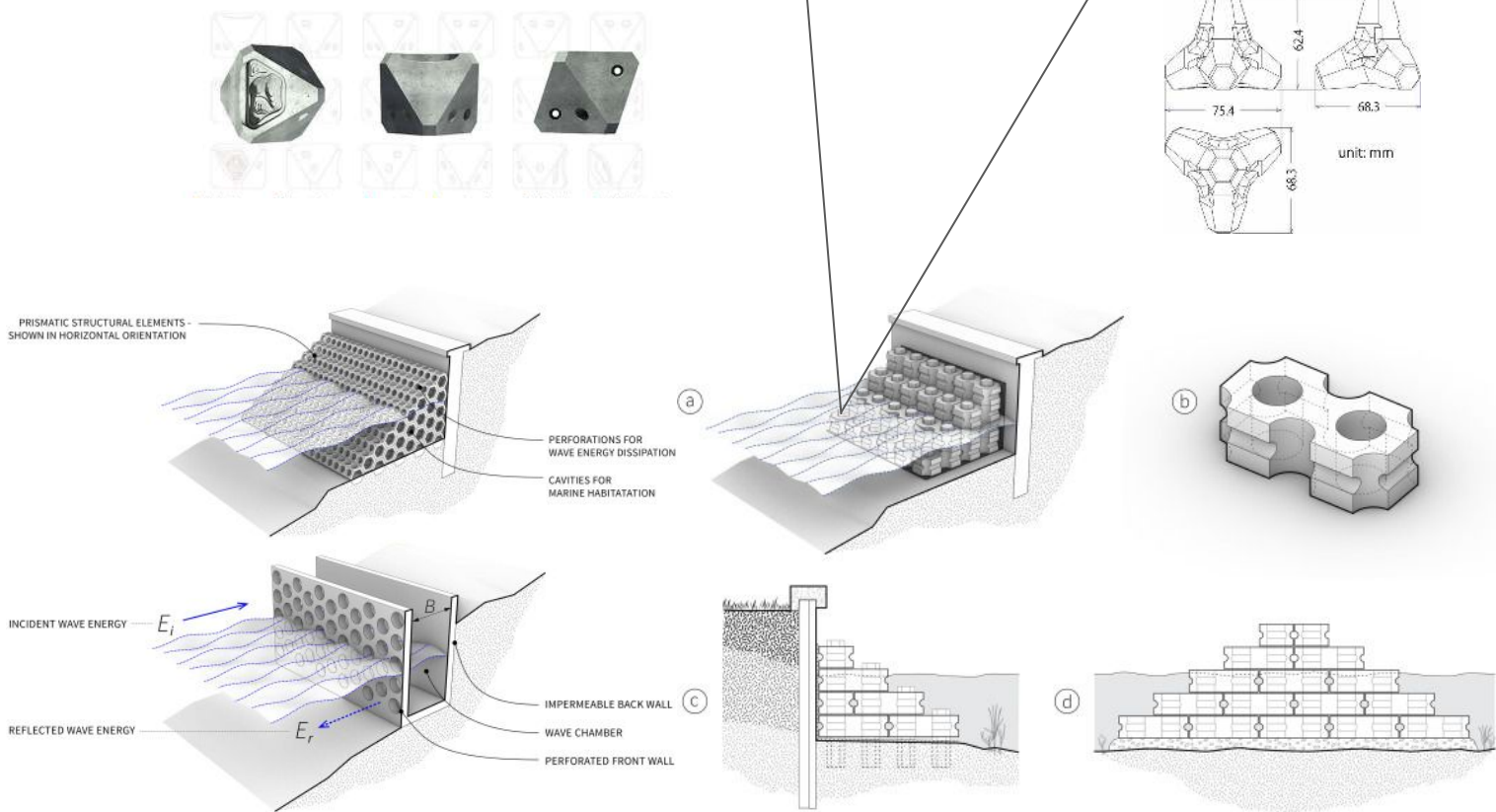


Wave Dissipation

When researching wave dissipation walls, I stumbled across a design which has a great resemblance to an artificial reef structure implemented in Palermo in the 90s. Both of these structures utilise concrete, This made me think of whether my buildings facade could both soften swells and encourage marine biodiversity simultaneously. All the diagrams shown below could be implemented in my submerged facade.

Concrete Mixing and Waterproofing

When contacting SICEP about concrete mixing, waterproofing would be essential. One way in which they would achieve this would be to add crystalline admixtures such as Xypex or Sika concrete powder. SICEP would make a decision based on compatibility with their mixture. Xypex would also add to the sustainability of the concrete as it would increase lifespan due to chemical reactions resulting in self sealing microcracks over time. Adding CSMs to the mixture such as fly ash or ground granulated blast furnace slag (GGBFS) whilst reducing cement usage would reduce the carbon footprint by 40% and also increase the impermeability of the concrete. Sicep's custom mixing potential mentioned on their website would mean that this is achievable.



Palermo Artificial Reef



Avoiding Erosion

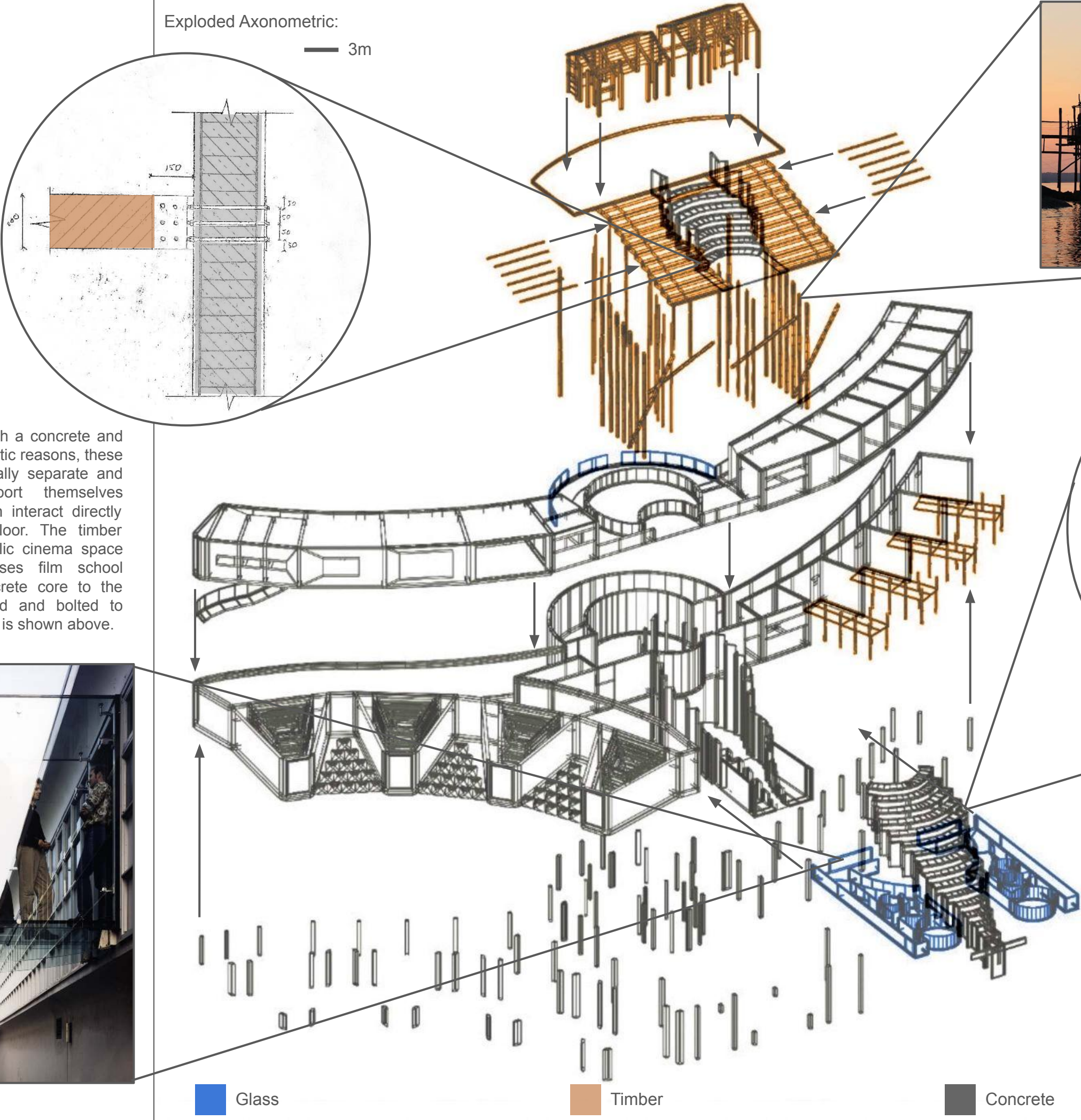
Alvaro Siza Swimming Pool

In Alvaro Siza's design of his Leça da Palmeira swimming pool he dealt with very similar topography to my site. He decided to use concrete as a primary building material. "The corrosive air calls for an impervious material palette, so water, sand and salt are all an integral part of the architecture. The concrete is raw and monolithic, with sand from the beach added into the mix for colour continuity, adding to the existing material density and solidity." Siza insisted that concrete was the best material to resist erosion from coastal conditions (both the wind and the sea)

Sourcing and Constructing

Based in the town of Caltanissetta, Sicep (Silica Concrete) is a company that specializes in the production and application of advanced concrete solutions, particularly focusing on high-performance concrete enhanced with silica fume. Their products are designed to improve the strength, durability, and longevity of concrete structures, making them suitable for challenging environments such as marine and industrial settings.





Timber Local Fishing Hut, 'Trabucco'

Building Overview

My building consists of both a concrete and timber structure. For aesthetic reasons, these two elements are structurally separate and are designed to support themselves individually. Therefore both interact directly with the limestone sea floor. The timber structure serves as a public cinema space whilst the concrete houses film school facilities. There is a concrete core to the timber structure, supported and bolted to horizontal beams. This joint is shown above.



Dirk Jan Postel - Glass Bridge

Inspiration

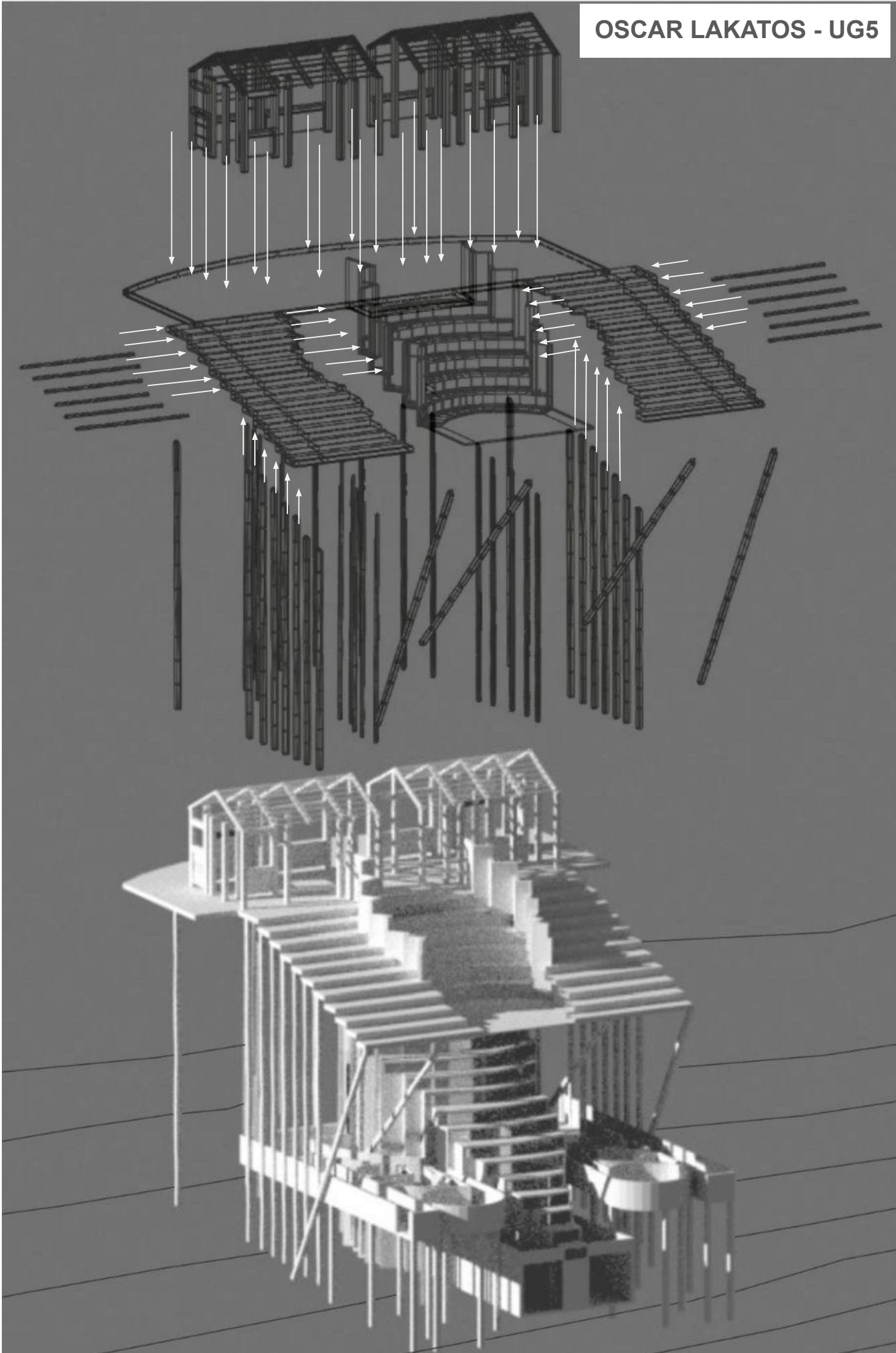
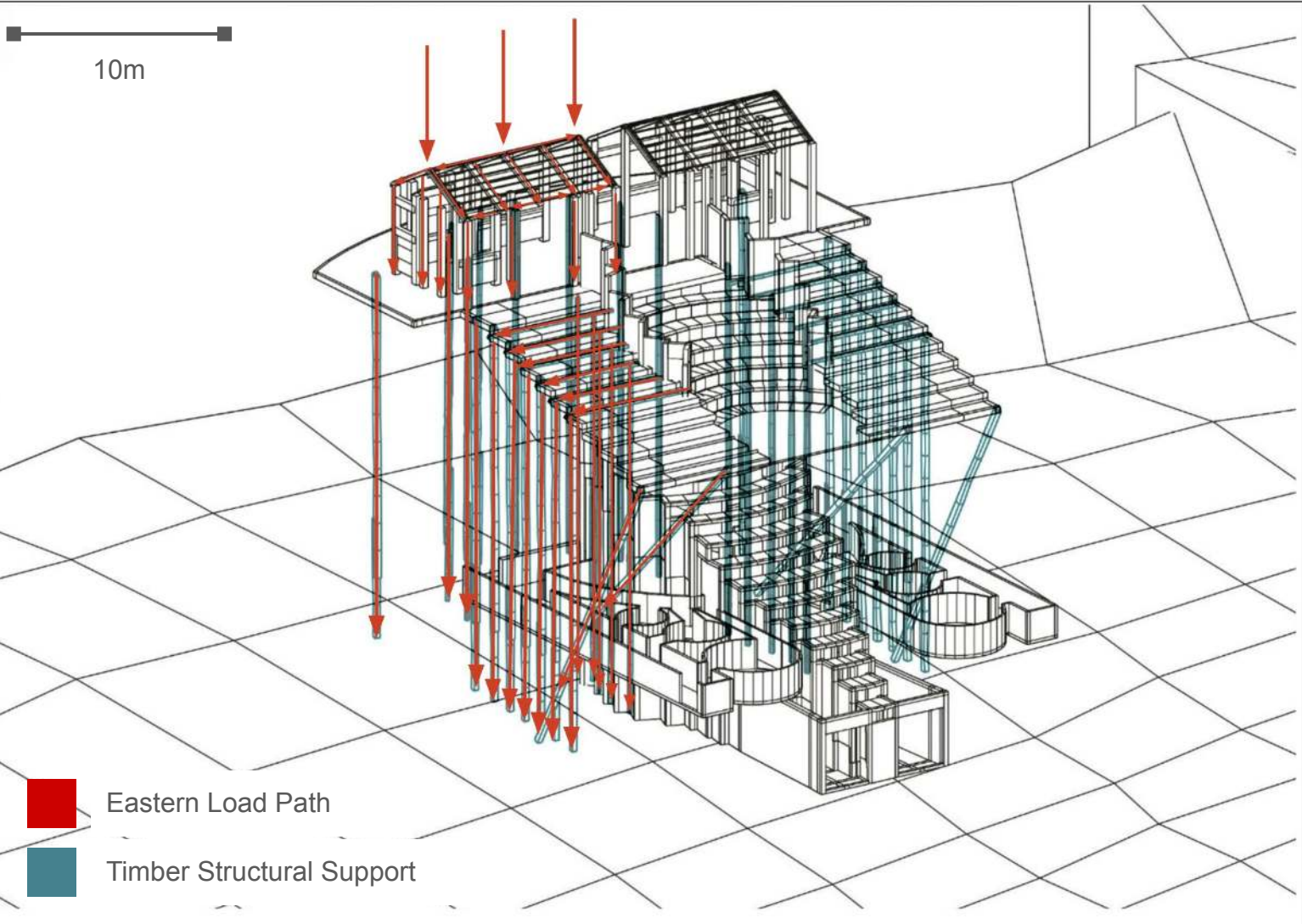
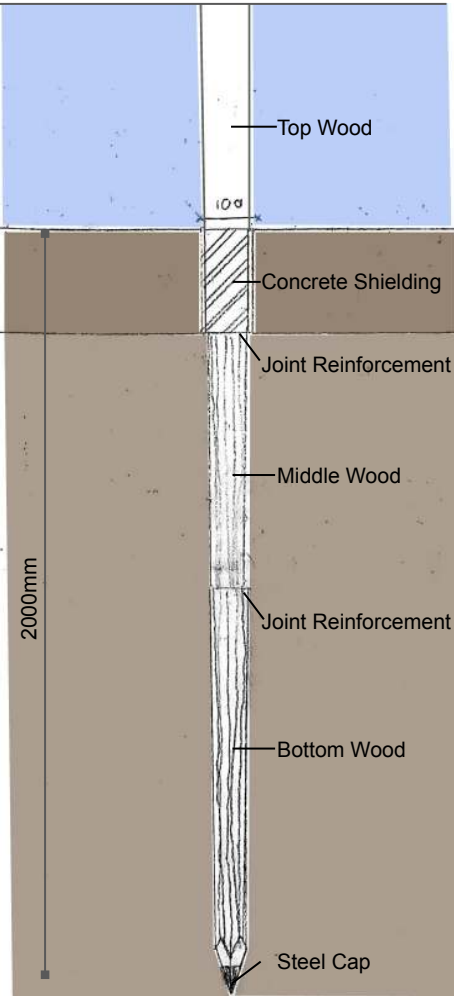
The timber structural system is inspired predominantly by local vernacular architecture. Fishing huts called 'Trabucco' in the surrounding region consist of braced timber piling that extends out over the sea floor.

The glass walkways extending over the sea join to the primary concrete structure. This joint was inspired by Jan Postel's Glass Bridge in Rotterdam (image in bottom left).



Peter Zumthor - Zinc Mine Museum

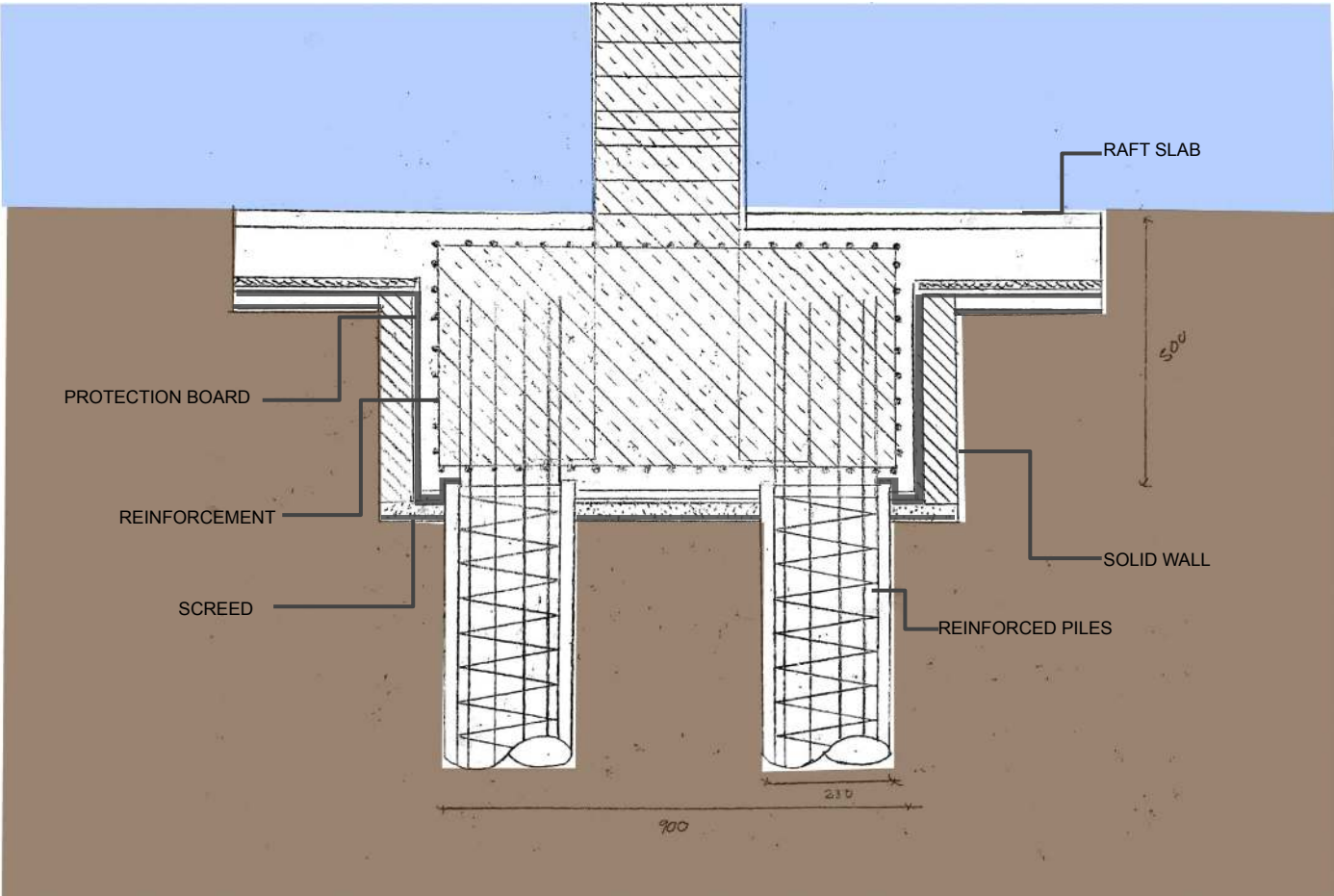
For the timber structural elements of my building, I took a lot of inspiration from vernacular Sicilian architecture, as well as more modern structures such as Peter Zumthor’s Zinc Mine Museum (which can also be found in a coastal context). Due to this part of my building relying on a separate structural system to my main concrete body, I explored the process of timber piling in bodies of water, and the traditional methods in which this is achieved. The diagram on the right demonstrates how these piles would interact with my site’s sea floor. The exploded axonometric displays the way in which this timber structure would bind together, utilising bolting, horizontal and diagonal bracing techniques whilst maintaining uninterrupted viewpoints for the central staircase below. I have also displayed the load path this structure will experience (I have only shown the east side for image clarity - the path would be mirrored on the west).





Stamp House - Charles Wright Architects

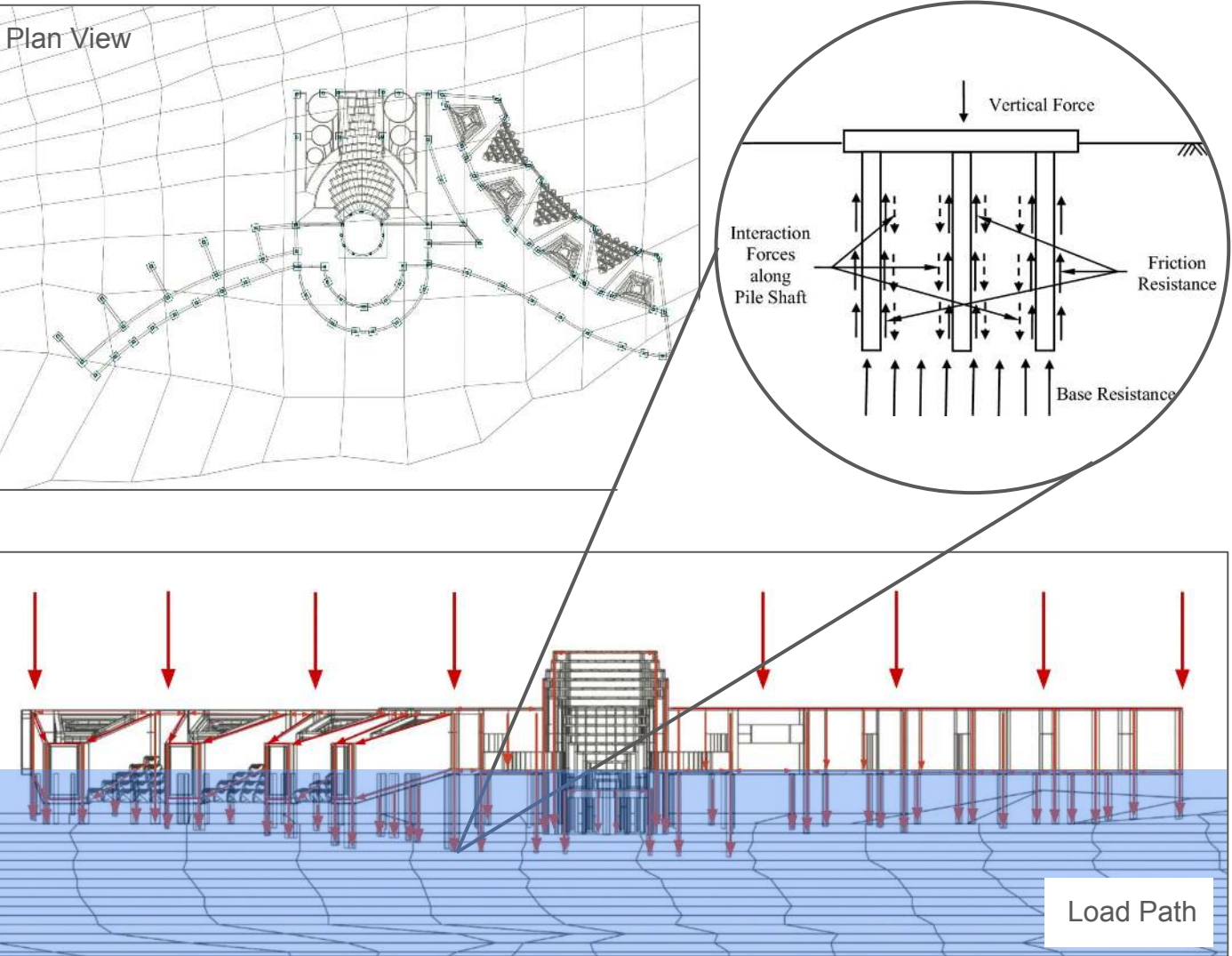
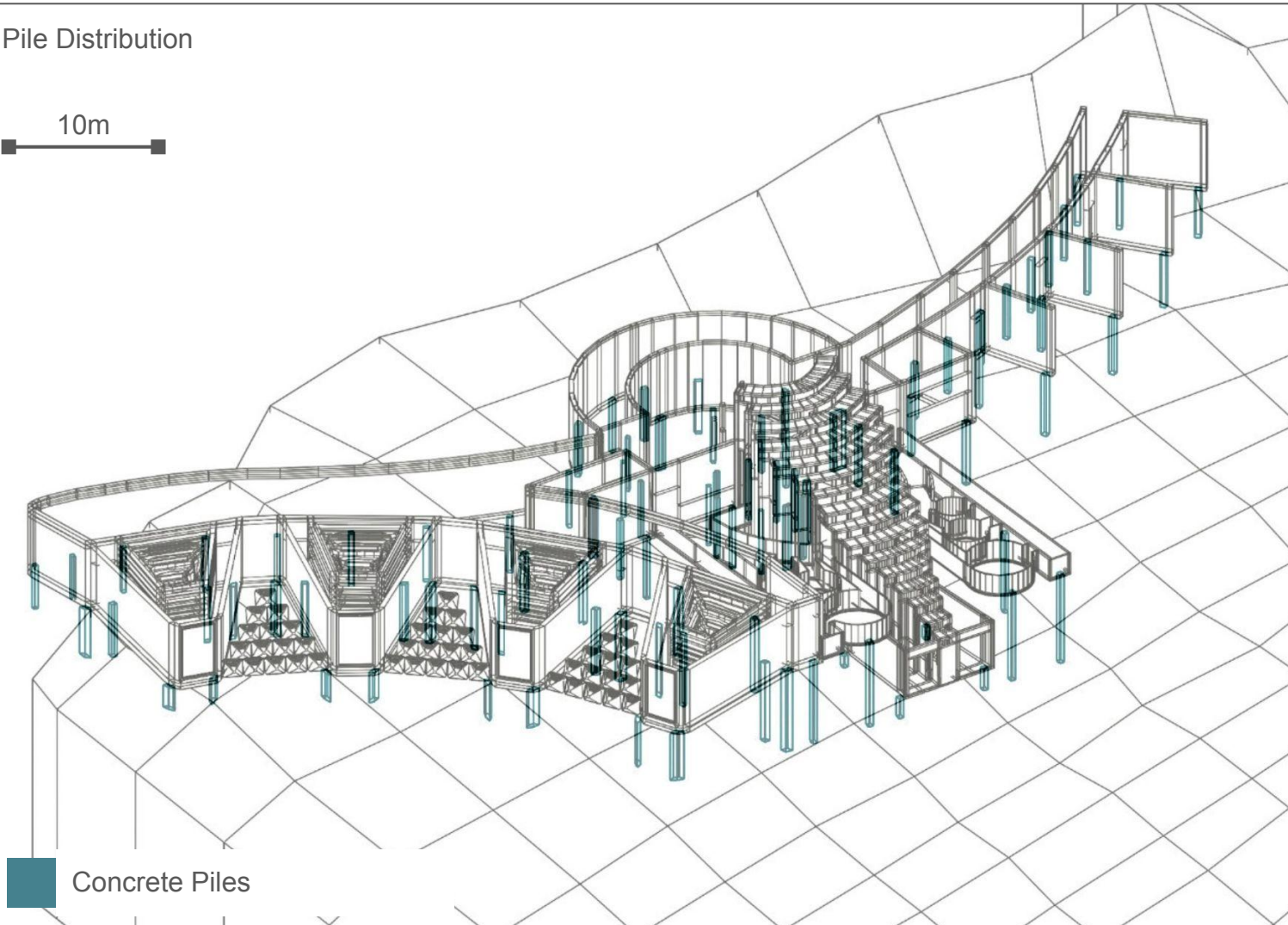
Stamp house is an example of a building that utilised concrete piling for structural support within a body of water. The structure also has aesthetic similarities to that of my building. The orthographic illustration below displays my intended distribution of these steel piles along the sea floor of my site. The building's weight is shared by a total of 88 piles, with the water itself providing an upward force for all the submerged and semi submerged regions of the school. The first floor load path diagram reveals which parts of the building are submerged and the forces acting through these piles. I also intend to implement pile caps at the base of these piles in order to dissipate the load and reduce the risk of load bearing damage. I have drawn a detailed section in order to demonstrate how this cap would interact with the seafloor. The noise of this part of the construction process would not exceed 87dB in immediate surroundings, therefore to the nearest residence roughly 75m away this would dissipate drastically and cause any major disruption.



Concrete Pile Cap Detail

Pile Distribution

10m





Prada Aoyama Epicenter



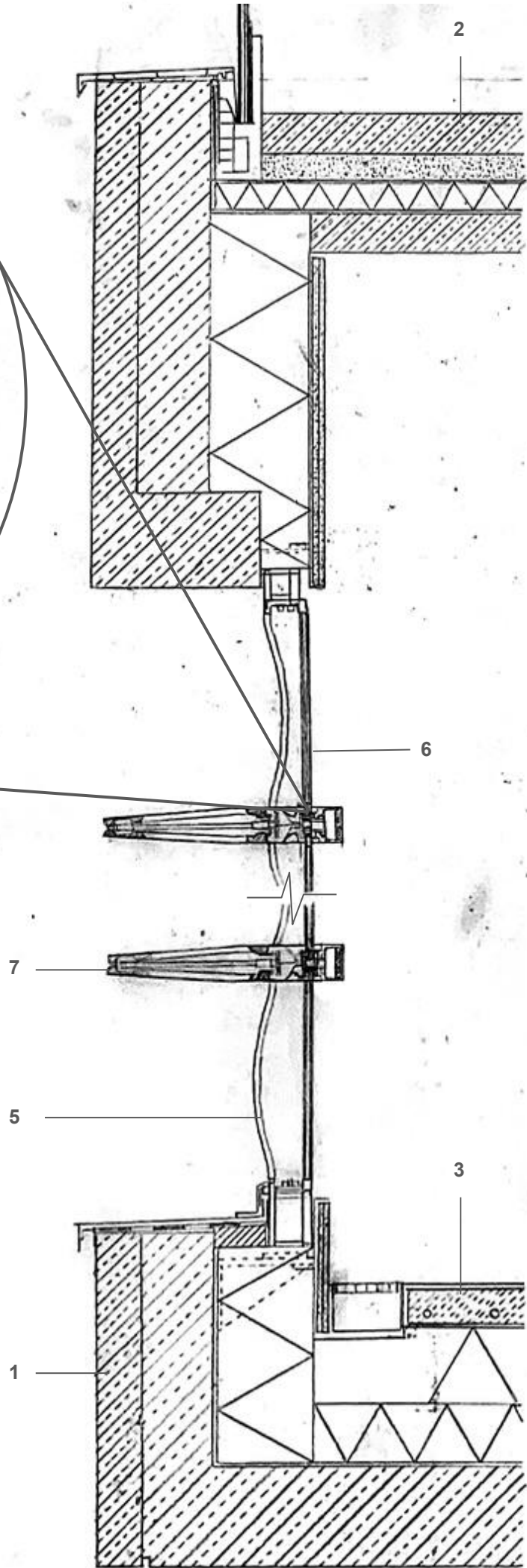
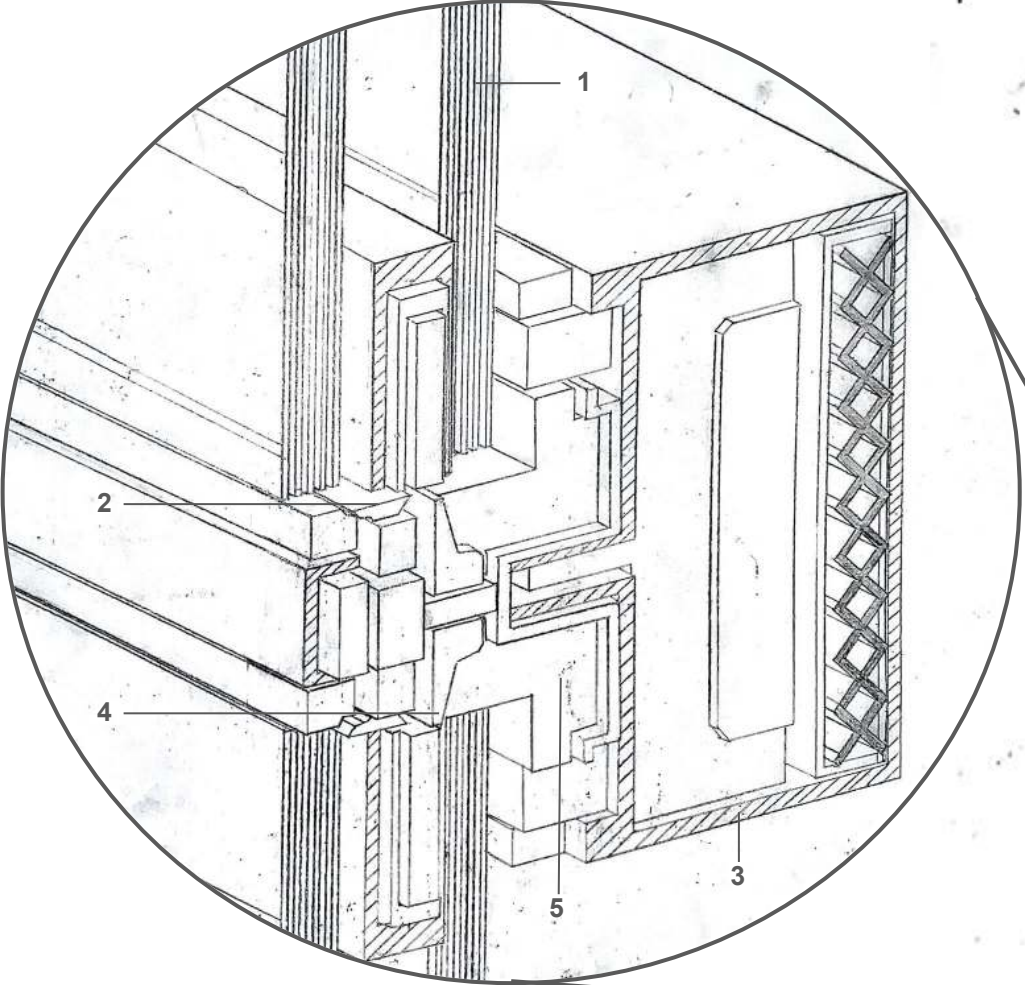
MAXXI Museum



Panorama Gallery

3D Section of Glass Joint
Scale 1:2

- 1. 6mm glass pane
- 15mm air cavity
- 2. Mechanical clip
- 3. Aluminium framework
- 4. Glass fixing clip
- 5. Mechanical seal



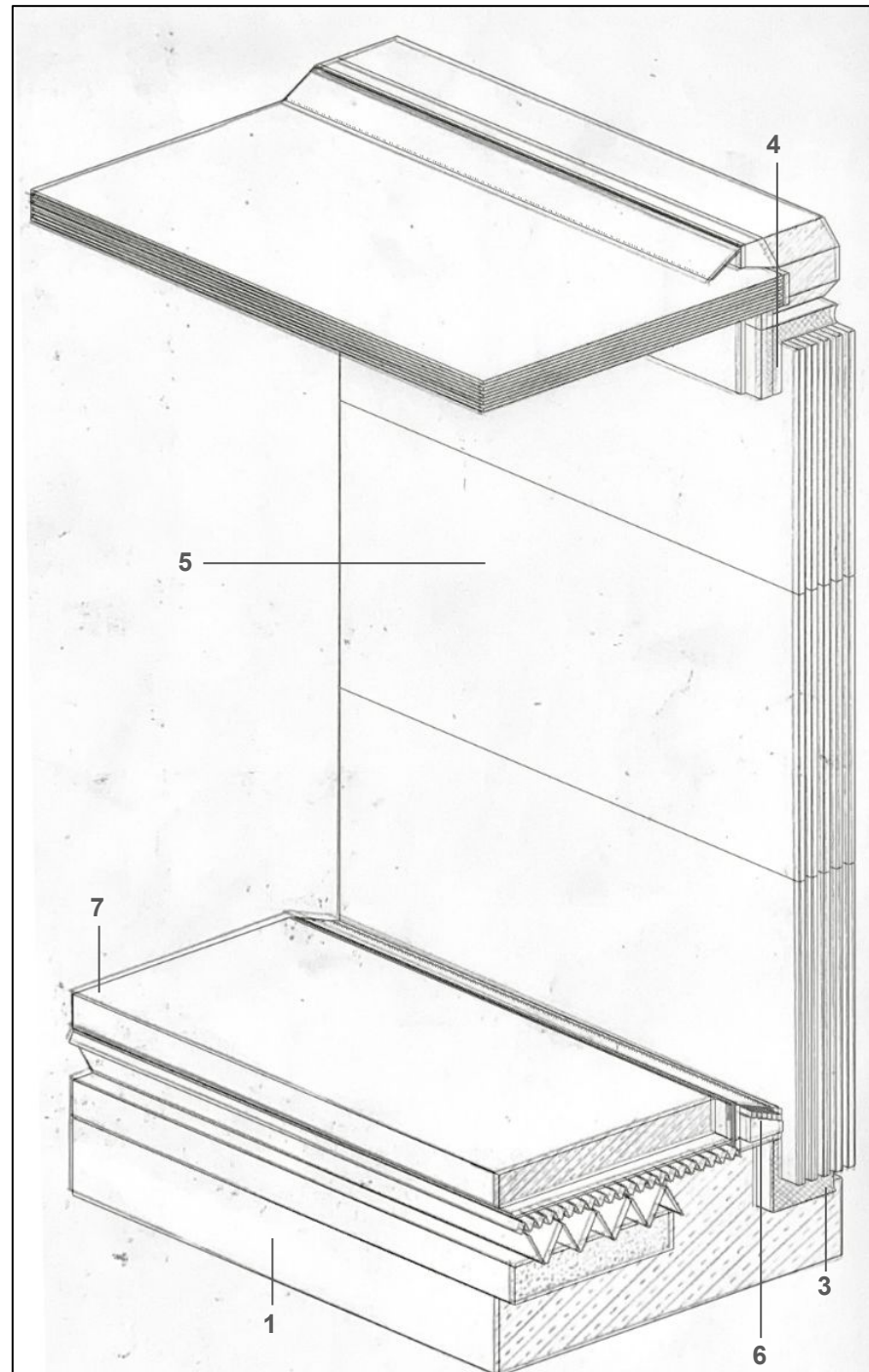
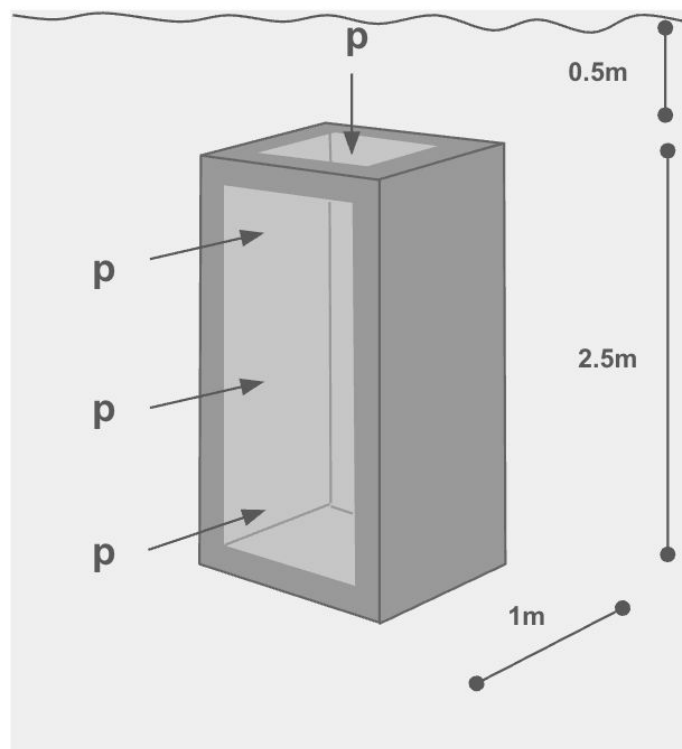
2D Section
Scale 1:10

- 1. Exterior wall structure:
Precast concrete 100mm
Concrete in situ 160mm
Insulation 220mm
- 2. Roof structure:
Concrete slab 60mm
Gravel fill 50mm
Insulation 50mm
- 3. Floor structure:
Concrete slab 50mm
Insulation 300mm
Reinforced concrete 220mm
- 4. Roof glass handrail
- 5. Convex curved glass pane
- 6. Straight glass pane
- 7. Concrete viewing slit



Snohetta Underwater Restaurant

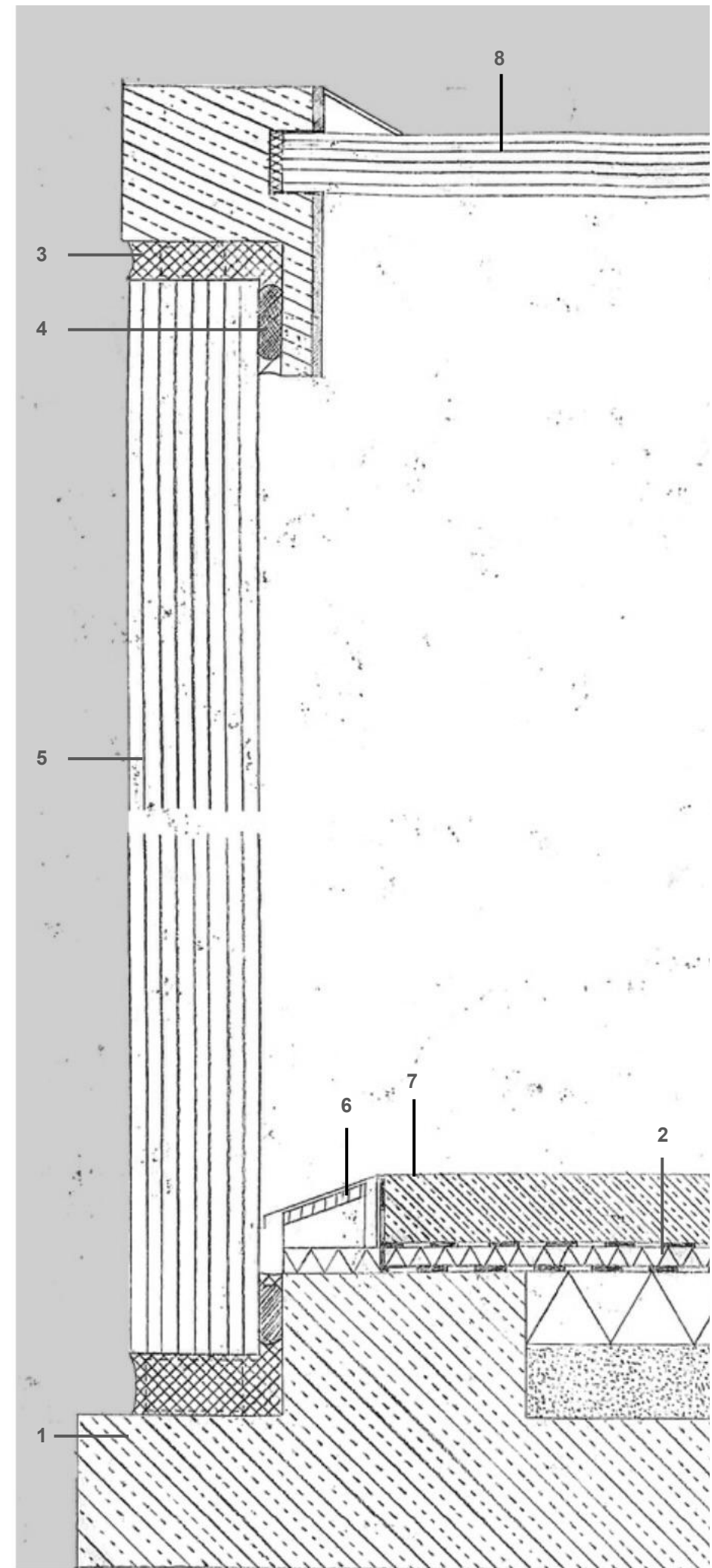
For the underwater section of my building, the pressure acting on the walls will be very similar to that of Snohetta underwater restaurant. Given that my two primary materials are also glass and concrete, and the depth of this room is almost identical to the restaurant's, I decided to let the details of this reference heavily influence my design. One key difference is that my room also consists of a glass roof 0.5 meters below the water's surface. Therefore I calculated the vertical and horizontal hydrostatic forces acting on my room using the restaurant as a basis for my required glass thickness and adjusting for the glass roof. I landed on a 125mm thickness for the glass ceiling, and a 300mm thickness for the glass wall. I also have thinner insulation compared to the restaurant as Palermo's water temperature reaches an annual low of 14 degrees celsius, much higher than the Norwegian Coastline.



3D Section of Underwater Wall

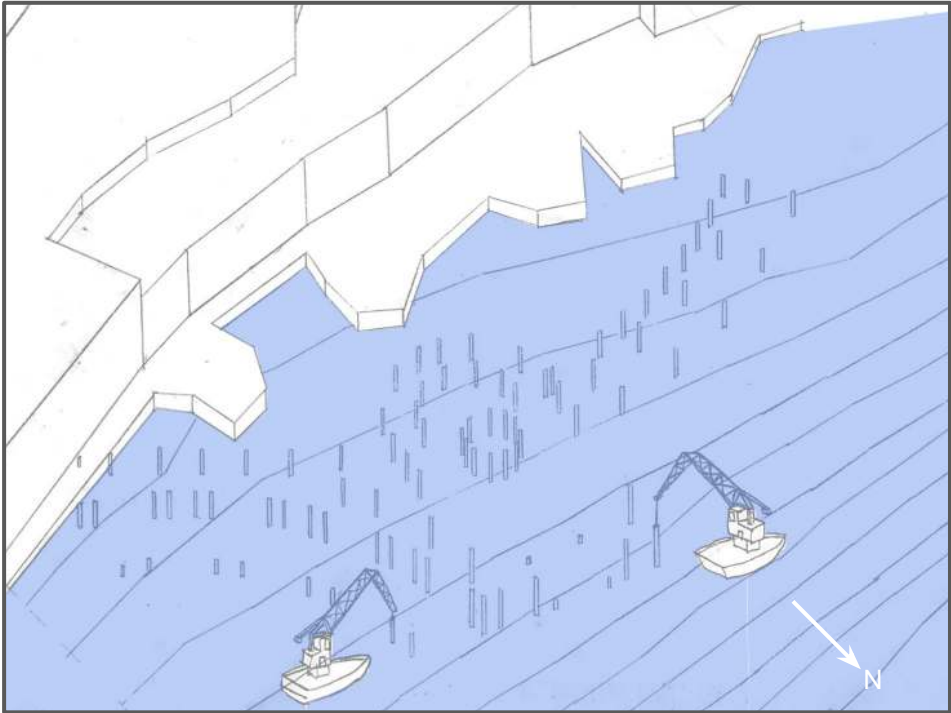
**Section
Scale 1:10**

1. 300mm waterproof board-marked concrete
2. 50mm foam glass thermal insulation
3. Sealing
4. Compression seal
5. 250 mm acrylic glass pane
6. Folded steel sheet
7. 150mm reinforced concrete sheet
8. 125mm acrylic glass plane



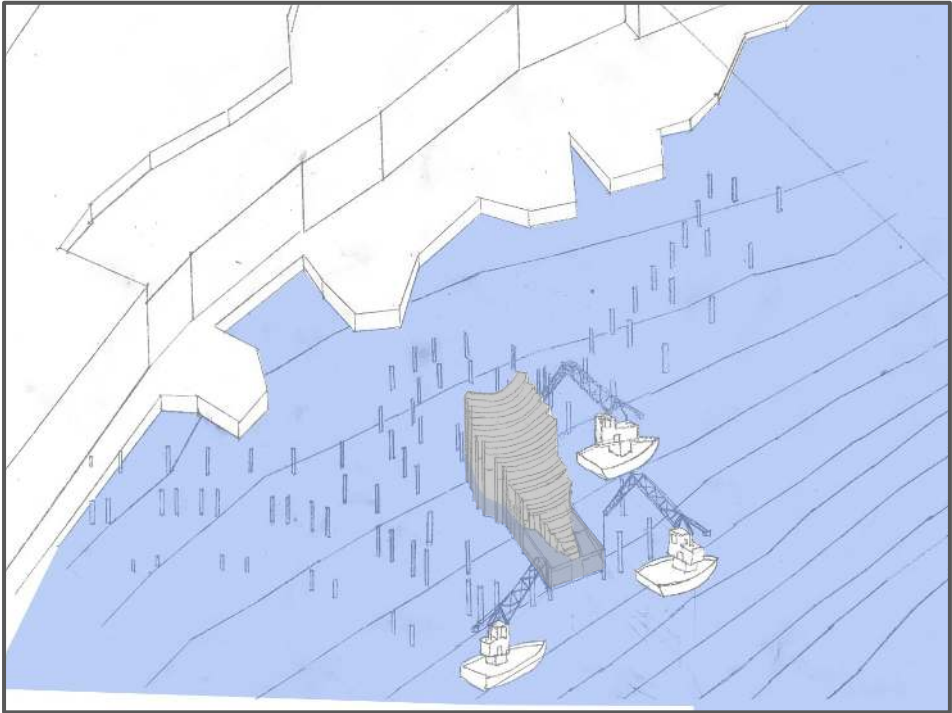
CONSTRUCTION - OVERVIEW

*Each contour line below water represents a depth of 0.5m
*Webuild is a large scale Sicilian building contractor with access to the equipment that would make this process possible



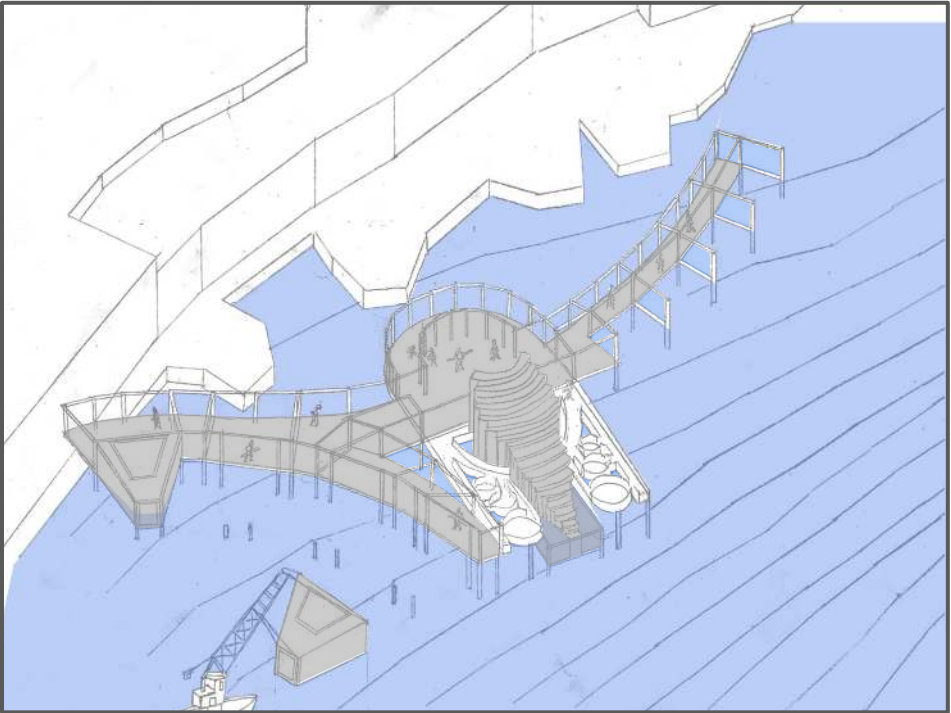
MONTHS 1-2

A series of 88 Concrete piles will be laid across the site, mapping out the base of the building, and providing a structure for the first floor to sit on. Time of construction will vary depending on weather. There tend to be calmer seas from late May to early September. Construction would ideally start in May.



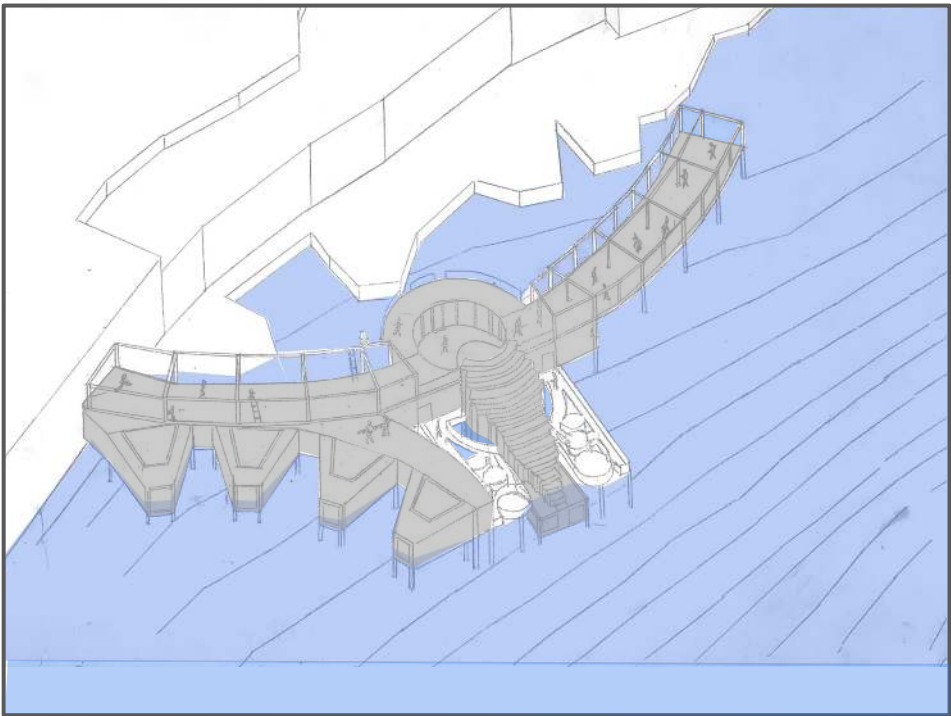
MONTHS 2-3

After roughly 6 months of on land construction (in my site), the primary precast concrete element will be transported, sunk and fixed to central piles at the north of the building. I break down this process further on the following page.



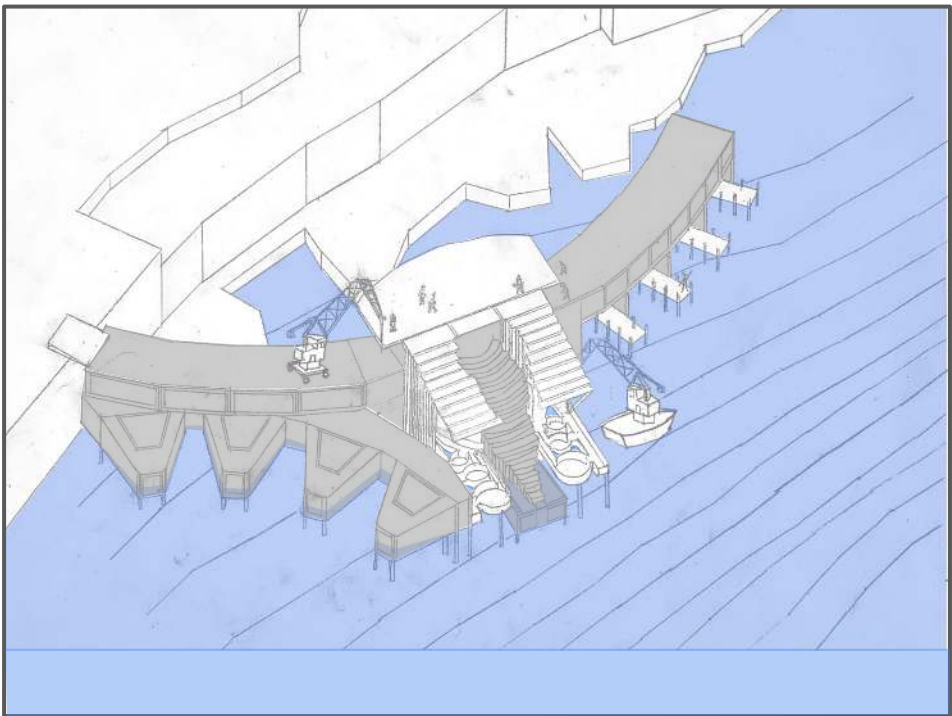
MONTHS 4-8

The base for the first floor will span across the groundwork and further precast elements built on land will be fixed to the building by barge. Personnel will access the building by temporary piers and small boat transportation.



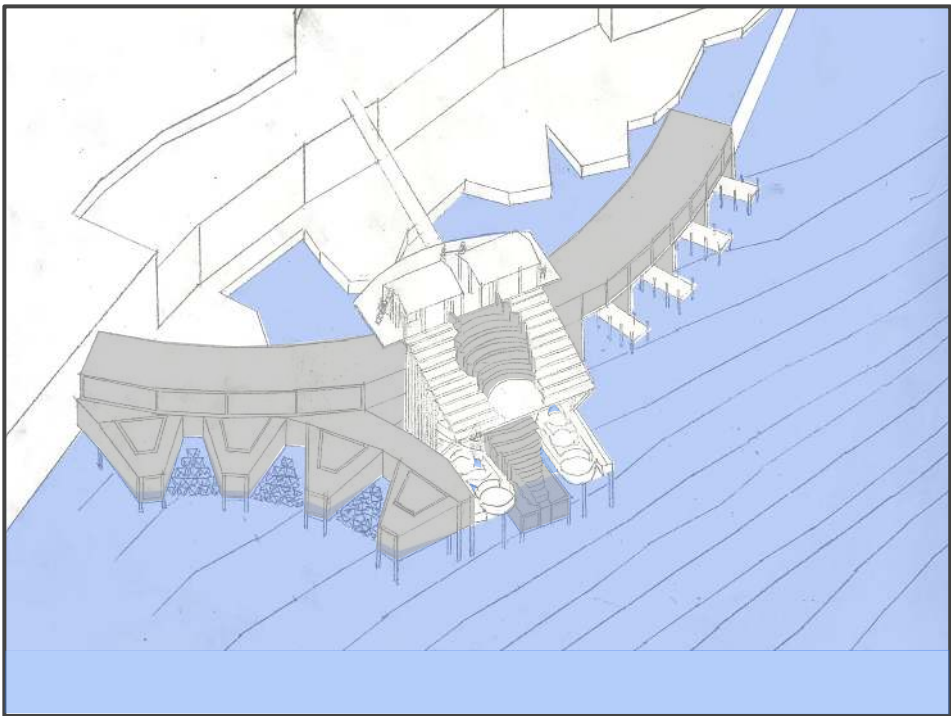
MONTHS 9-13

Framework for the second floor will be constructed, with all work now taking place above sea level, following similar routines for on land concrete construction.



MONTHS 14-17

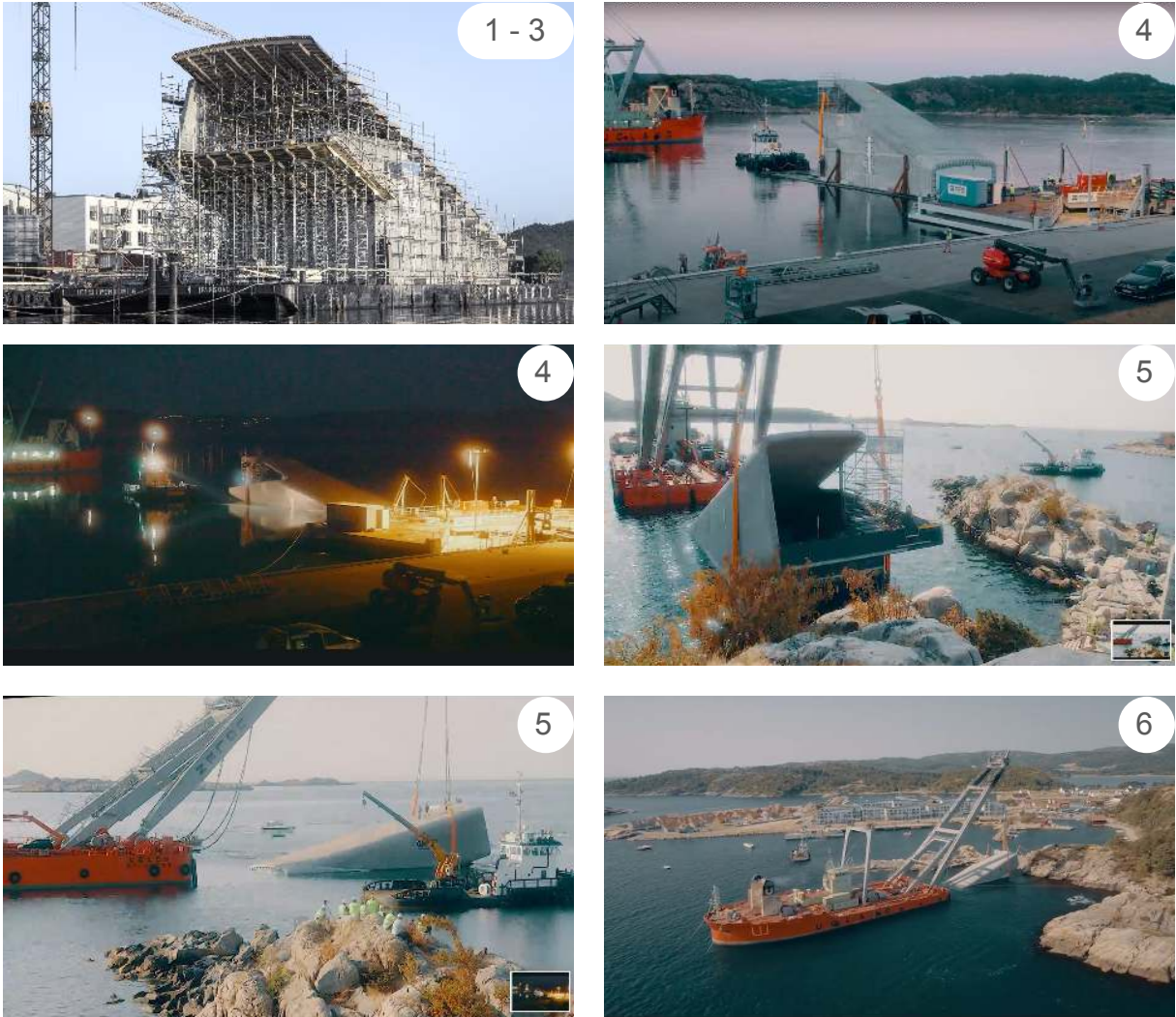
Timber piles and structure will be built around the concrete near to the end of the construction process. This process will be made easier by the existing concrete structure providing a base for the timber construction.



MONTHS 17-20

A series a thorough inspections will commence before details and small changes are made accordingly. Ecrete sea walls will be installed on the eastern side of the building. The construction process in total will take approximately 24 months to complete (with on land concrete work operating before this diagram starts).

Underwater Restaurant Precast concrete Placement:



On site boat slips will help with the transfer of the concrete structures onto the custom barge

Southern roads will provide access for personnel and machinery.

A nearby harbour will serve as a great docking/transfer point for heavy machinery and on water vehicles.



On Land Construction for Precast Concrete.

1. Setting up framework and reinforcement moulds for concrete shell . This will be done adjacent to the site (1 month)
2. Pouring the concrete shell into framework moulds (provided by SICEP) in phases to prevent cold joints. Curing the concrete for strength in marine environments. (1 month)
3. Adding internal reinforcement, including window frames, ballast compartments and water barriers, before inspecting the structure for watertightness (3-4 months)

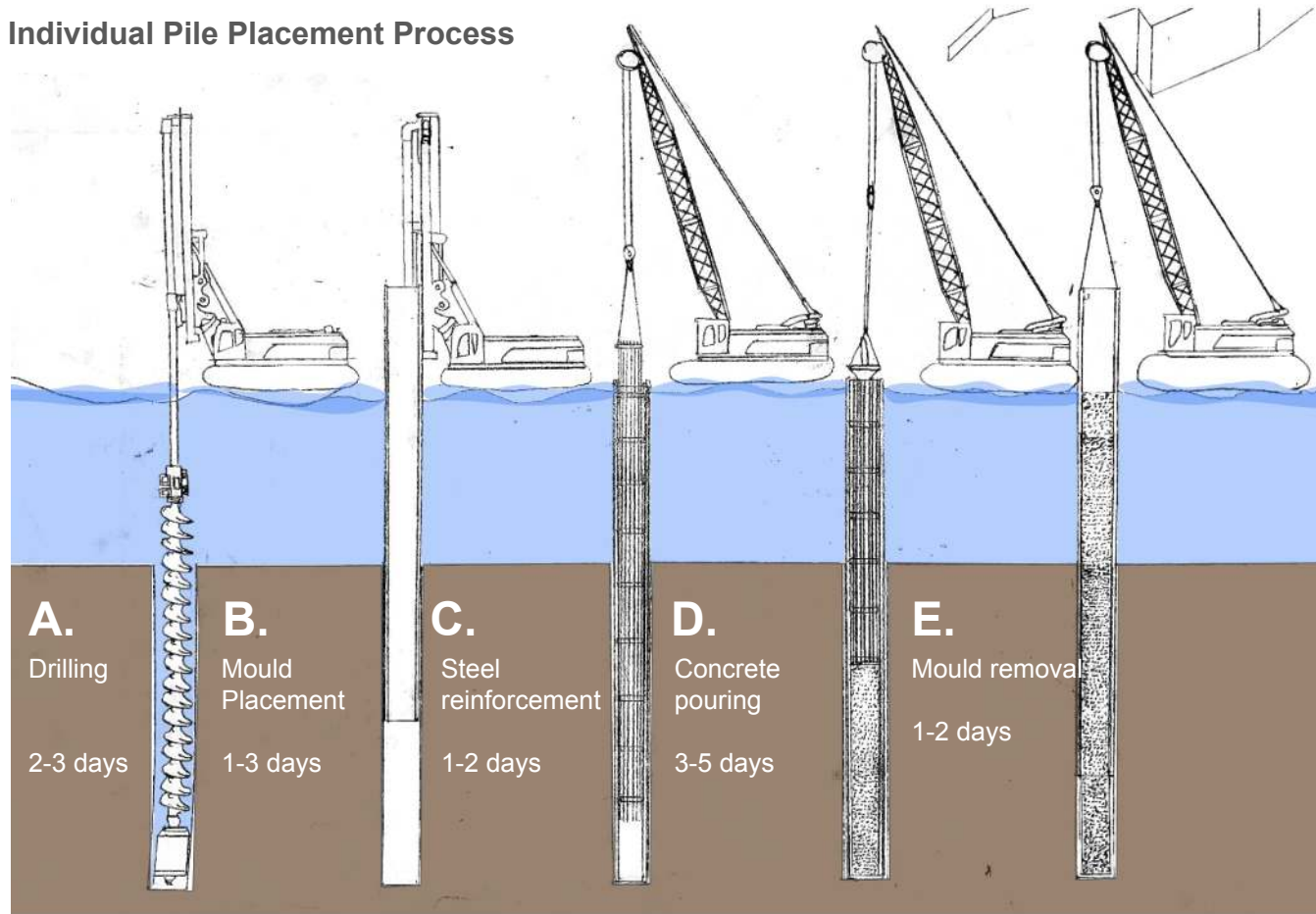
Transportation into Water

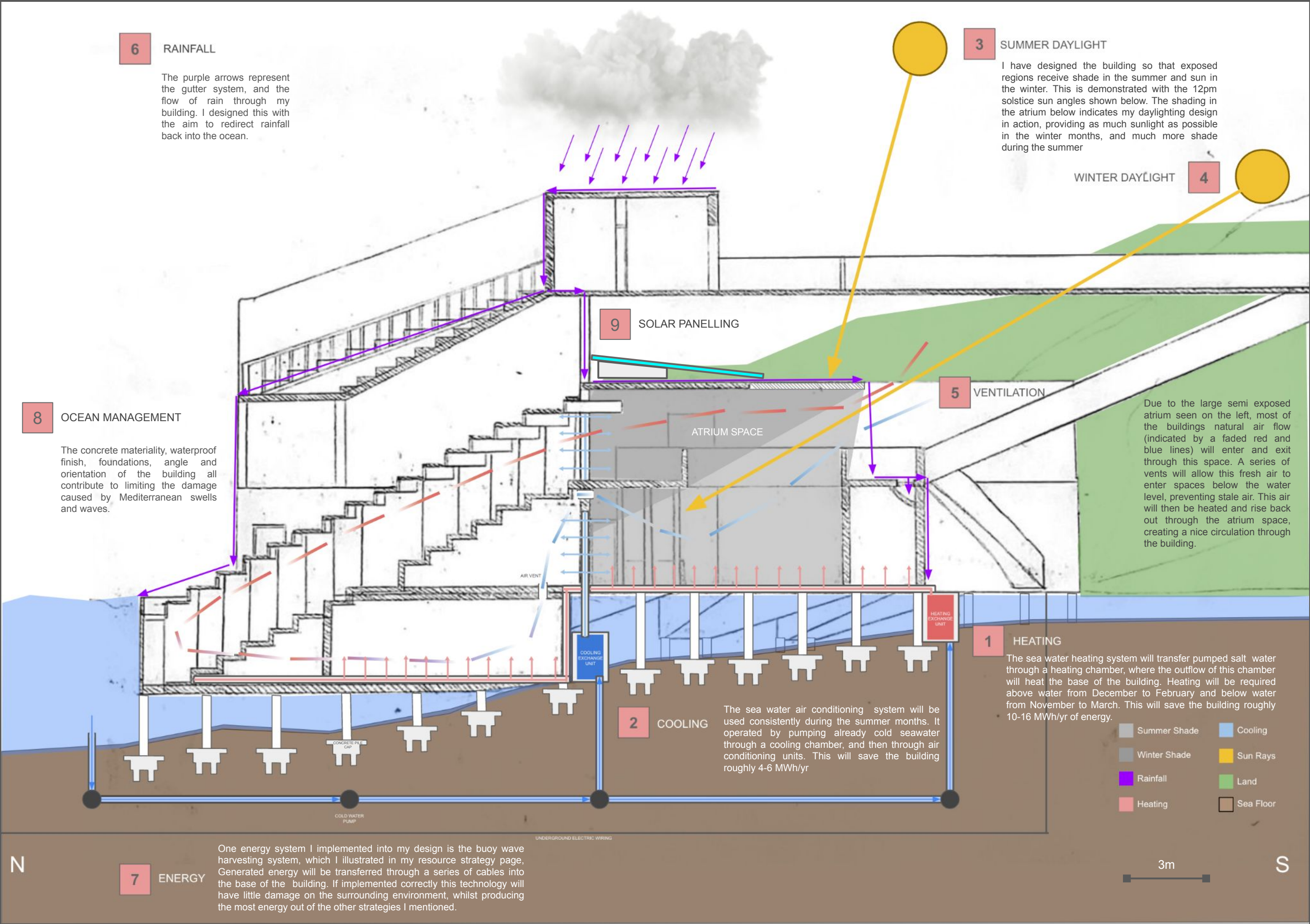
4. Once piling is completed and the on land construction of the concrete forms is inspected, the structure will be loaded onto a custom barge and transported 50m towards its final location in the site. (3 days)
5. Ballast tanks will be calibrated and controlled sinking will commence. Divers and sensors will monitor the descent. It will be lowered onto the preinstalled reinforced concrete piles and adjusted using laser levelling (5-10 days).
6. The structure will be anchored to the piles using steel rods and bolts. Final inspections for watertightness will occur after underwater welding.

Underwater Piling

- A. A custom heavy machinery will drill holes into the Limestone seafloor surrounding my site
- B. Hollow steel piles will be lowered into these holes, extending above the water's surface. Water will be pumped from these piles in order to provide an airtight environment for concrete pouring.
- C. Steel reinforcement will be lowered into the hollow piles, acting as the framework for the concrete.
- D. The concrete will be poured into each hole, moulded by the steel piles and supported by the reinforcement.
- E. Once the concrete has set, the steel mould will be lifted out of the seafloor and the concrete will be left to stand alone.

Individual Pile Placement Process



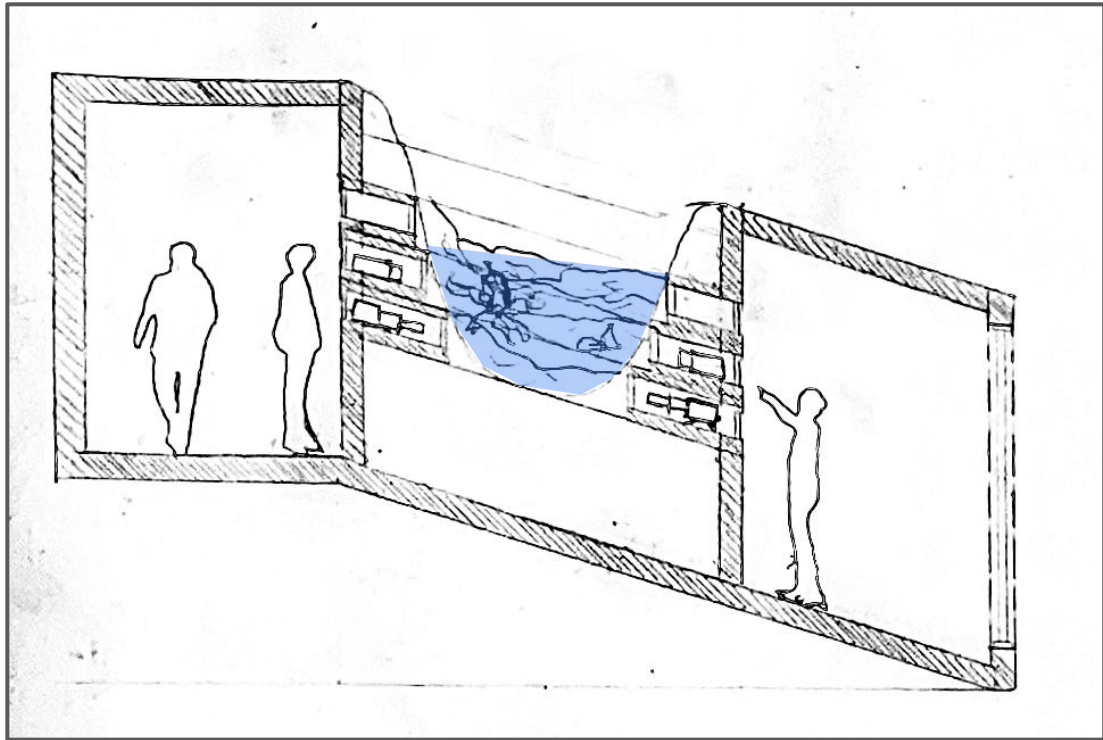




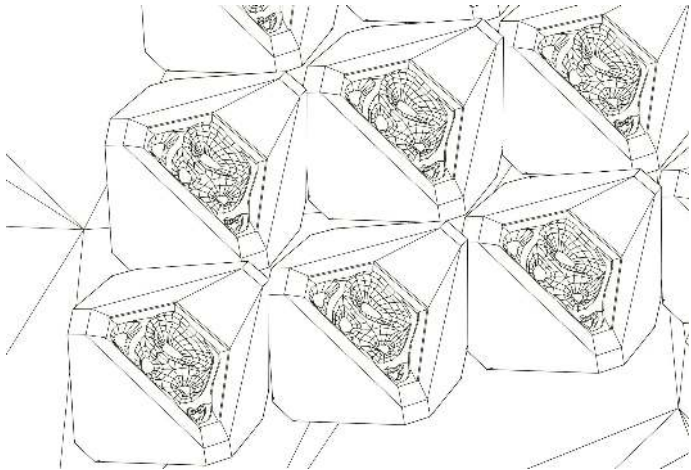
Render of Film School in Context



Existing Econcrete Block Design



Section of Macro Filming Booth



Modelled Concrete texturing for expanding ecosystem

A key part of my environmental design, is the implementation of Econcrete technology. (something I mentioned previously on my materials strategy page). This technology consists of interlocking blocks of concrete, simultaneously designed for wave dissipation as well as the promotion of marine tidal pool habitats. This is achieved via non toxic and sustainable concrete mixing, complex surface textures for marine wildlife to cling onto and tunnels for animals to inhabit.

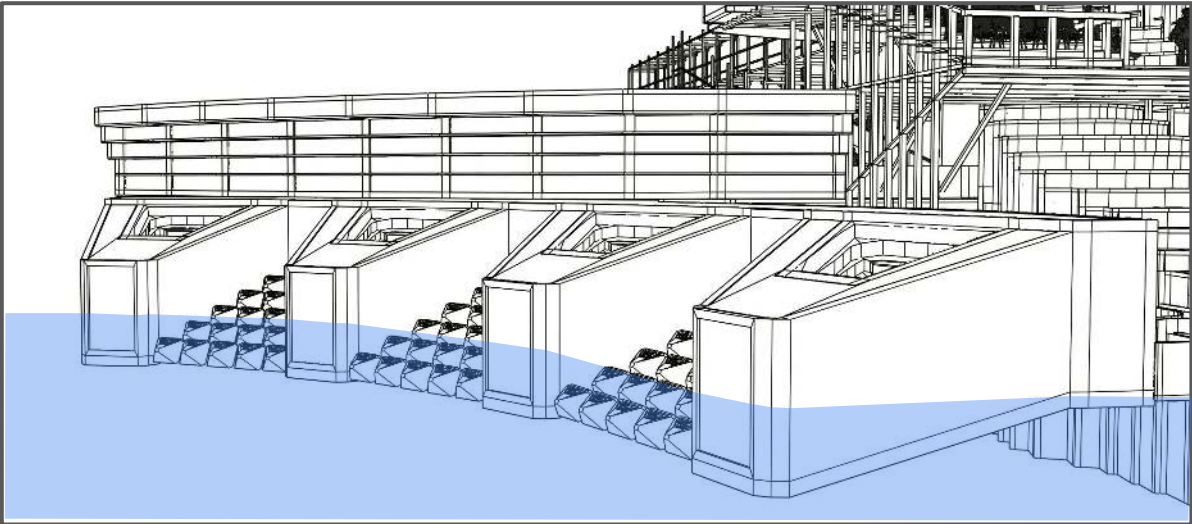
When designing my film school, the forms created by this technology, heavily inspired the shape of my Macro wildlife filming booths. I provided students with rooms revolving around a central rock pool. This pool descends below sea level and is enclosed by surrounding concrete walls. The idea is that sea water will be caught in these pools during high tide, allowing for marine wildlife to grow within them and subsequently granting students the perfect opportunity to film Mediterranean marine life up close.

This shape also defends the building from strong north easterly swells generated by the Tramontana and Bora winds. At the tip of each room is a window providing a scope both above and below the water line, opening eyes to further wildlife.

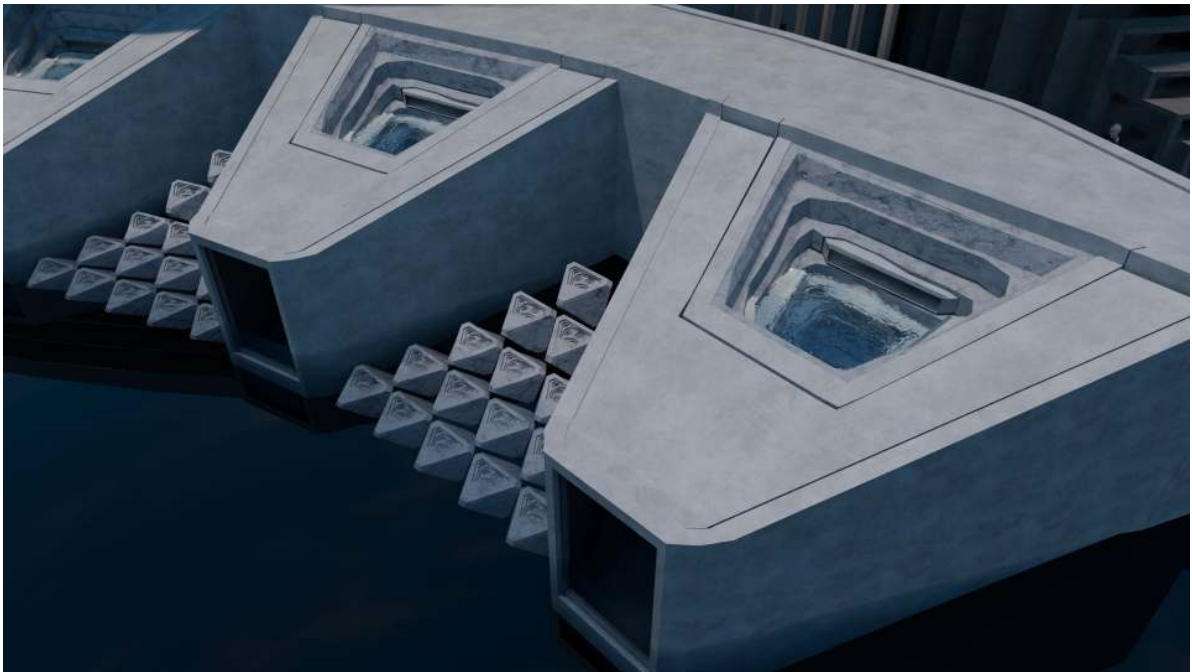
Essentially I have designed econcrete blocks on a much larger scale, allowing my building to become inhabitable for both humans and wildlife, whilst allowing the original concrete blocks to exist in unison with the eastern facade of the building.



Integration of Predesigned Concrete Blocks



Eastern, North facing facade design



External Render of Macro Filming Booth



Artificial Rock Pool Close Up Render

Cost breakdown

In order to break down costs I started by categorizing the separate components of the building (these can be seen in the chart below). I then used references such as the Snohetta Restaurant to get rough estimates of how much each of these parts of my building would cost. I looked at the cost per square meter and then multiplied this by the size of different parts of my building. I then accounted for uncertainty in the construction process, adding contingency to cover weather delays and potential marine risks. Finally worker's fees were added based on buildings using similar materials and of a similar size. Pie chart below shows the median of each cost uncertainty providing a rough illustration of how money would be divided. I have also included a column for when each sum of money would be required in relation to the construction process of my building (the stages are shown in my construction overview page). In total my film school would have an estimated costs of €15.7-20.9 million. On top of this, due to the buildings extreme conditions, careful maintenance will be required in order to extend the lifespan of the materials and to keep systems running. This totalled to roughly €240-380,000 per year. Therefore if the school takes in a rough total of 150 students, tuition fees would have to be a minimum of €2530 per year to keep the school running as a non-profit organisation. I also assume EU university funding will help with total costs for both maintenance and construction .

Category (maintenance costs)	Scope of Work	Annual Cost (€)
Structural Inspection (Concrete, Piles, EConcrete)	Diver and ROV inspections, crack monitoring, waterproofing checks	50,000–70,000
Acrylic/Glass Cleaning & Inspection	Robotic or diver-assisted window cleaning, seal checks	30,000–50,000
Timber Walkway Maintenance	Sealing, sanding, minor repairs every 1–2 years	10,000–20,000
HVAC & Dehumidifiers	Filter changes, desiccant replacement, system calibration	20,000–30,000
Electrical & Plumbing Systems	Safety testing, lighting checks, marine plumbing inspections	15,000–25,000
Interior Works (Cinema, Library, Suites)	AV equipment servicing, seating repairs, paint touch-ups	10,000–20,000
Marine Access & Dock Infrastructure	Dock repairs, boat tie-downs, safety gear	10,000–15,000
Cleaning (Interior & Public Areas)	Daily cleaning, marine-safe products, waste disposal	25,000–40,000
Insurance (Marine + Public Access)	Premiums to cover marine risk + public cinema use	50,000–80,000
Contingency (~10%)	Unplanned repairs, weather damage, emergency works	20,000–30,000

Category (construction costs)	Estimated Cost (€)	Cost per m² (€)	% of Total	Timeline Stage
Foundations & Piling	2.5M – 3.2M	2,500–3,200	15%	Stage 1
Precast Concrete & Substructure	2.2M – 2.8M	2,200–2,800	14%	Stage 2
Superstructure & Upper Floors	2.0M – 2.4M	2,000–2,400	12%	Stage 3–4
Mechanical, Electrical, Plumbing	1.4M – 1.8M	1,400–1,800	9%	Stage 4–5
Contingency	~1.5M	~1,500	9%	All stages
Glazing (Acrylic + Structural)	1.2M – 1.6M	1,200–1,600	7%	Stage 2–4
Marine Logistics & Barging	1.0M – 1.5M	1,000–1,500	7%	Stage 1–3
Professional Fees & Permits	1.3M – 1.6M	1,300–1,600	8%	All stages
Interior Fit-out	800K – 1.2M	800–1,200	5%	Stage 5
Environmental Features (EConcrete)	600K – 900K	600–900	4%	Stage 6
Timber Structures & Walkways	400K – 600K	400–600	3%	Stage 5
Total Estimate	€15.7M – €20.9M	15,700–20,900	100%	—

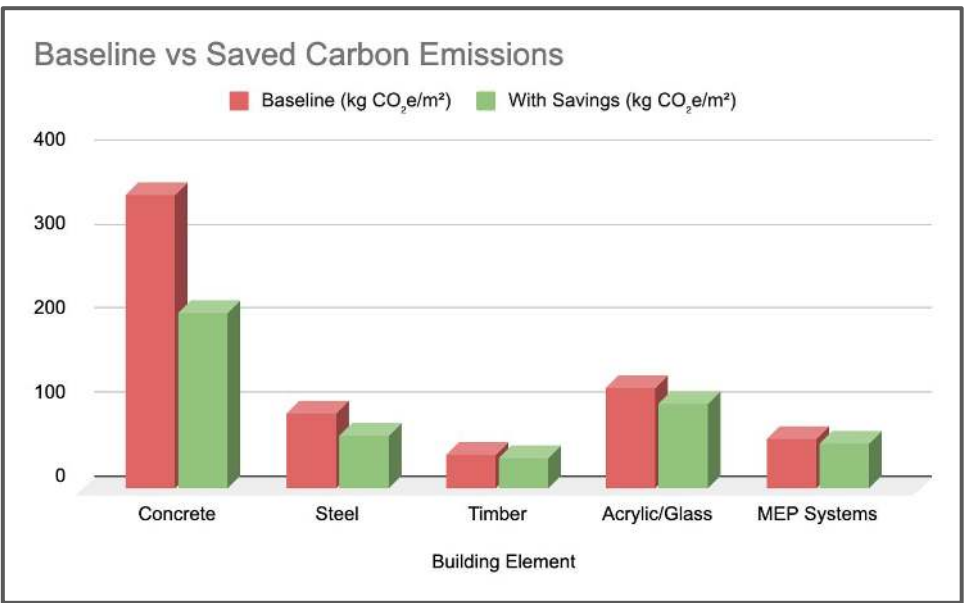
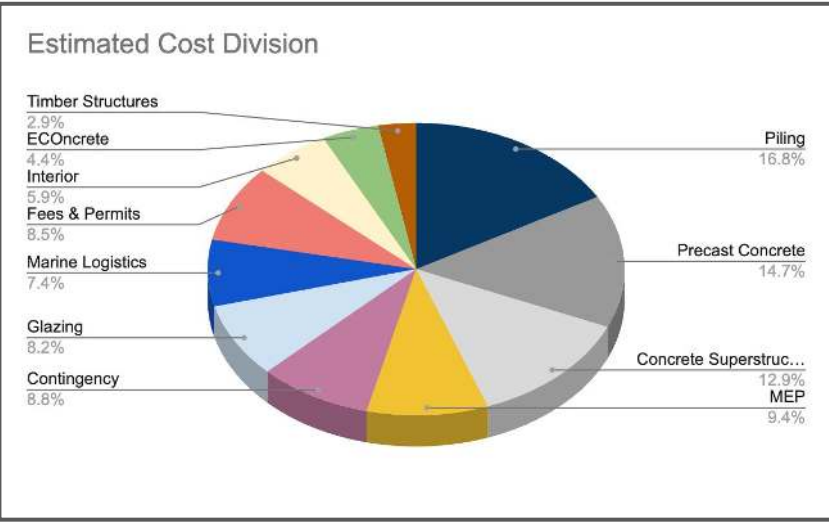
Safety & Risk Assessment

Due to the rather extreme location of my film school, there is lots of risk for injury during construction and maintenance. Underwater works will require certified dive teams, decompression plans as well as constant weather monitoring in order to insure safety. Barge operations will require certified cranes and fail safe protocols. Underwater glazing will require vacuum sealing specific to my building in order to prevent flooding. Other safety measures would include scaffold fall protection for the second floor, and emergency evacuation protocols



Building Occupants

The primary occupants of the building will be approximately 150 students, 15-20 faculty members (including lecturers and tutors), as well as public visitors utilising the cinema space. Secondary occupants would include building management professionals, security staff, specialised cleaning staff (for underwater spaces) and maintenance technicians.

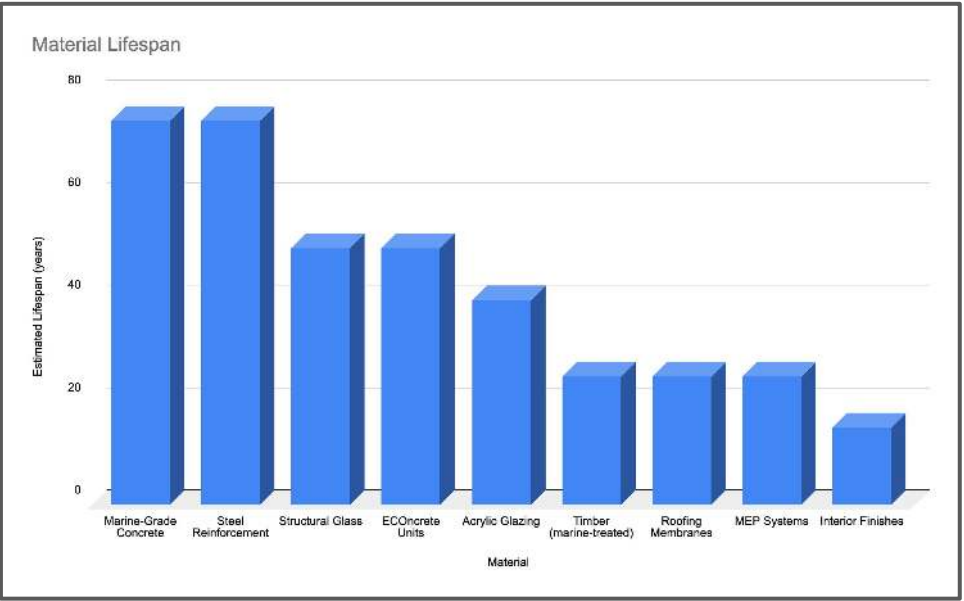


Carbon Footprint

In the bar chart above I have calculated the carbon emissions of baseline material usage vs the sustainable alternatives. This would include using fly ash concrete (saving 40% of relevant emissions), a service that local suppliers SICEP can accommodate. Using recycled steel (saving 30%) for concrete reinforcement as well as local timber (saving 10%) directly from the island. The optimized construction of glass elements as well as MEP systems would also result in roughly 15% and 10% reductions in respective carbon emissions. All of this would result the total costs of building to look closer to the higher price bracket.

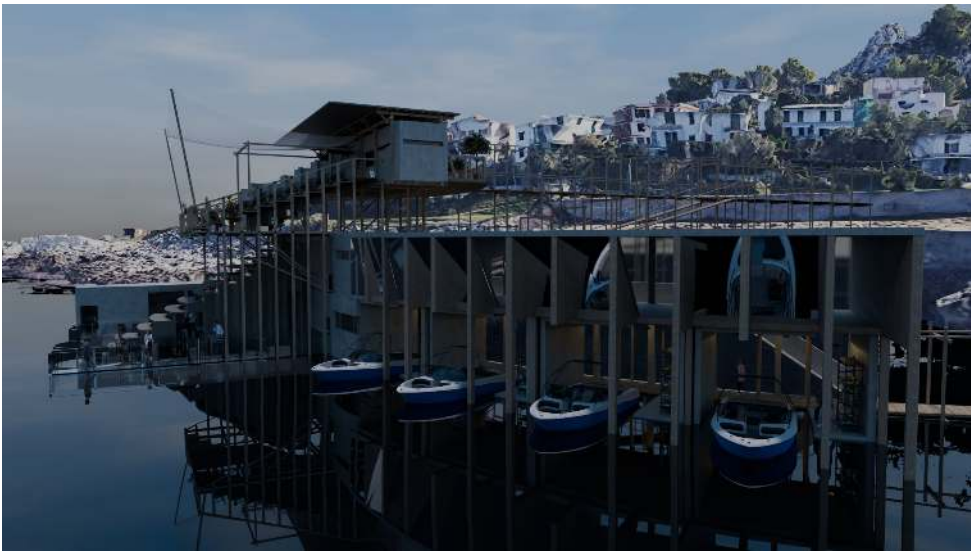
Building Lifespan

For the lifespan of the materials and various building components to be optimised action must be taken every few years. For the steel reinforced concrete, annual inspections must take place and minor crack sealing will be necessary roughly every 10 years. The internal steel must also be monitored for corrosion if cracks are revealed in the concrete. Together these materials will last 75 years before any serious work must be initiated. The timber will have a lifespan of 30-40 years (depending on proximity to water) if resealing occurs every 5-10 years. The underwater acrylic glazing will require frequent edge seal inspections and diver cleaning, with an estimated lifespan of 40-50 years. The structural glass above the water will have a slightly longer lifespan of 50-60 years with less frequent inspections also being required. The EConcrete blocks will last over 75 years with minimal inspection required. The MEP systems such as the HVAC, will require annual maintenance with filter changes and upgrades, with the units I've chosen each lasting roughly 20-30 years before replacement is necessary. Interior finishes and equipment will likely require refurbishment every 15 years.



Adaptability

If my film school fails in the future, the building itself has lots of potential for repurposing. Perhaps the most obvious way in which this could be done is by converting it into a marine research center. Artificial marine habitats will have already been created by the buildings, classrooms could be converted into labs, and the lecture theatre and library would maintain their functions. Small interior changes will be necessary and more storage for scientific equipment and scuba gear may be necessary, but overall this wouldn't be a difficult change. The building also has potential to be converted into a museum, gallery space or even an aquarium given the abundance of water resistance walls and technology already implemented. Finally the building could also act as a private event venue, accommodating private screenings and conferences in the underwater lecture theatre. With slightly more difficult changes I also think the school could be converted into a hotel, as its unique aesthetic and location may attract tourists to an already desirable region, and the docking rooms could be altered to accommodate water sports and leisure activities.



My current film school design



AI adaptation of my design into a hotel

Climate Change Resilience

I have designed my building with a long lifespan in mind, therefore I have thought about resilience to rising sea levels, increased storm surges and unpredictable weather. The first floor of my building will be constructed of waterproofed concrete with carefully sealed glazing, meaning it will withstand extreme winds, large storms and waves, as well as the potential for sea level rise. The use of piles to elevate and secure my structure ensures defense against ocean swells as well as giving leeway for sea level rise. Eoncrete sea walls also act as sea defense. The low profile of my building doesn't only prevent the disruption of local villa views, but also provides a wind and wave resistant shape to the school. Elevated walkways also prevent the entry/flooding of rain and seawater within the building. The orientation of my building and curved facades is also designed to dissipate strong ocean forces.

Concrete Recycling

If my building was dismantled after its lifespan, I would intend for the majority of the concrete used to be recycled. Firstly it would be broken into large pieces, before being separated from the steel reinforcement using magnets and sorting. Once separated, the steel used for reinforcement will be fully recyclable. Then the concrete would be crushed into smaller pieces and these pieces will be assessed for different reuse applications. The most common ways in which the concrete would be reused is for road base, fill material for civil projects and raw material in new low carbon concrete mixes. The problem my building presents, is that some of the submerged concrete may have an extremely high salt content and therefore would not be suited for structural reuse. Waterproofed concrete is also harder to reuse. Therefore the submerged and semi submerged parts of my building will be left in place after dismantling and serve as an artificial marine habitat. The textured concrete design will continue to promote the growth of wildlife and will prove useful and sustainable both during and after the buildings lifetime. This may even provide the potential for a dive site and marine research after deconstruction.

Timber Recycling

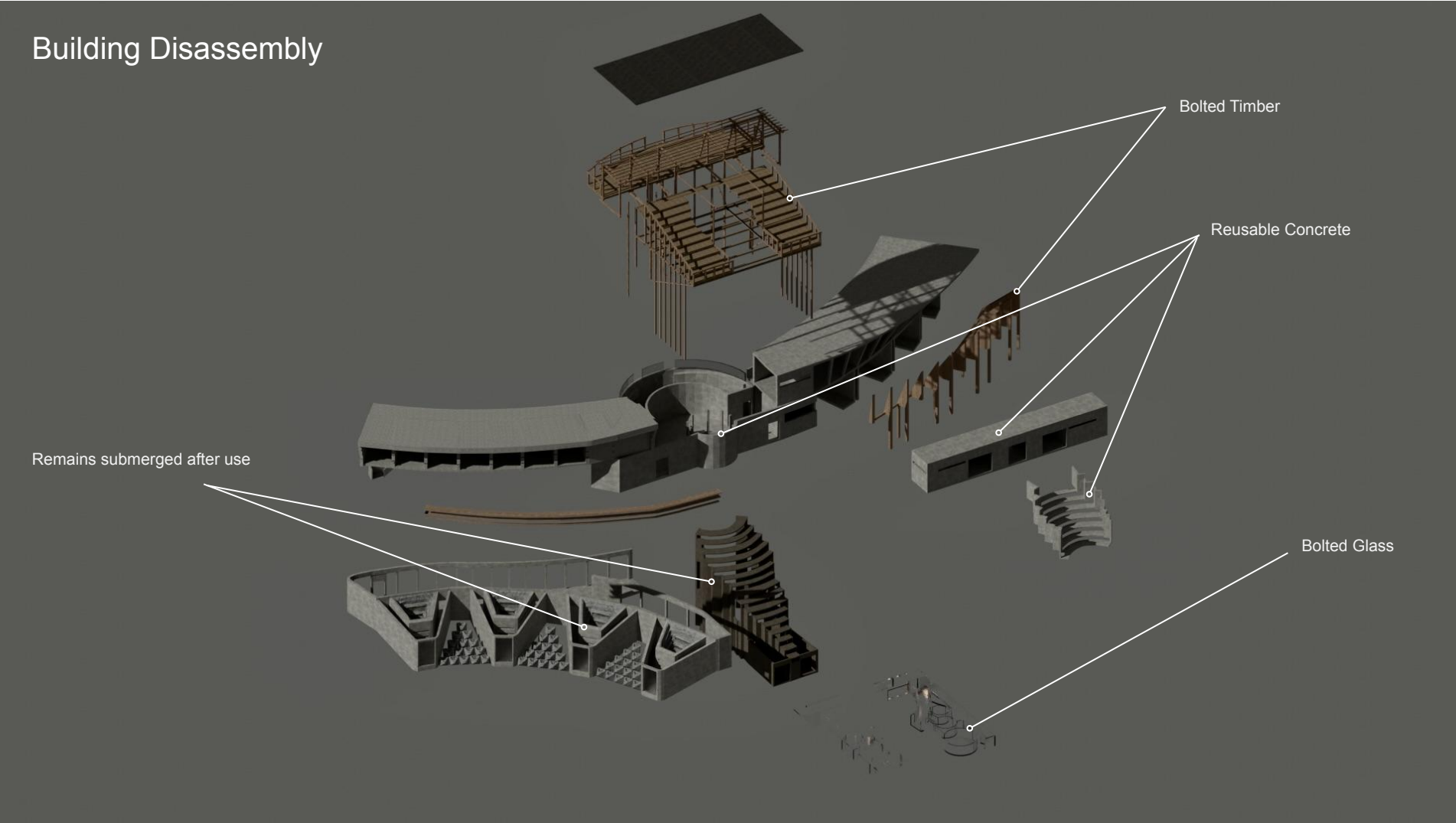
Bottled and screwed timber will be dismantled, before being stripped of waterproof surface treatment and paint. It will then be graded in terms of quality and size. After this is completed it will have the potential to be reused as structural or decorative timber, furniture or converted into engineered wood products such as MDF. The low graded timber will be used as biofuel, although this is only possible if it hasn't undergone chemical treatment. Therefore I will make sure that the waterproofing preservatives used comply with timber recycling paths. I will also use bolts and screws instead of adhesives so disassembly is made easier and so that there is less chemical contamination.

Structural Glass Recycling (above water)

For structural glass used above water, it will be carefully removed from frames and any adhesives and chemicals will be removed from the panes. Then the glass will be collected and crushed into cullet before being melted and reformed into new glass or fibreglass. Bolted fixings will result in an easier recycling process than adhesives.

Acrylic Glazing Recycling (below water)

The acrylic glass that I will use in the semi submerged filming rooms will be collected, removed of marine coatings, cut and shredded into small flakes. These flakes will be remelted into new acrylic sheets. This will require specialist recyclers and therefore difficult transport logistics. I will try to keep the use of acrylic glass at a minimum below the water to avoid these complexities in the recycling process.

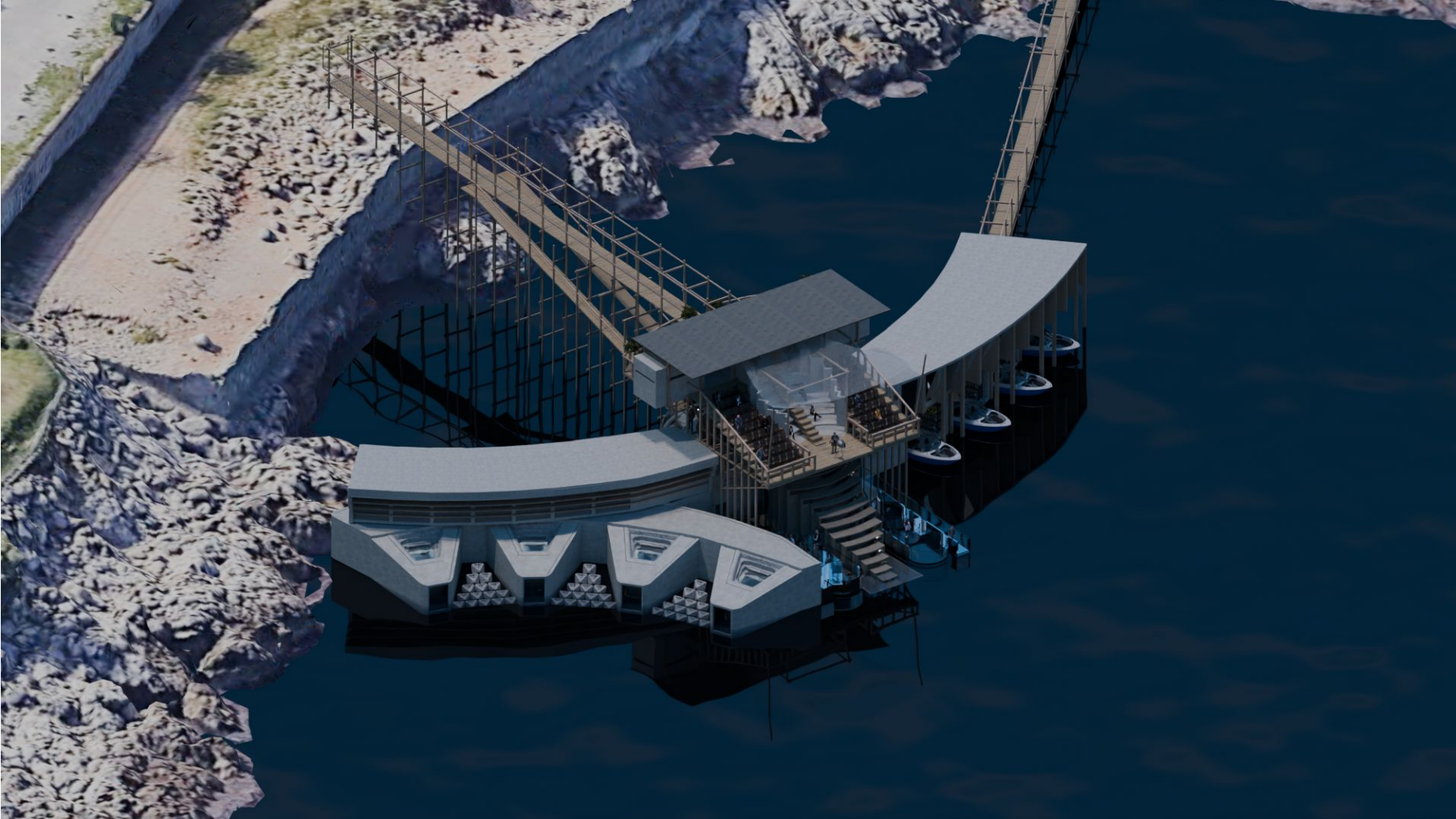


Conclusion

Through this process I have discovered that my rather elaborate and ambitious plan to design over the sea floor presents many difficulties for the logistical elements of the construction. Due to an intense curiosity to see whether or not my design could ever be realistically executed on the coast of Palermo, I have taken a very rigorous approach to this document when trying to describe the school’s interaction to the environment and its cost. Through this approach I have learned that in order to maintain a healthy surrounding marine environment (which is essential for the programme of my project), the construction process would have to be tailored perfectly to the site and extremely precise, and therefore extremely expensive. Although this is perhaps a slightly disappointing revelation, I have also hopefully revealed to readers of this document that, with the correct funding, materials and equipment, this project is entirely feasible. This has given me more excitement when returning to the design of my building, as it has provided me with a new confidence that this proposal isn’t completely wishful.

The scale of my school has probably been the most difficult element to navigate in this process, and due to this I have tried my best to balance the display of specifics with that of the overview in order to provide the clearest possible picture. When diving into details of the building I decided to focus on parts that pose the most personal interest in terms of structural and environmental challenges. This process has taught me the extensive complexities of marine construction, but also the endless opportunity for variable approaches and innovation within this field. When moving forward with my design, this has definitely reminded me to be more conscious of the logistics behind certain form making as well as material interaction. I am also now more wary of costs and budgeting in the world of architecture.

Overall this document has definitely helped with building a more in depth understanding of my site and the context surrounding it. It has opened my eyes to elements of construction that I would have otherwise ignore, and therefore it will inevitably improve my approach to design in the future.



Current Orthographic Render of Proposed Film School

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Artificial Intelligence (AI) Coursework Declaration

This page will be submitted as the first page of any final (summative) coursework in the Bartlett School of Architecture. You may need to combine this into the final PDF.

UCL's rules on [academic integrity](#) state that you must be transparent in your use of AI. You must therefore acknowledge when you have used AI to assist you in the creation of your academic work, such as to manage primary data (data analysis, transcription, and translation), enhancing your own visual material, giving feedback on content, or proofreading content. Acknowledgement also needs to be made within coursework itself, e.g., in an image caption.

Please select the most appropriate answer.

- ☐ 1. AI tools have not been used in my work at all.
- ☒ 2. AI tools have been used in an assistive role.
- ☐ 3. AI tools have been used as a primary tool (e.g., ChatGPT).

If you answered yes to 2 or 3, please elaborate below. As a minimum, include the name, version, and URL of the AI tool(s) and a brief description of the context in which the tool was used. For example: *I acknowledge the use of artificial intelligence tools in the production of this report. ChatGPT4 (<https://chat.openai.com/>) was used to provide an initial summary of focus group transcripts.*

I have used AI in the following way(s) (leave blank if you selected 1 above)

I acknowledge the use of artificial intelligence tools in the production of this report. ChatGPT was used in a secondary assistive role for verifying research, helping with mathematical equations and for producing one image in my document. This image is seen and labelled appropriately on my resilience and adaptability page.

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Module/unit name:	DESIGN AND TECHNOLOGY
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