TECHNOLOGY

North Sea: Landscapes of Coexistence
Transitional Territories Studio 2018-2019

Graduation Studio Building Technology Report:
Grey Lines in the Sand
The Nomos of the North Sea; a parliamentary state of exception

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2019

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Structure

1. Structure

1.1 Research Question

How to assemble structural elements in the North Sea, to create a transnational archipelago identity?

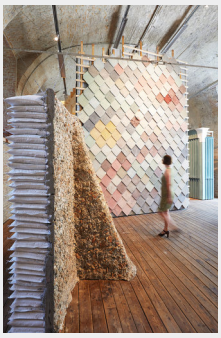
Sub-questions

1. How to transport and reassemble elements of existing infrastructure into a new circular economy?

references



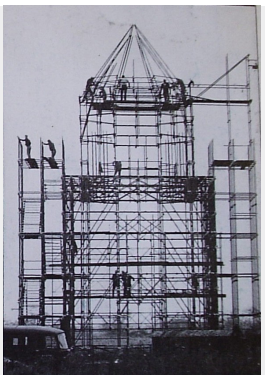
North Sea oil platform



Sand (bag wall)



North Sea fishing boat (wood)







Teatro del Mondo | Aldo Rossi







Acheron I | Renato Nicolodi







Watersnoodmuseum | Zeeland

1.2 Breakwater protection methods

The breakwater acts as the first form of protection against the power of water. Technology has developed into alternative methods to produce a breakwater other than scarce natural resources - rock - for the whole structure.

(a) Burj Al Arab (1994)
structure length - ~800m
maximum depth - 7m
wave design length - 2m (diameter)

(b) Malamocco, Venice
structure length -1000m
maximum depth - m
wave design length - m

(c) Langosteira II West Breakwater, Port of A Coruña
structure length -877m
maximum depth - 22m
wave design length - 8.75m

Structure protection

The bridge walkway legs and the prefabricated will be retrofitted with a *steel jacket*, this is a common practice in the construction of oil platform structures. Left, shows the three different types of ways to apply the Carbon fibre reinforced polymer (CFRP) jacket.

(d) CFRP jacket
(e) Steel jacket
(f) Concrete/ECC jacket grout, at the end of the jacket, a 50 mm (2 in.) gap

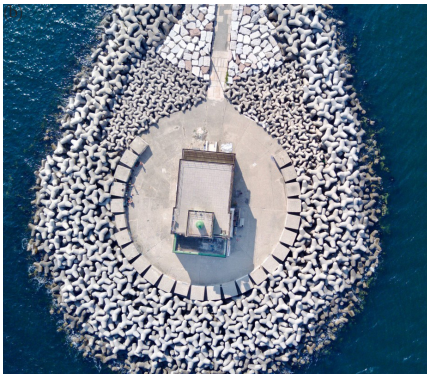
Like in an oil platform, the jacket's role will be to act as protection layer around the steel frame. The jackets have anodes for sacrificial corrosion protection all over it. Every so often a ROV (remote controlled car) will check the anodes on the bridge legs or maintenance man will check the prefabricated structures to see if the anodes are badly corroded. Typically the anodes are made of made of an alloy such as aluminium.

1.2 Breakwater protection methods



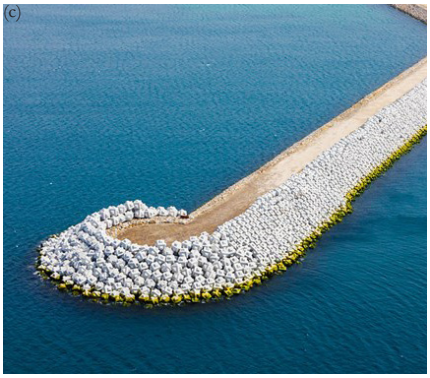
(d)

Burj al Arab, Dubai
-concrete honeycomb pattern



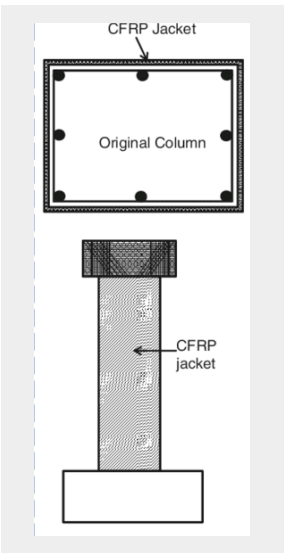
(e)

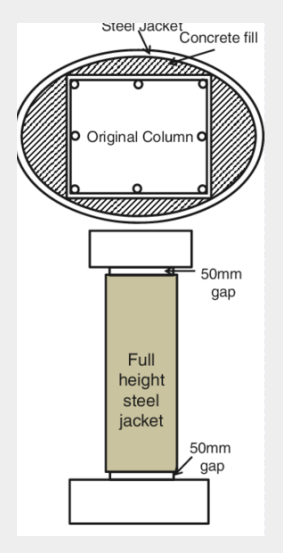
The breakwater head of Malamocco, Venice
-concrete tetrapods

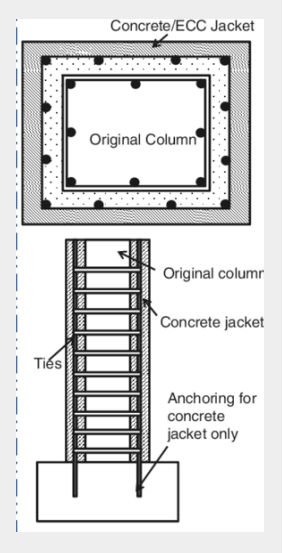


(f)

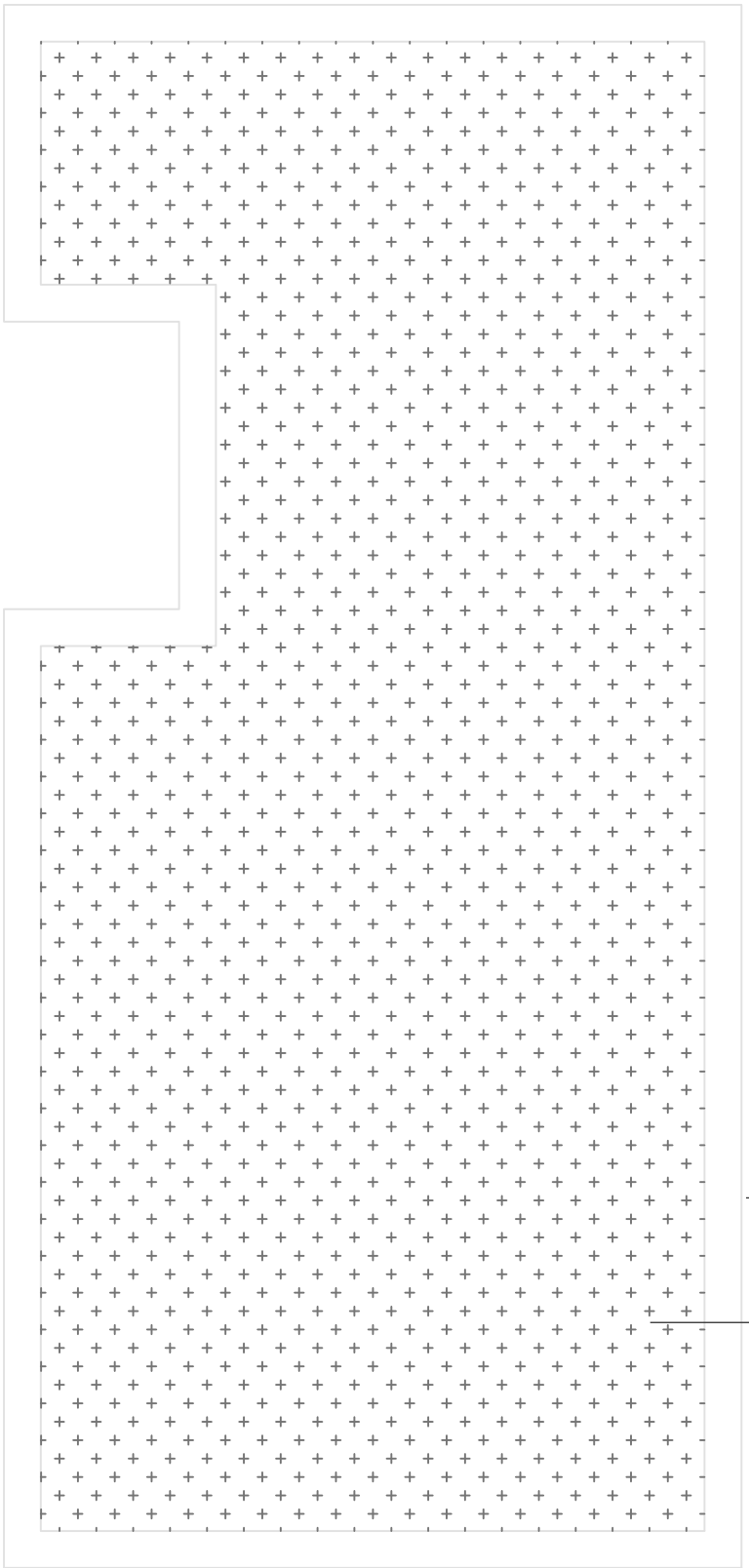
Langosteira II West Breakwater, Port of A Coruña
-concrete cubipod (2 sizes- 25stone, 45 stone)

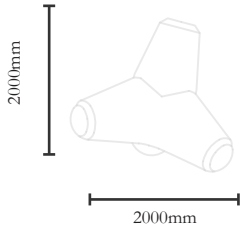


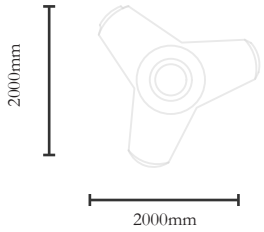


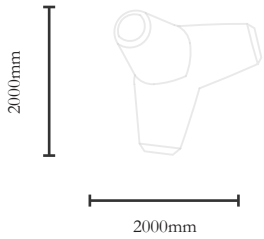


Steel / concrete frame protection methods







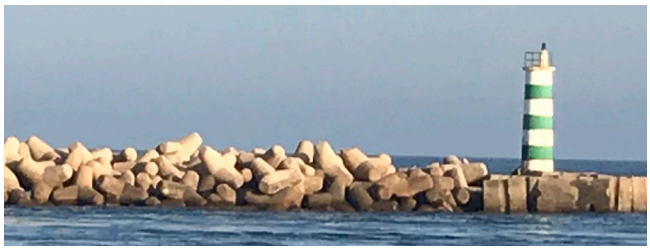


Outer protected shell, will be using recycled concrete recast into tetrapod. North Sea countries will contribute from their disused concrete buildings.

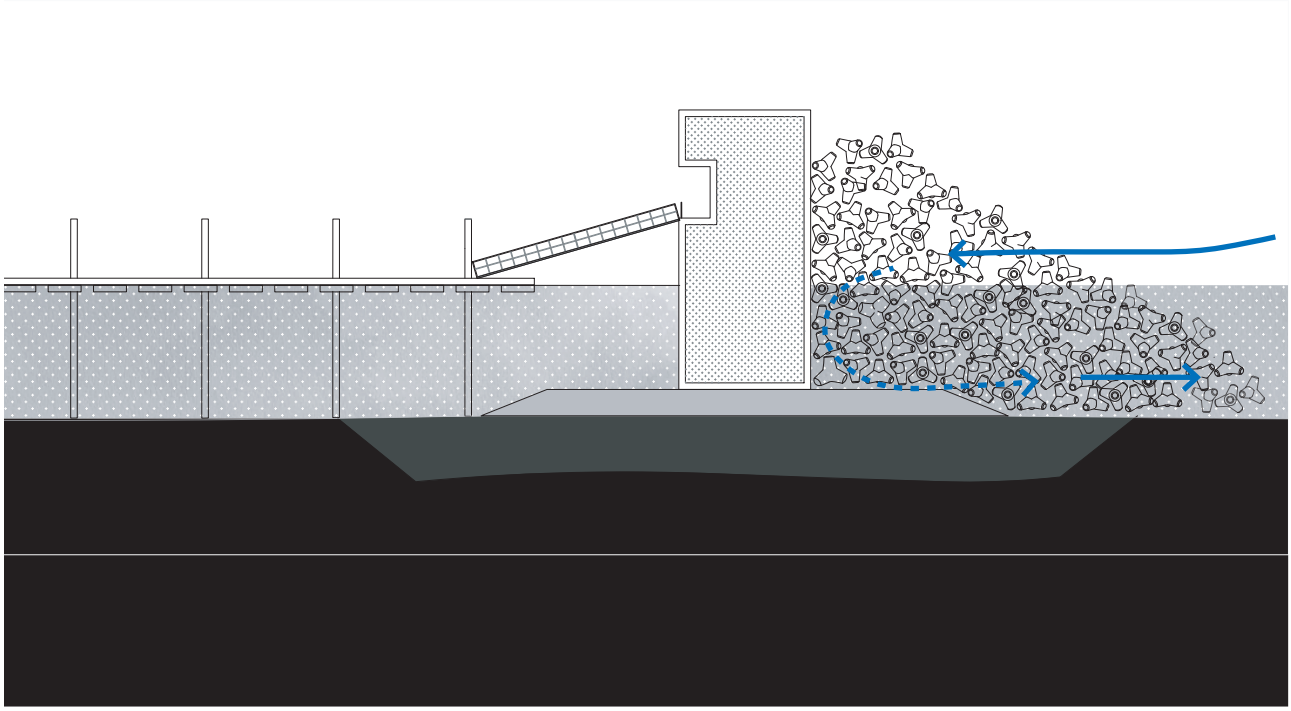
Concrete caisson box

Sea water

1.2 Breakwater protection methods



Faro Deserta Island breakwater



North Sea Parliament |
Breakwater section
Scale: 1.100/1.500@a3

N

0 10m

1.3 Caisson box research

Today, caisson box have become a quick method to construct harbour dock extensions. Built in a nearby floating dock, it is then floated to the site. This means multiple boxes can be made at once and floated when the weather is suitable.

This system has been expanded to inhabitable caisson boxes, the Snøhetta underwater restaurant completed in 2019.

1.3 Caisson box research







Top - Monaco harbour extension built on floating dock
Middle - Monaco harbour extension caisson box birds eye view
Bottom - Snøhetta underwater restaurant lifted into place

1.4 Assembly | disassembly system principles

Why prefabrication modular system?

The benefits of modular construction are multiple:

01 Faster build time – the modular construction process is independent and can occur before site and foundation work, or simultaneously. This allows new buildings to be completed up to 50% faster, and refurbished projects up to 70% faster, than traditional site-based construction methods.3

02 Reduced waste – off-site construction generates up to 90% less waste than traditional on-site building methods.4 The factory-controlled process also minimises the amount of energy necessary to create a building.

03 Cost-effective – modular building projects are not subject to weather-related delays or site-based skills shortages. Once assembled on site, the buildings are ready to be occupied, creating a faster return on investment.

04 Less noise and disruption on site – factory-based construction minimises time on site, reducing site disruption and environmental noise pollution, leaving the construction site cleaner and safer.

05 Fewer vehicle movements – modular construction results in 90% fewer vehicle movements to, from and on the construction site, reducing transport-related emissions and disruption.5

06 Future flexibility and reuse – modular buildings can easily be expanded, reduced, reconfigured or even relocated to meet your changing needs.

Construction method:

a Individual factory-built modules are delivered by lorry to the site.

b The first layer of modules is lowered into position by crane.

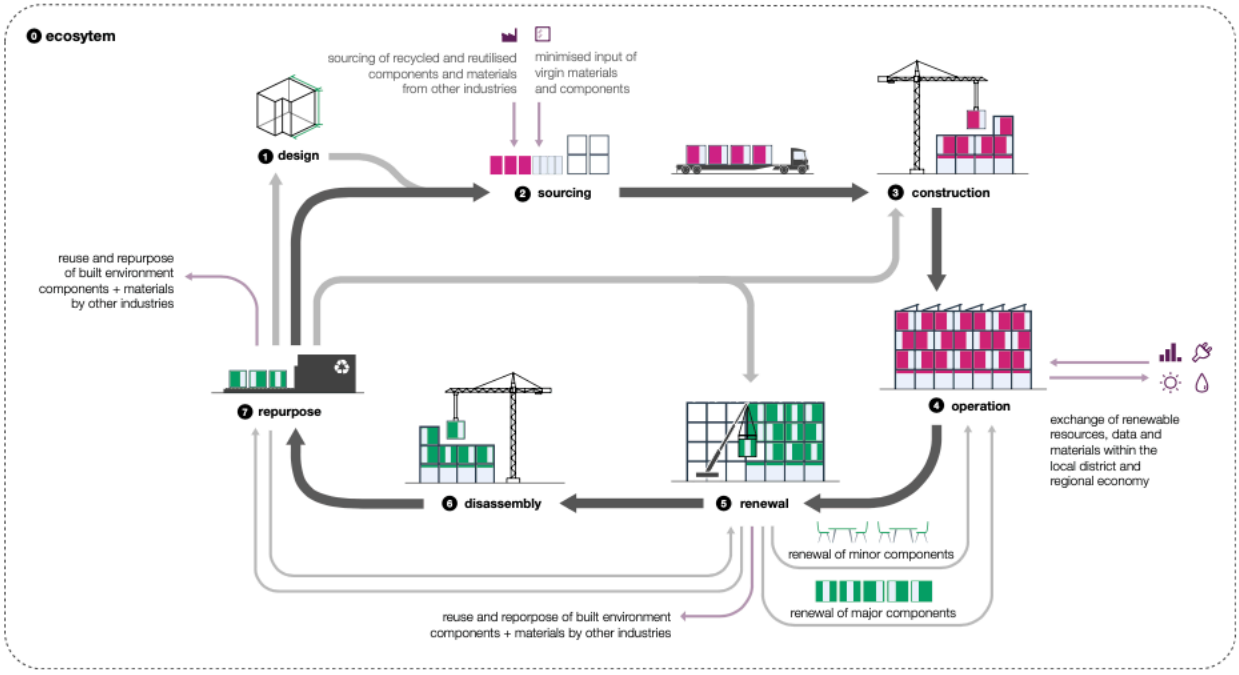
c A single building is created.

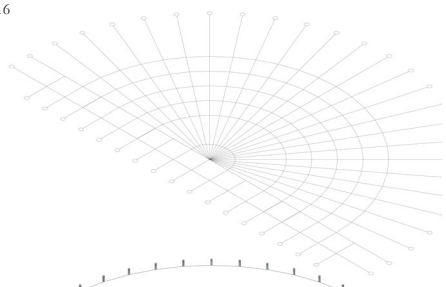
d Additional storeys can be added to create more space according to your specific requirements.

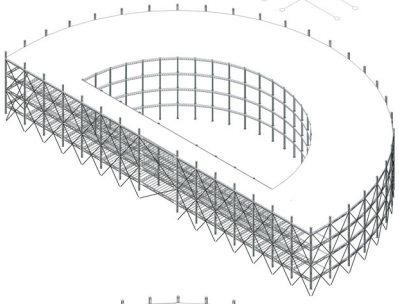
e Positioning modules side-by-side or end-to-end can create the required building floor area, with bespoke internal layouts designed using partition walls, stairs and lifts.

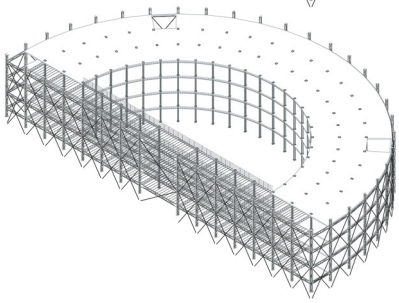
source: https://www.portakabin.co.uk/what-is-modular.html

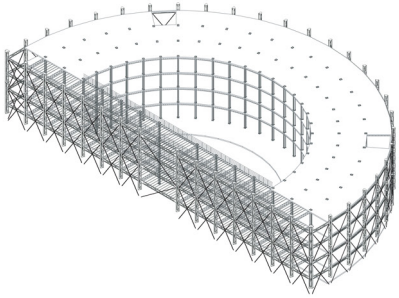
1.4 assembly | disassembly system principles

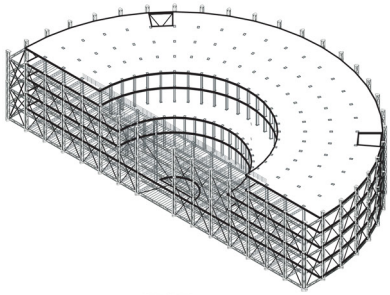


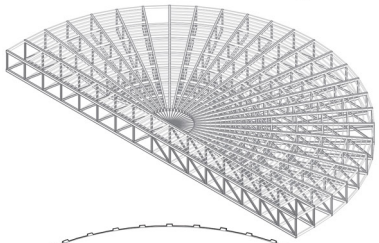


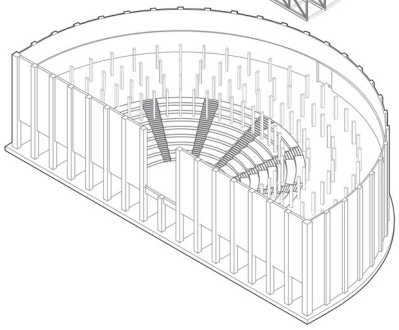










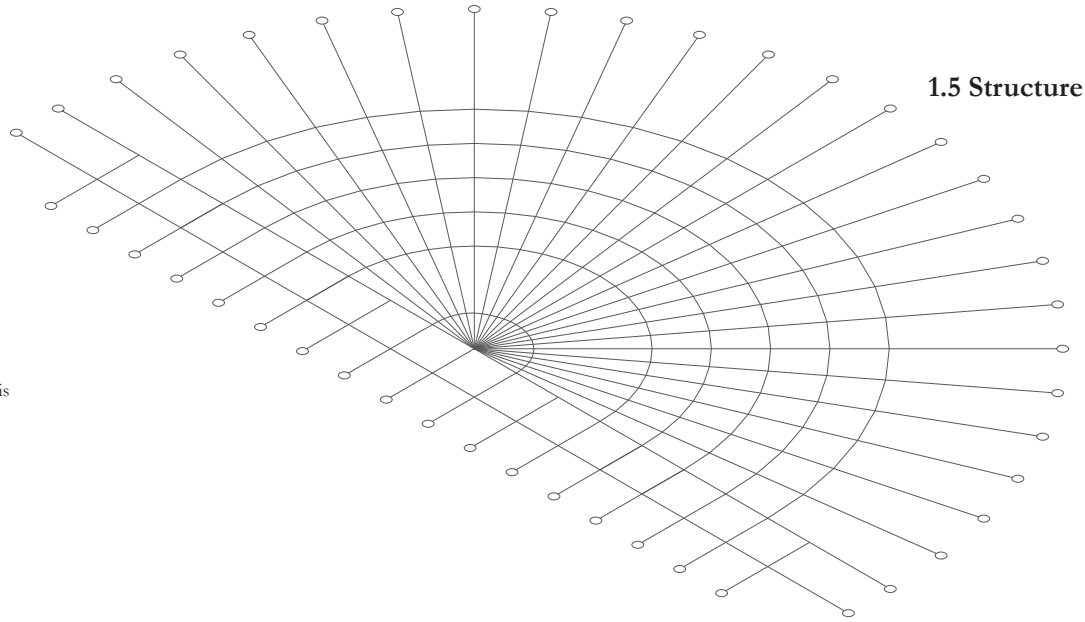


1.5 Structure systems

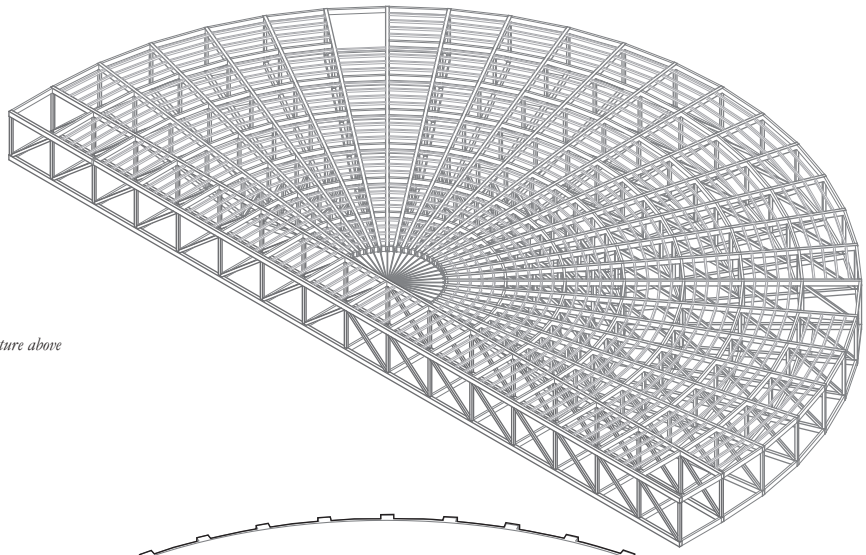
The project has two structure systems, the caisson box on the bottom and breakwater and the steel structure on the upper part.

The caisson box becomes an inhabitable space than a traditonal

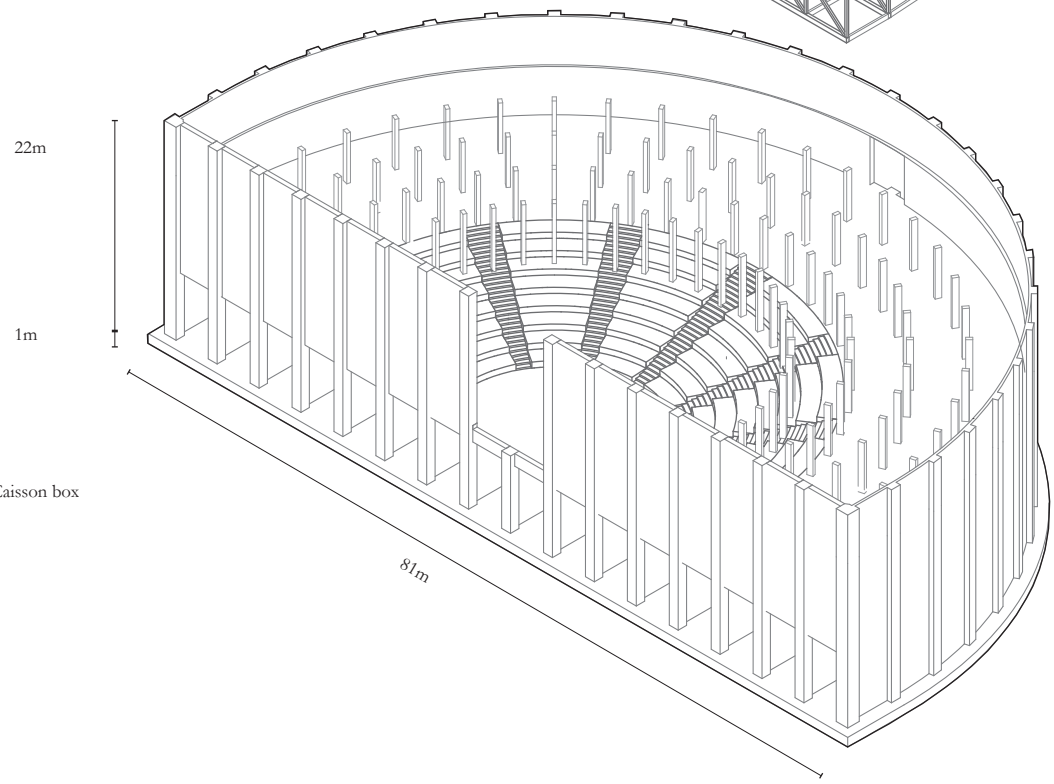
1.5 Structure systems



Structure axis

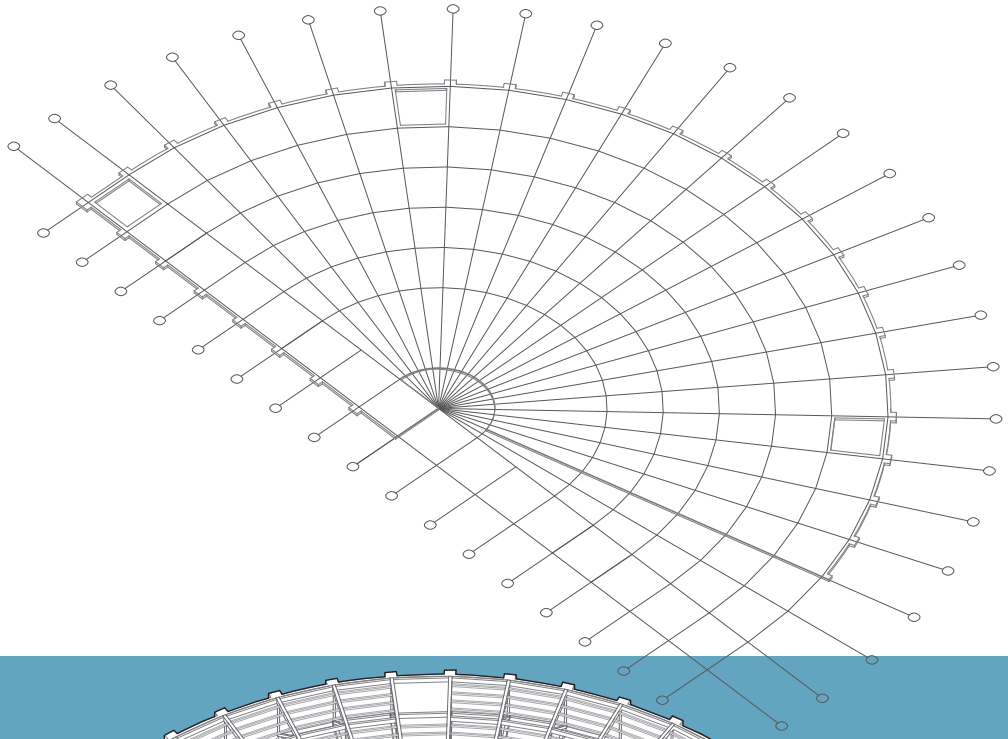


Assembly truss
Ceiling | Floor to steel structure above

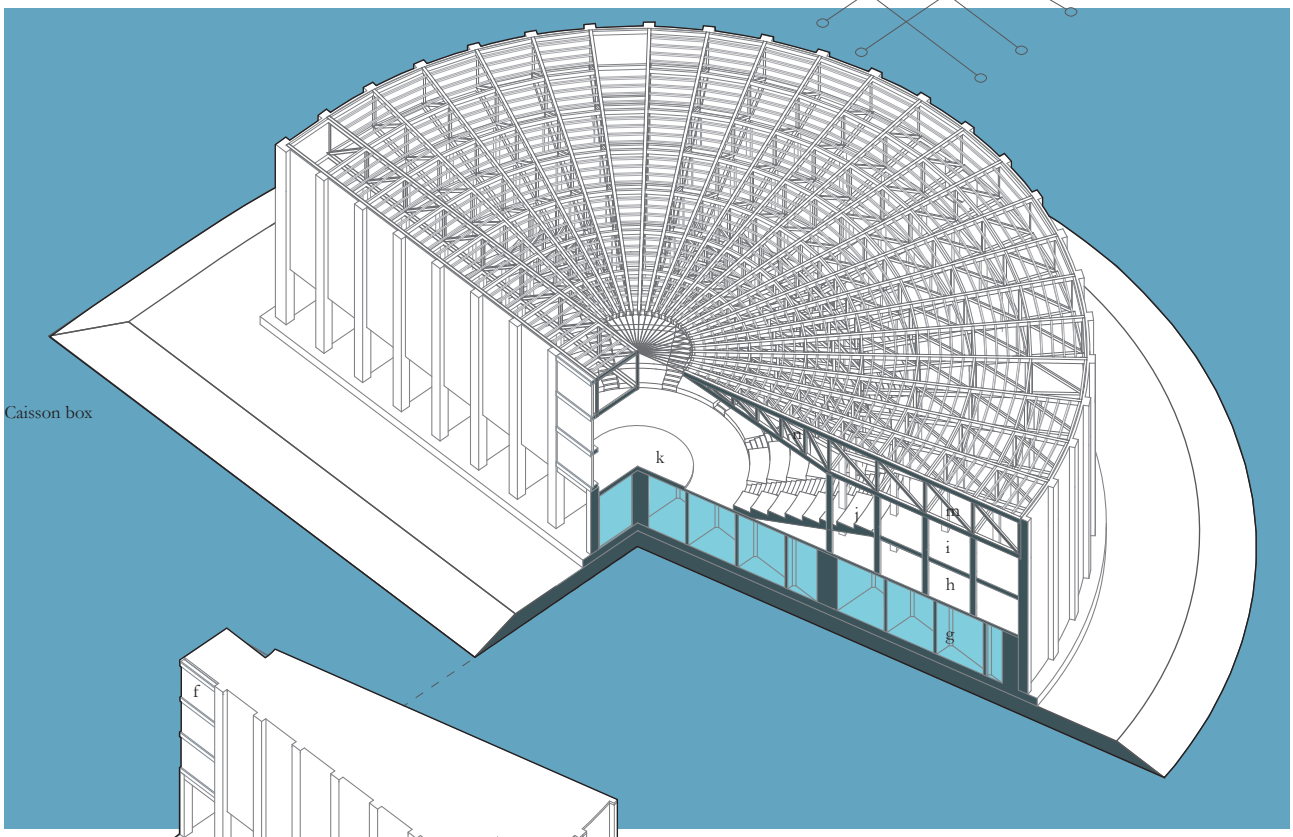


Caisson box

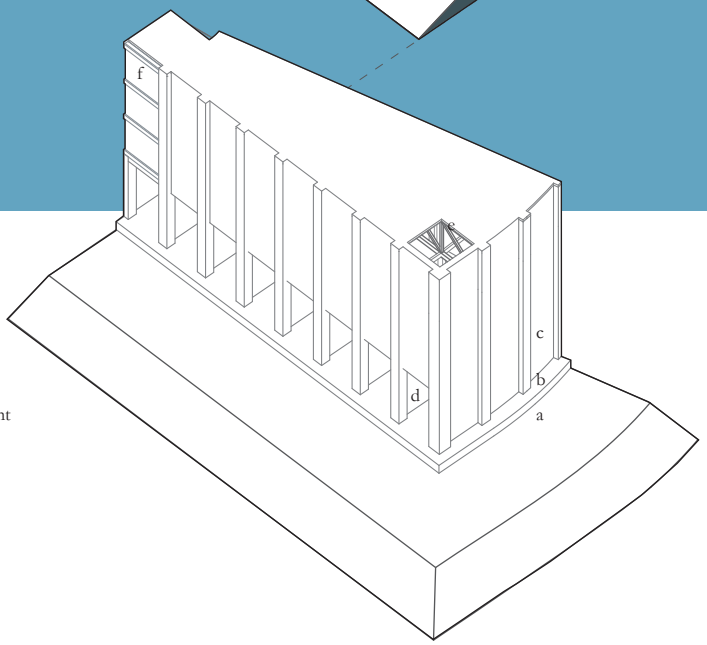
0 10m



Structure axis
Caisson box roof



Caisson box



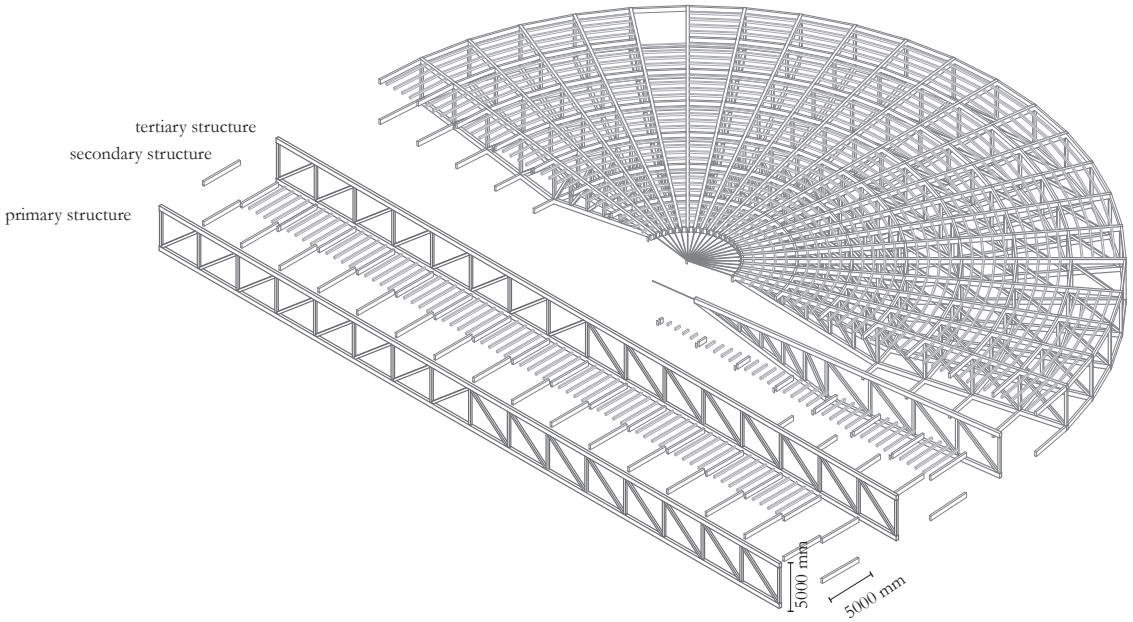
Segment

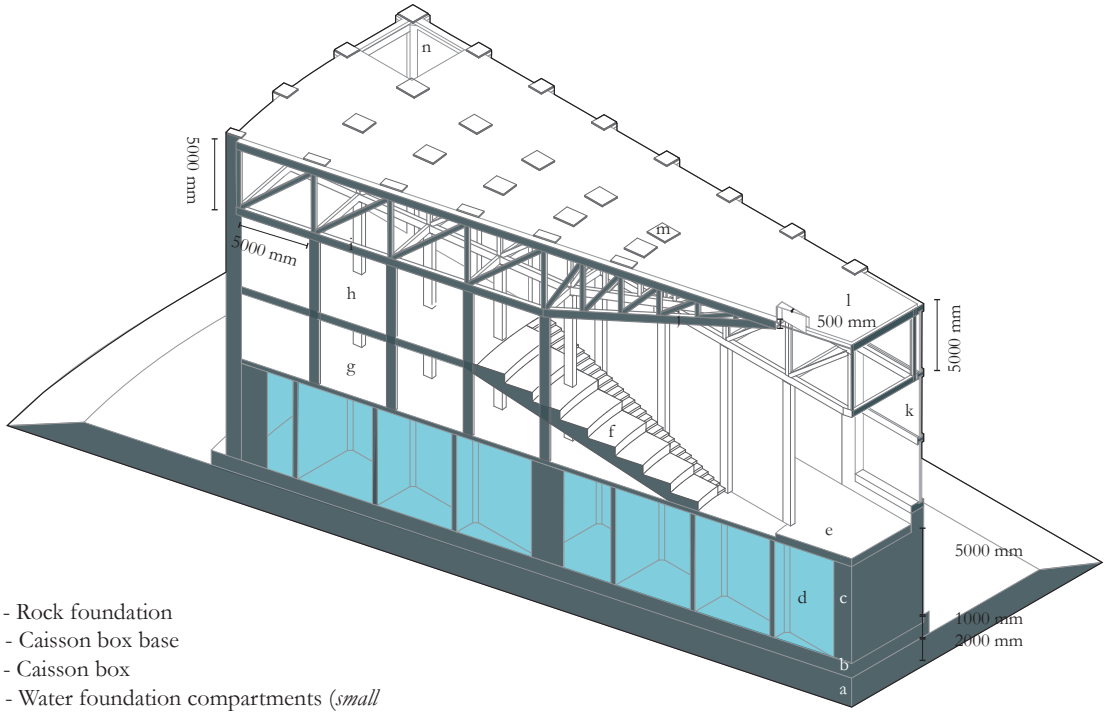
a - Rock foundation
b - Caisson box base
c - Caisson box
d - Open compartment
e - Screen stair zone
f - Assembly room window
g - Water foundation compartments*
h - Plant room
i - Entrance level
j - Assembly stair
k - Stage
m - 5 metre high Howe truss
n - 15m metre cantilevered truss

0 10m

*(*small holes each compartment allow the water to balance the caisson box in transit)*

1.5 Structure systems

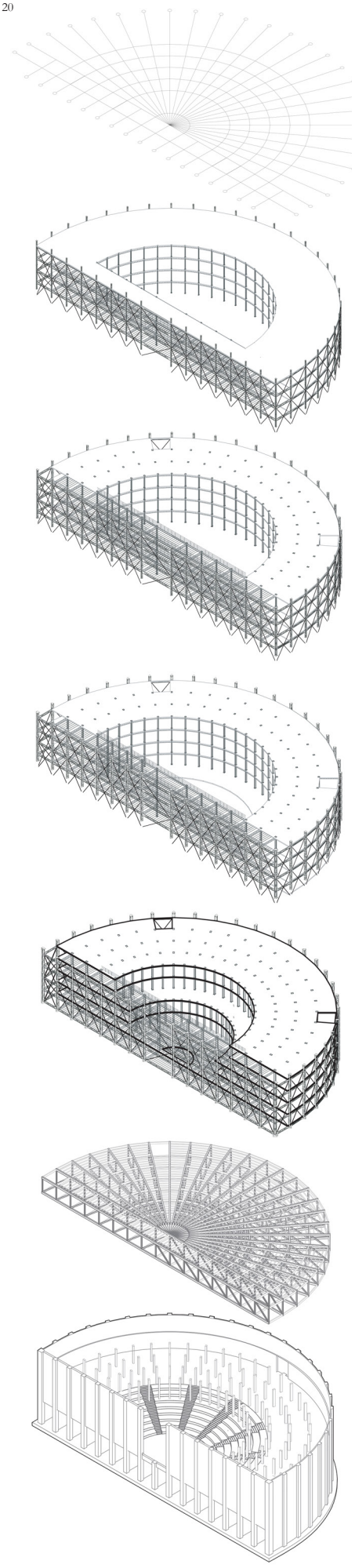




a - Rock foundation
b - Caisson box base
c - Caisson box
d - Water foundation compartments (*small holes each compartment allow the water to balance the caisson box in transit)*
e - Stage
f - Assembly stair
g - Plant room
h - Entrance level
i - 5 metre high Howe truss
j - 15m metre cantilevered truss
k - Assembly room window
l - Caisson box roof
m - Concrete pads for steel structure above
n - Screen stair zone

0 5m

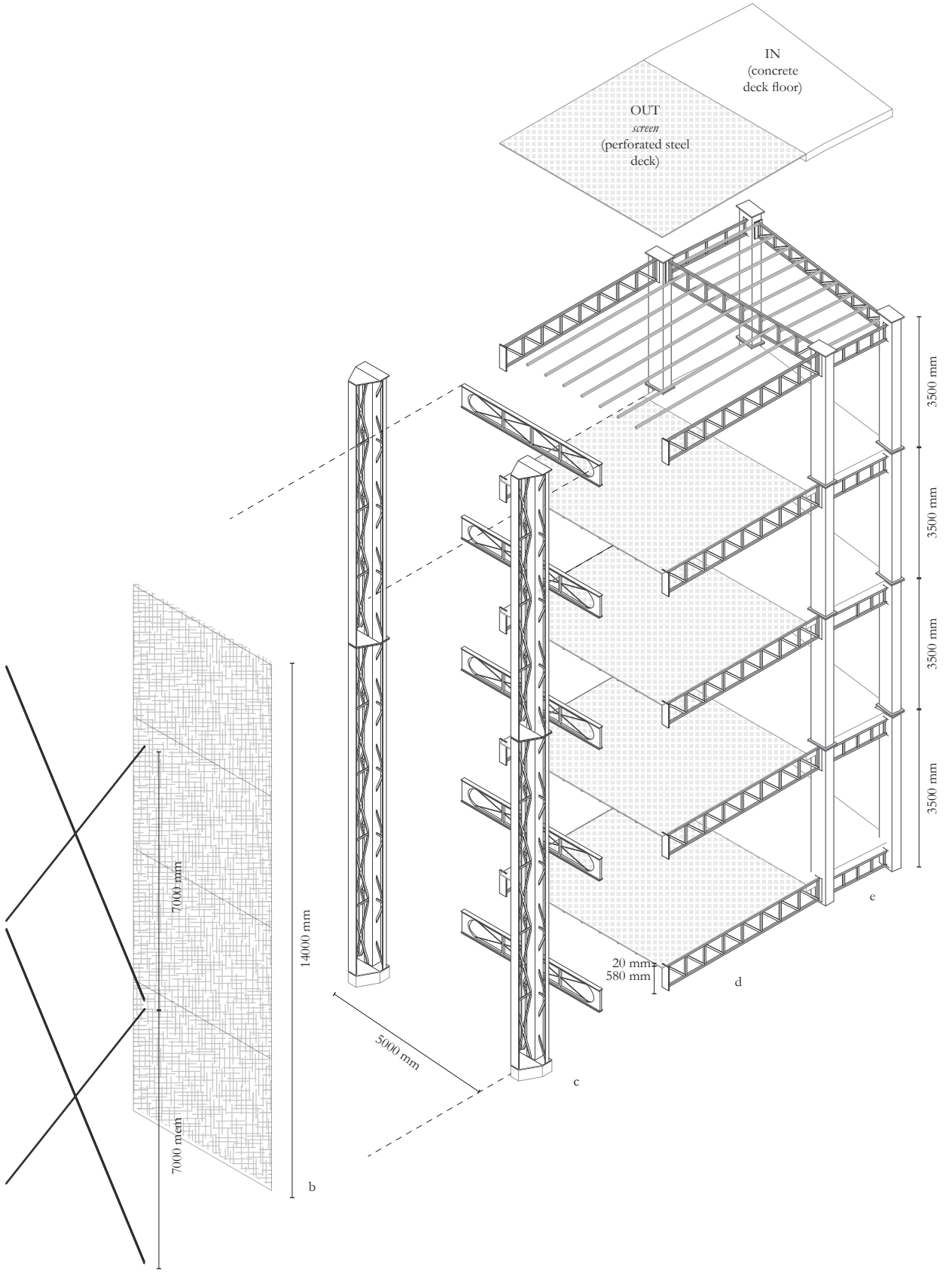
**At the bottom the gasholder column is 500mm longer to accommodate the lowest truss.*



a - Tension rod
b - Perforated mesh screen
c - Steel exoskeleton structure *disassembled from the Oval gasholder structure, London*
d - Perforated mesh "screen" floor
e - Concrete deck floor

*At the bottom the gasholder column is 500mm longer to accommodate the lowest truss.

1.5 Structure systems



0 5m

2. Façade

2. Façade

2.1 Research Question

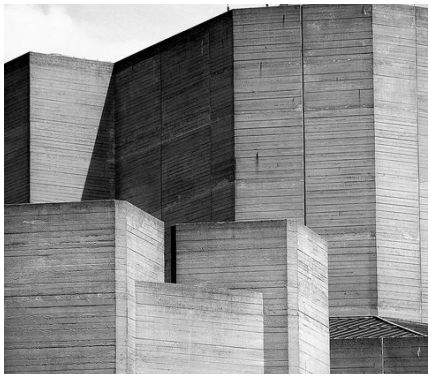
How to protect the structure but still allow light into the space?

Sub-questions

1. How to be disassembled and assembled at ease, to fix parts of the building damaged?

references

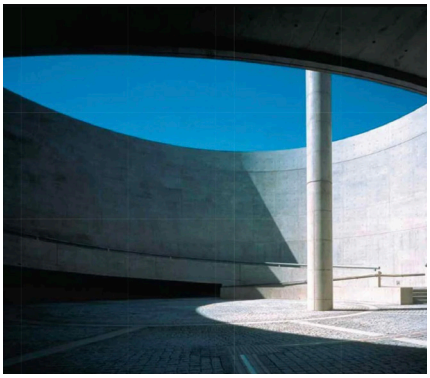
solid



The National Theatre, London | Lasdun's Cliff



unknown | Durisch + Nolli Architetti

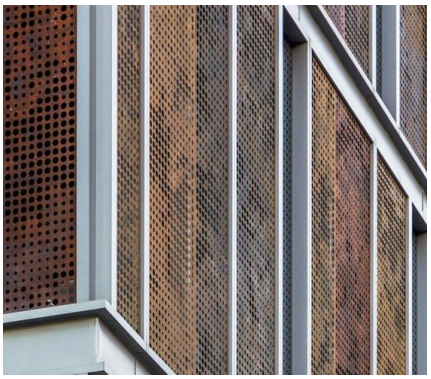


Forest of Tombs museum | Tadao Ando

perforated



Taiwan Townhouse | KC Design studio



Children's Hospital VCU

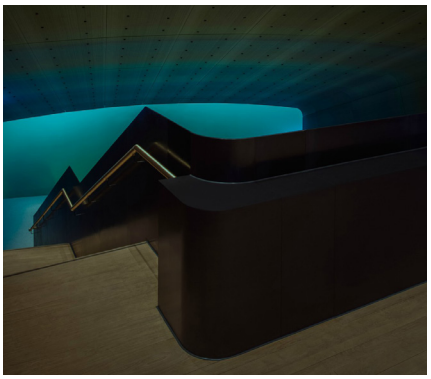


FRAC Dunkerque

opening



Rue des Suisses, Paris | Herzog & de Meuron

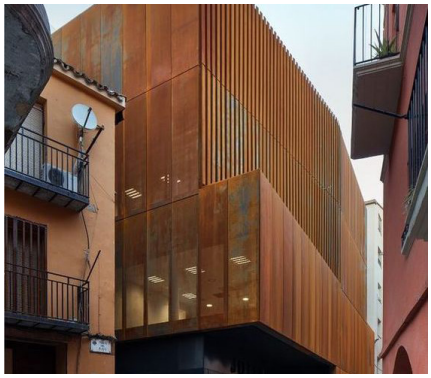


Underwater restaurant, Norwat | Snøhetta



Showroom and Offices DFG-Pavestone / OLAestudio

colour



Law Court Balaguer | camps+felip arquitecturia



San Pedro de La Paz, Chile. |Estudio Palma.



unknown | Tham & Videgård

1.2 Materials

Board formed concrete façade

Material used: reinforced concrete
Coating: board formed finish

Material Qualities
"Board-formed Concrete" is the name for a process of patterning concrete that leaves a wood grain image on the finished face of the concrete. It is a method of construction that is being used more frequently these days because concrete is extremely well-suited as a finished material in modern design, and by imprinting the wood grain on the surface, it visually softens and warms concrete's somewhat cooler appearance while still allowing concrete to express the construction technique.

Technique
When concrete walls gets placed (or poured, cast or set … whatever) there is form work that gets built on site that holds the wet concrete in place until it has hardened. Typically, the form work is built out of sheets of plywood that the wet concrete sits against, and the curing (drying) concrete takes on the patterns of the plywood surface. Board formed concrete, uses a plywood form work and you add an additional layer of wood to the inside faces so that the wet concrete takes on this new pattern. In the picture above, you can see to concrete labourers adding this layer of wood to one side of the form work. Finally, the surface is sandblasted to remove the tooling marks.

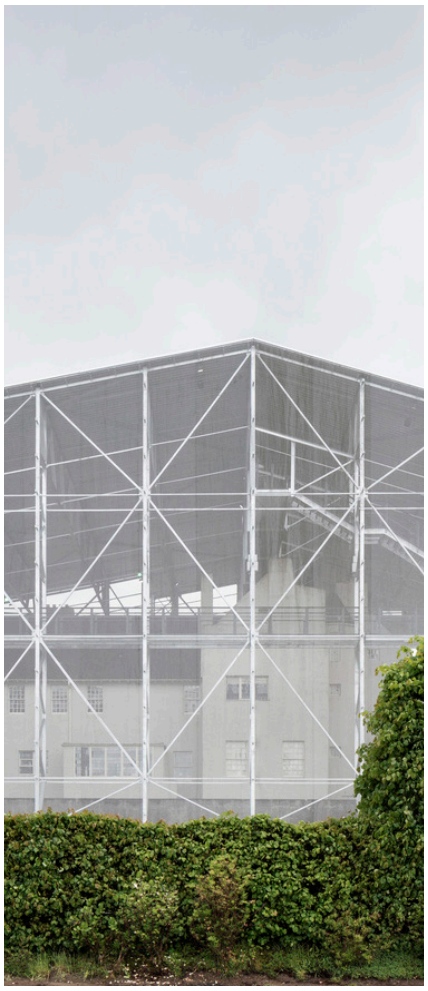
source: https://www.lifeofanarchitect.com/board-formed-concrete/

1.2 Material research

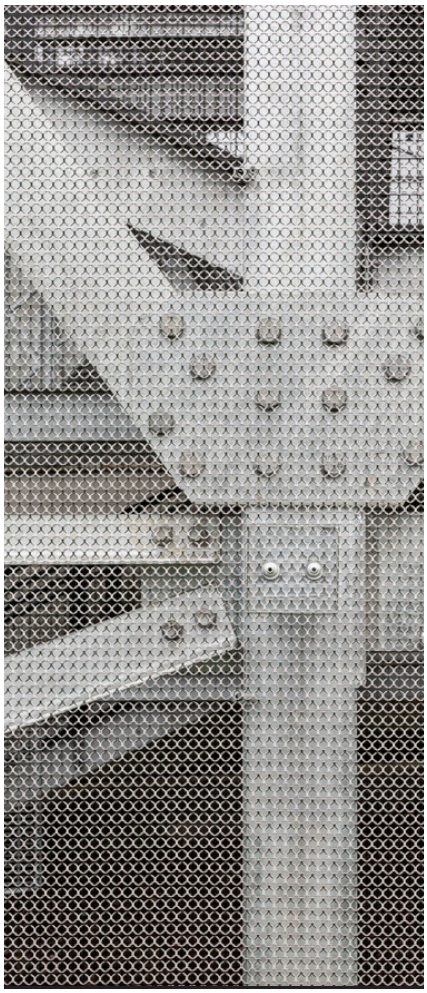




The National Theatre, London | Lasdun's Cliff







The Hill House Box/ Carmody Groarke

It involves a fully demountable, reusable and recyclable structure, essentially a semi transparent delicately engineered steel framed shelter, lightly stiletto into the ground via concrete pads. A galvanized steel roof protects against the rain, and curtain walls of stainless steel chain mail not only allows bees to get in to pollinate the soft landscaping that's also contained within the new structure





Oil Rig/ North Sea

Perforated sheets and modular design enable wind to pass through and panels to be easily replaced.

3. Climate

3. Climate

3.1 Research Question

How to create an system which can support itself independently from a national grid?

Circular economy source:
Circular economy in the built environment by Arup

Sub-questions

1. How can water play role in supporting itself?



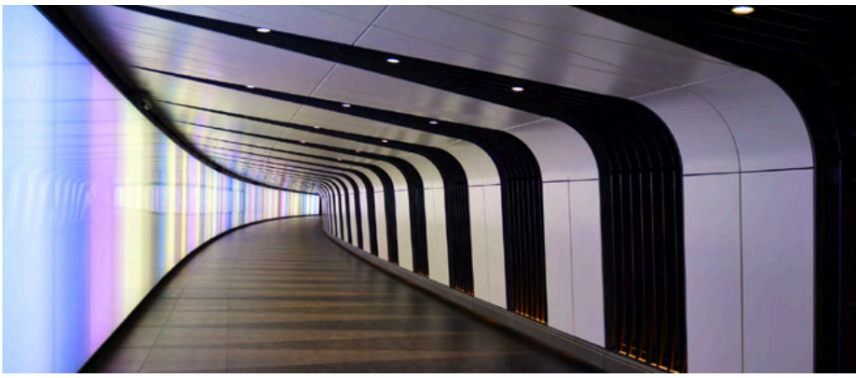
SHARE - Caterpillar is a world leader in reducing, reusing, recycling and reclaiming materials



EXCHANGE - Minimising negative externalities, noise and air pollution is a core aim of the circular economy



OPTIMISE - Bussum Water Tower, an office that includes its own wastewater and sewage treatment facility



OPTIMISE - The system uses light-emitting diodes (LEDs) which are expected to cut the airport's energy consumption by as much as 50%



REUSE - Reclaimed tyres act as planters



LOOP - Sustainable zero waste living



REGENERATE - Solar collectors to heat water on roofs



LOOP - Sustainable zero waste essentials

3.2 Circularity Research

The circular economy concept offers a chance to make the step change needed. It aims to decouple economic growth from resource consumption. Instead, products and assets are designed and built to be more durable, and to be repaired, refurbished, reused and disassembled.

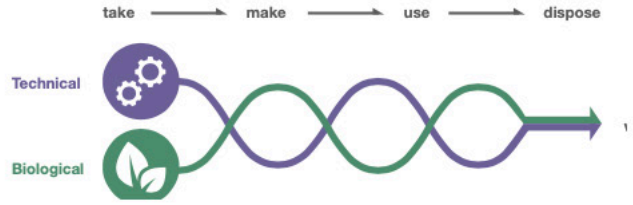
This maintains components and their materials at the highest useful purpose as long as feasible which minimises resource waste. By moving away from the linear model to an ecosystem where natural capital is preserved and enhanced, renewable resources are optimised, waste is prevented and negative externalities are designed out. Instead, materials, products and components are held in repetitive loops, maintaining them at their highest possible intrinsic value. As things stand, a global economy predicated on growth is helping to increase the world's middle class and its purchasing power. This trend is starkly at odds with the finite nature of our natural resources. Ongoing volatility in global commodity markets shows we need to reconsider how society consumes goods.

Gradual change is underway. We are already seeing the emergence of a sharing economy. Research suggests that young people are more inclined to rent, lease or share items such as clothes, cars or houses than previous generations.

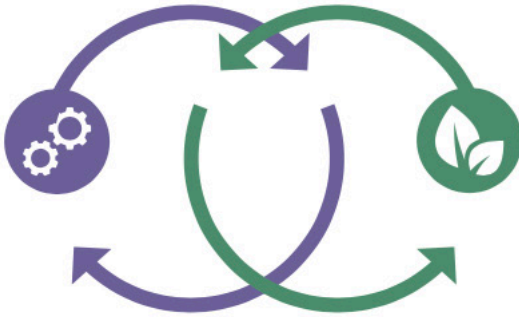
Then Ellen MacArthur Foundation developed the system or 'butterfly' diagram (Figure 2) based on the notion that material flows can be divided into two interacting loops: the technical and biological resource cycles. Within the biological cycle, renewable and plant-based resources are used, regenerated and safely returned to the biosphere — as in composting or anaerobic digestion. The bio-economy is a growing sector with the potential to lower raw materials consumption, reduce waste and generate higher-value products for sustainable biological re-use. Within the technical cycle, man-made products are designed so that at the end of their service life – when they can no longer be repaired and reused for their original purpose their components are extracted and reused, or re-manufactured into new products. This avoids sending waste to landfill and creates a closed-loop cycle.

3.2 Circularity research

linear | circular diagram



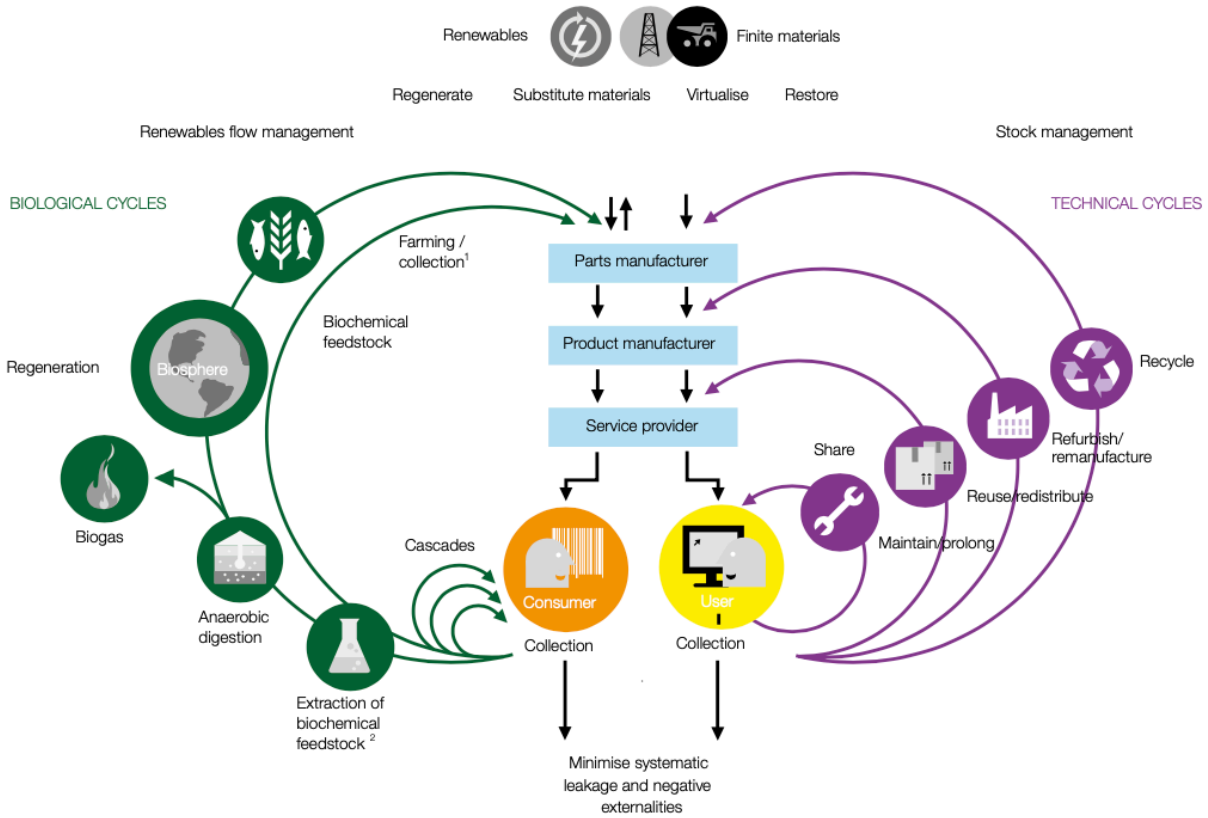
Technical +Biological Nutrients mixed up - energy from finite resources



Living Systems, energy from energy resources

Adapted from Ellen MacArthur Foundation, 2015

the butterfly diagram



Adapted from: Ellen MacArthur Foundation and McKinsey Center for Business and Environment; Adapted from Braungart & McDonough, Cradle t Cradle (C2C).

0. Ecosystem
In a circular economy, buildings will be designed for a whole life-cycle and not simply an end use. Policy and incentives will encourage clients to issue full lifecycle contracts from design to operation and disassembly as well as pushing their ambitions in achieving holistic lifecycle certification and awards. Components and structures will often be leased rather than purchased Design decisions such as optimising disassembly and reuse from the beginning of the programme have implications for the operation, renewal and re-purposing of the building and its components. In the circular model, a building's construction will be integrated with the resource and reuse cycles of other industries. In operation the building will use renewable sources and, where possible, locally available used material streams. This will make it more resilient, and will lower risks to investors. Buildings will also be used flexibly 24/7 with high levels of occupation during the day and night.

1. Design
A circular building will be more than just a structure providing space and shelter; it will accommodate future change such as remodelling, expansion or disassembly. Open-source design will become standard practice and architects, engineers and designers will share their designs and build on each other's work. The mind-set of building designers will change and structures and buildings will be reused and retrofitted where possible before new structures are considered. Design will be more than just form, structure and space. Operation and performance will be embedded into design processes, to incorporate energy-efficient principles such as passive design and minimised externalities.

2. Sourcing
The extraction of materials may be dramatically curtailed in future, as resources become scarce. Modularity and adaptability will be key components of design in a circular built environment. Buildings will be constructed from flexible, durable, reused and reusable parts And non-standardised materials and components left as a long-term legacy of the linear economy will be reused as much as possible. For example, in-situ concrete components could be transformed into other building modules..

3. Construction
The word construction in a circular world will be used in the context of assembly. Off-site manufacturing and prefabrication will help to eliminate waste from construction sites. Designs and detailing will be done so as to minimise material use.

4. Operation
All buildings and structures will be designed to high efficiency standards, minimising externalities and environmental impacts. These will include structures with internal circular resource cycles such as water capture and filtering. Buildings will be net producers of energy.

5. Renewal
Designs will allow for easy access to building services or include demountable and reconfigurable façade systems. Circular buildings will be retrofit- and upgrade-ready. This will minimise the time and cost for renewal and eliminate waste and other outputs. Policies and industry standards will ensure components from different manufacturers and providers are interchangeable

6. Disassembly
Demolition will be minimised in a circular world. Structural pieces may be transported. As a result, buildings will be highly mobile, versatile and flexible – lengthening their useful lifespans.

7. Repurpose
To make maximum use of components and materials, circulating them between buildings and projects and maintaining them at the highest possible value and performance. After a certain period of time, components will no longer be suitable for use in the same context. They will then need to be recycled and re-manufactured into other less structural parts or other products for other industries

3.2 Circularity research

Regenerate	Regenerating and restoring natural capital	Safeguarding, restoring and increasing the resilience of ecosystems Returning valuable biological nutrients safely to the biosphere
Share	Maximising asset utilisation	Pooling the usage of assets Reusing assets
Optimise	Optimising system performance	Prolonging an asset's life Decreasing resource usage Implementing reverse logistics
Loop	Keeping products and materials in cycles, prioritising inner loops	Remanufacturing and refurbishing products and components Recycling materials
Virtualise	Displacing resource use with virtual use	Replacing physical products and services with virtual services Replacing physical with virtual locations Delivering services remotely
Exchange	Selecting resources and technology wisely	Replacing with renewable energy and material sources Using alternative material inputs Replacing traditional solutions with advanced technology Replacing product-centric delivery models with new service-centric ones

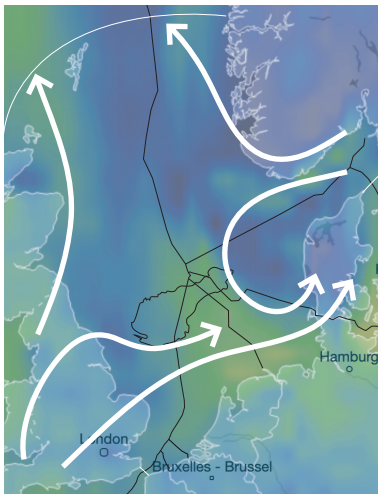
Adapted from: 'Growth Within: a circular economy vision for a competitive Europe', Ellen MacArthur Foundation, SUN McKinsey Centre for Business and Environment

3.3 Environment analysis

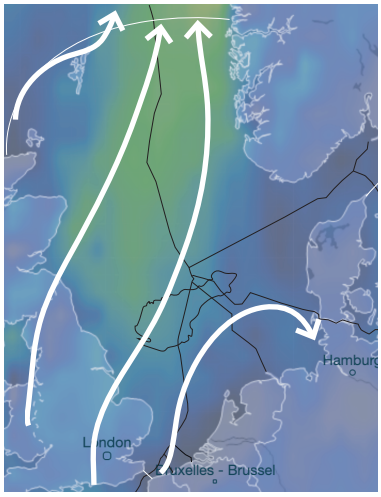
Wind speed on site location:

1st May 2018: 37km/h
1st June 2018: 10km/h
1st July 2018: 25km/h
1st August 2018: 19km/h
1st September 2018: 17km/h
1st October 2018: 51km/h
1st November 2018: 41km/h
1st December 2018: 36km/h
1st January 2019: 38km/h
1st February 2019: 36 km/h
1st March 2019: 16km/h
1st April 2019: 21km/h

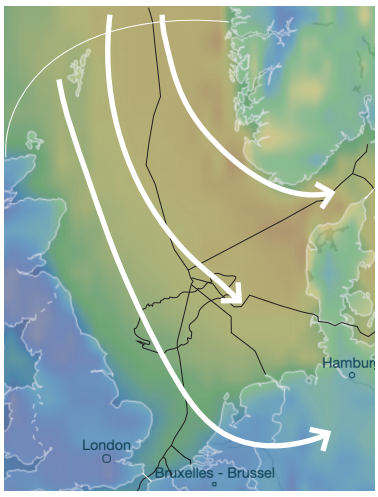
Strongest winds: 58km/h 16/01/19 (1400)



May 2018

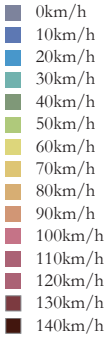


September 2018

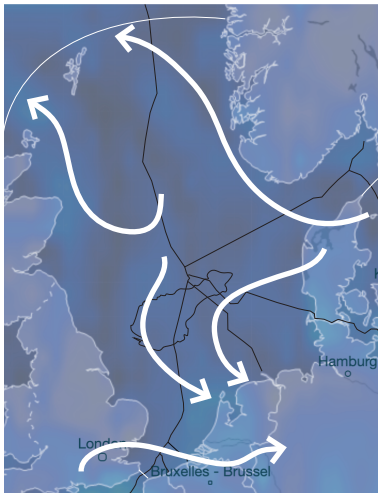


January 2019

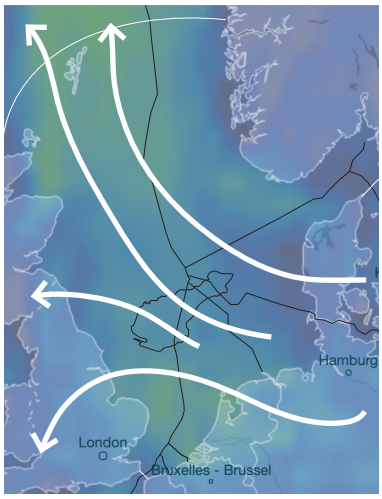
North Sea
Wind speed
Source: Ventusky



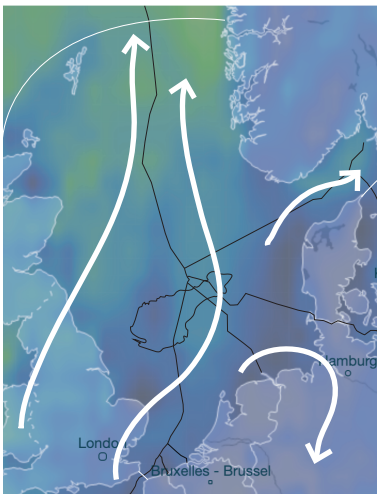
3.3 Environment analysis



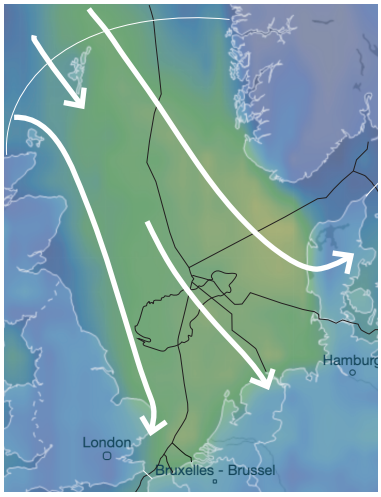
June 2018



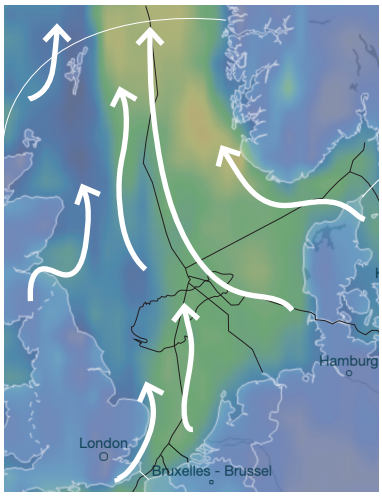
July 2018



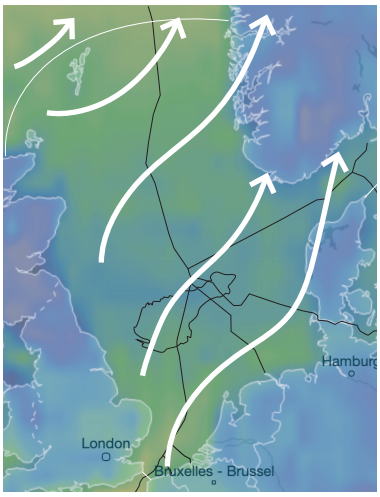
August 2018



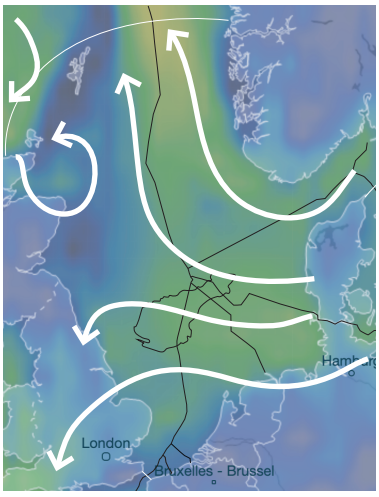
October 2018



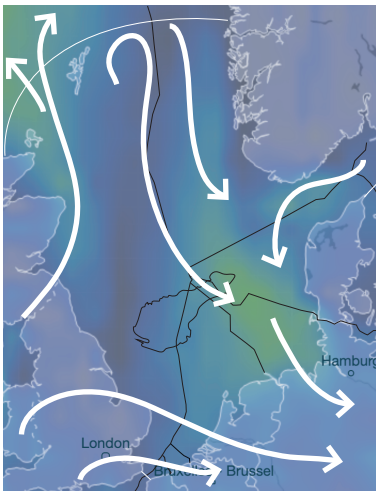
November 2018



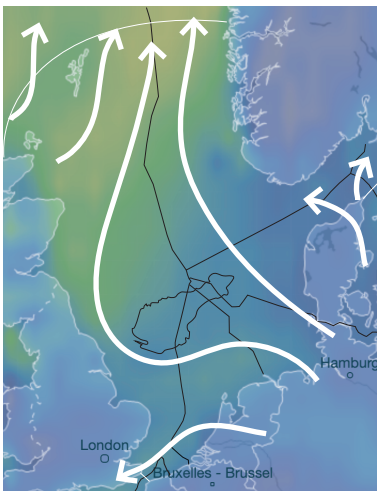
December 2018



February 2019



March 2019



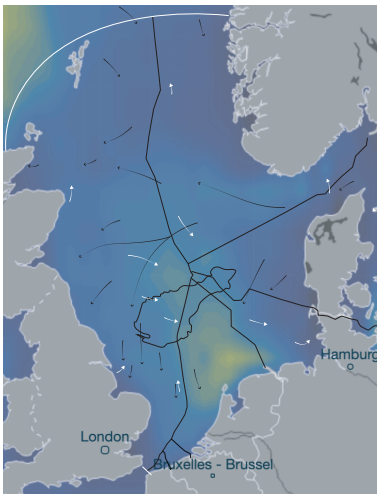
April 2019

3.3 Environment analysis

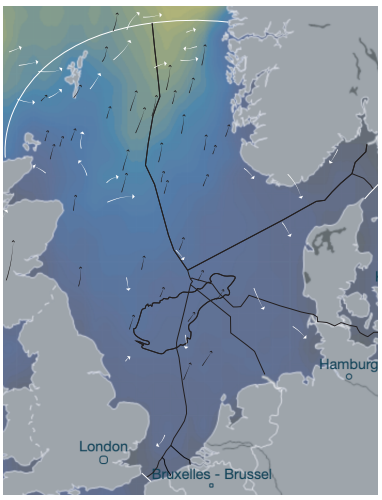
Swell height on site location:

1st May 2018: 2.1m
1st June 2018: 0.3m
1st July 2018: 1.1m
1st August 2018: 0.5m
1st September 2018: 0.5m
1st October 2018: 3.6m
1st November 2018: 1.8m
1st December 2018: 1.8m
1st January 2019: 3.1m
1st February 2019: 2.1m
1st March 2019: 1.2m
1st April 2019: 1.6m

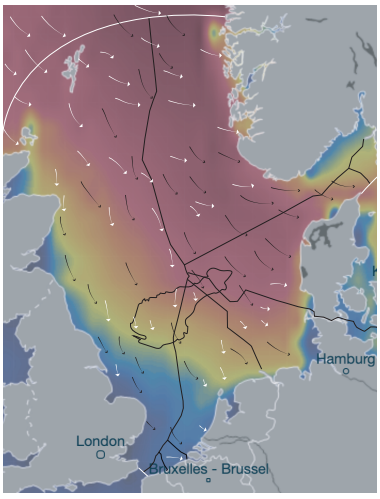
Strongest wave: 4.8m 14/01/19 (1400)



May 2018



September 2018



January 2019

North Sea
Wave force and current direction
Source: Ventusky

Surface current
Under surface current

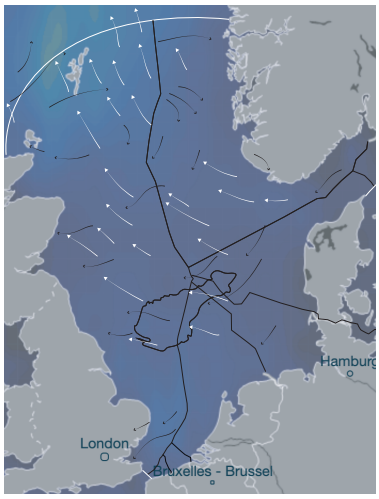
0m
0.5m
1m
1.5m
2m
2.5m
3m
4m
5m
6m
8m
10m
12m
14m

N

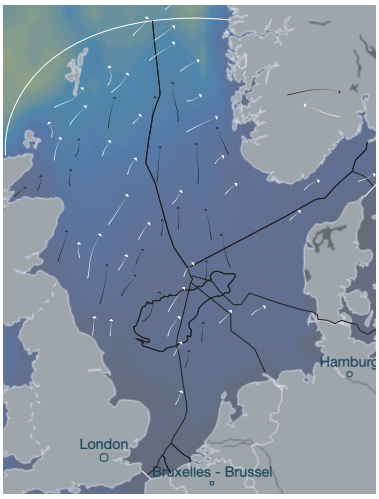
3.3 Environment analysis



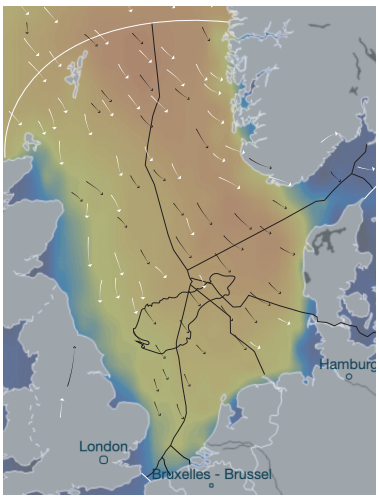
June 2018



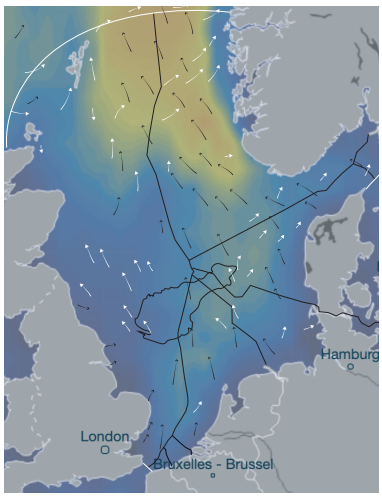
July 2018



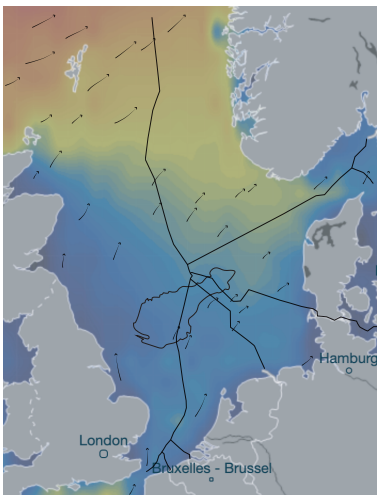
August 2018



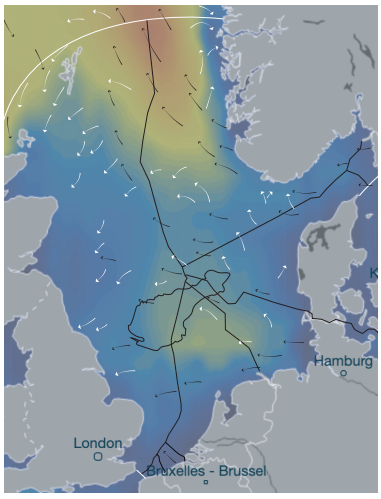
October 2018



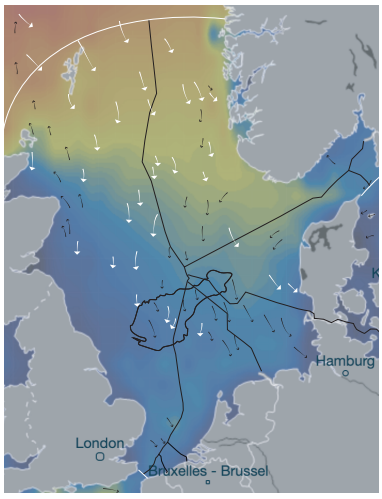
November 2018



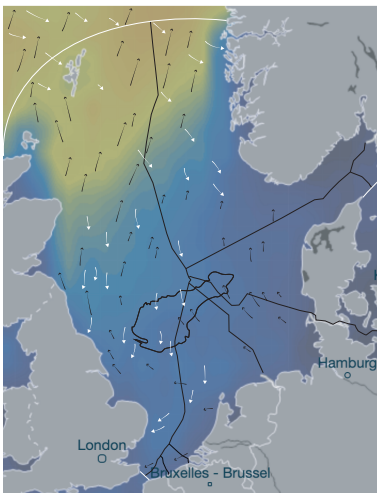
December 2018



February 2019



March 2019



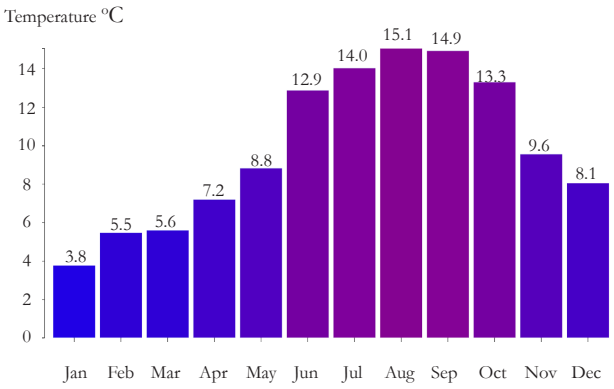
April 2019

3.3 Environment analysis

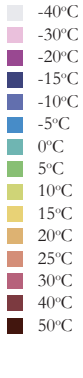
Temperature on site location:

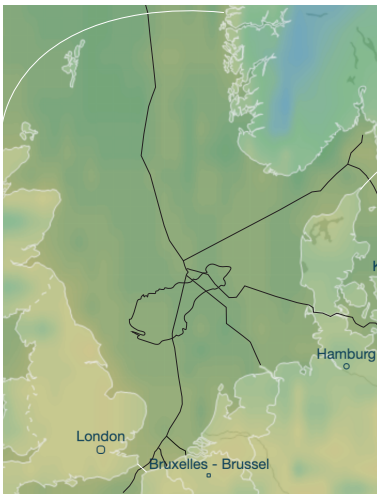
1st May 2018: 7°C
1st June 2018: 8°C
1st July 2018: 16°C
1st August 2018: 18°C
1st September 2018: 17°C
1st October 2018: 11°C
1st November 2018: 13°C
1st December 2018: 9°C
1st January 2019: 8°C
1st February 2019: 4°C
1st March 2019: 5°C
1st April 2019: 5°C

Dogger Bank is a geographical landform. The water temperature around Dogger Bank varies dramatically year round. The graph shows the temperature ranges from 3.8°C in January up to 15.1°C in the month of August. The best time for water activities is late

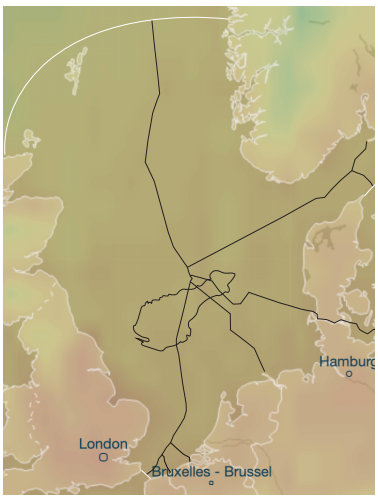


North Sea
Temperature
Source: Ventusky

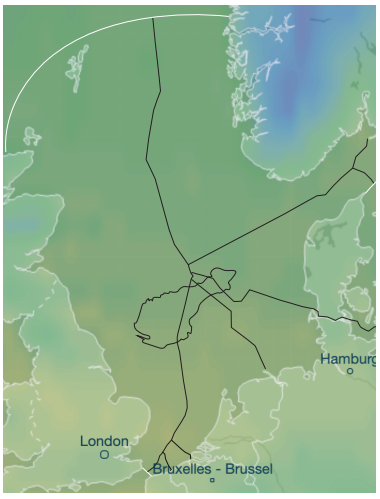




May 2018

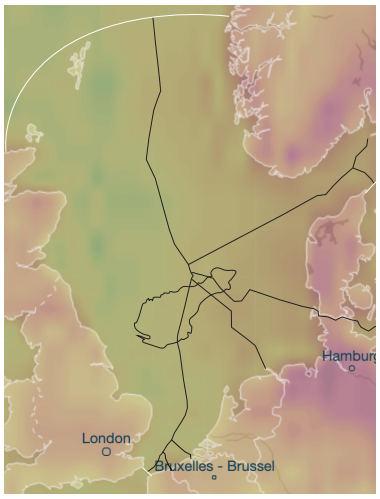


September 2018

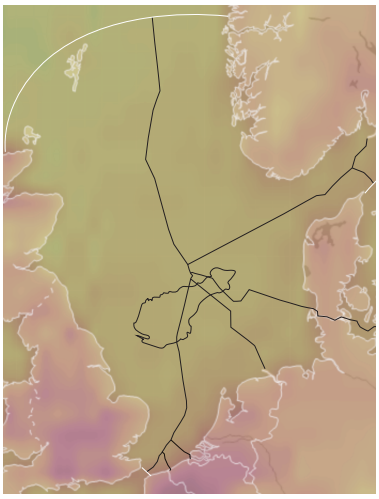


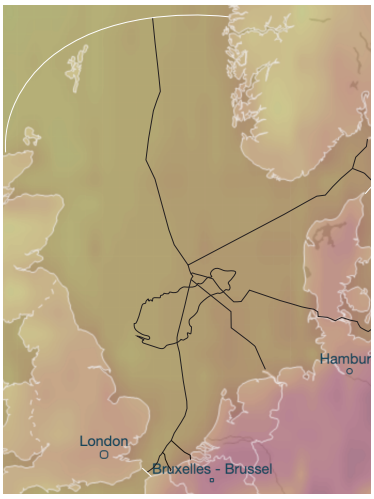
January 2019

3.3 Environment analysis

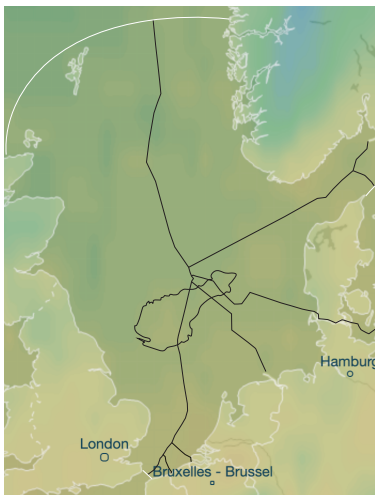


June 2018


July 2018



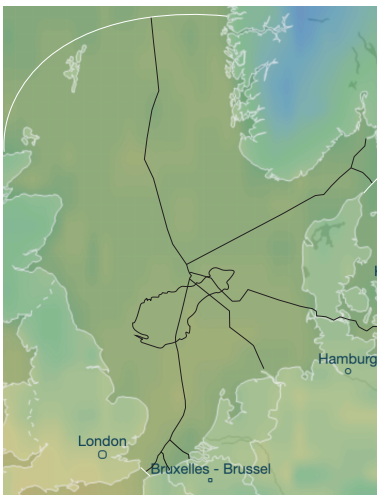
August 2018



October 2018



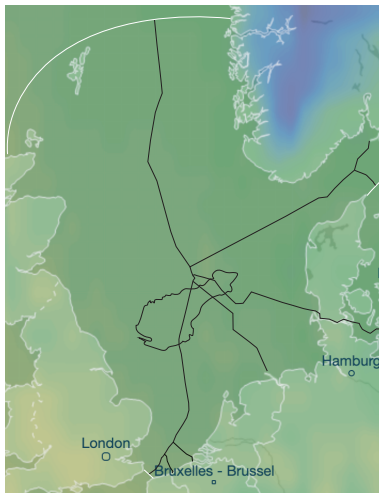
November 2018



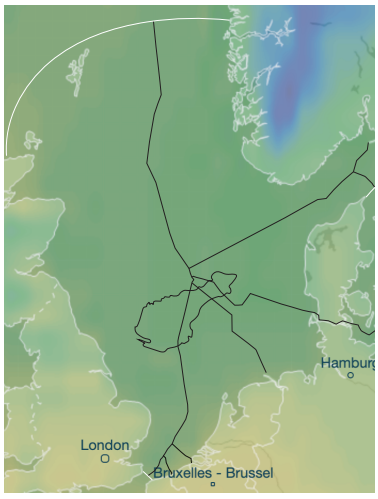
December 2018



February 2019



March 2019



April 2019

3.4 Power

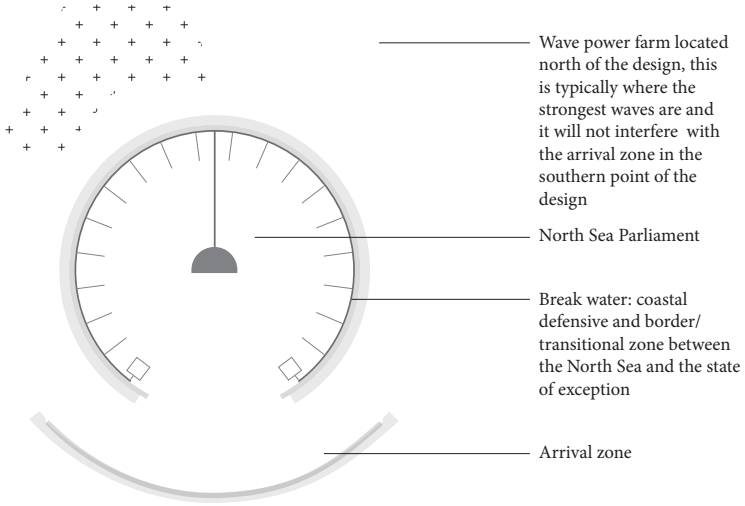
Wave energy

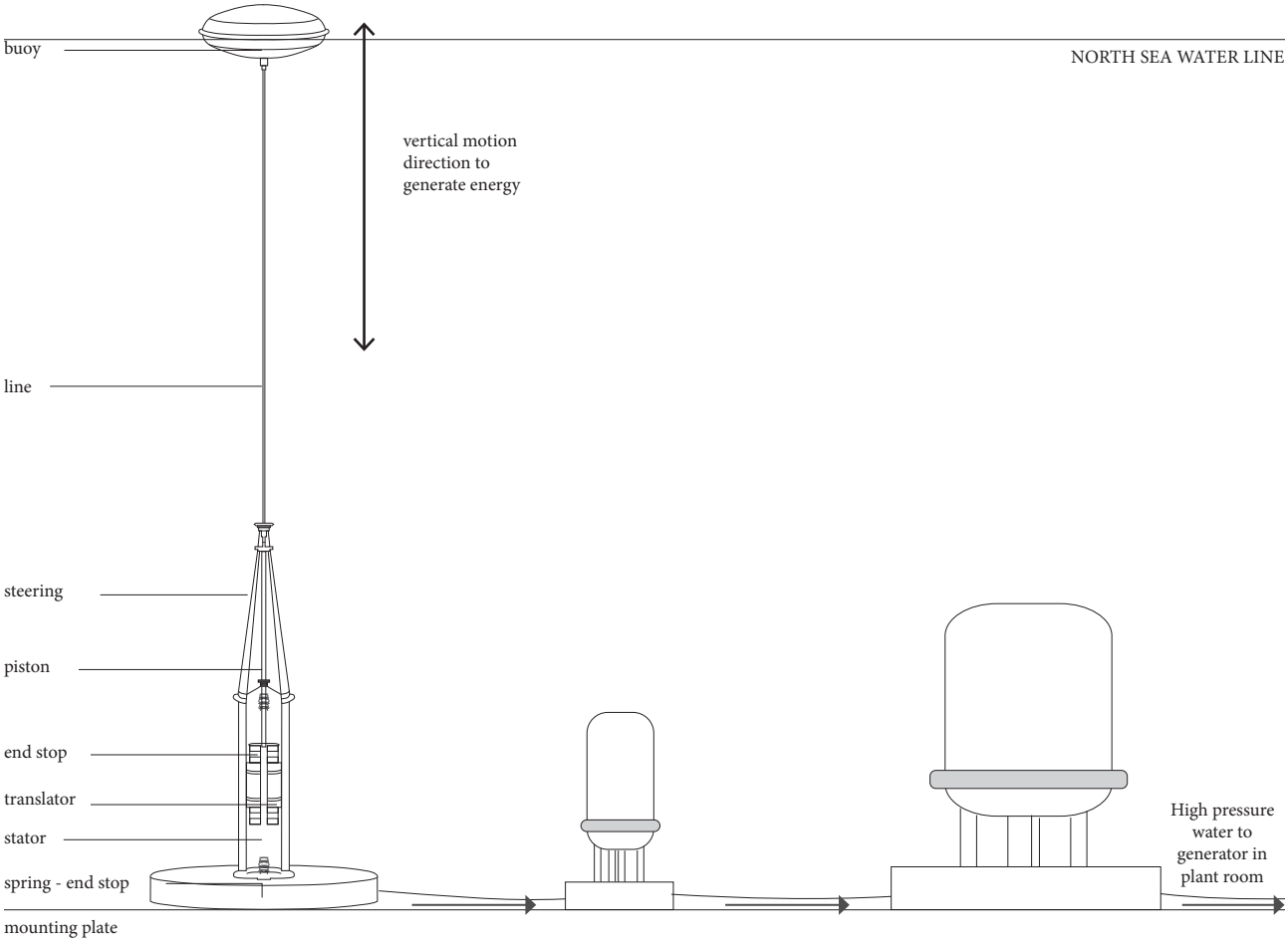
There is an estimated worldwide potential in the order of 1000-1500 TWh/year, waves are amongst the highest energy dense renewable resource. Waves are a result of wind and ocean interactions, that lead to generation of local waves which tent to be amplified as they propagate. Wave energy has the advantage of being predictable and less volatile compared to some of the other renewable energy sources.

Point absorbers are floating structures that have a small horizontal dimension compared with their vertical dimension and utilize the wave action at a single point. Most designs for point absorbers resemble a typical buoy, at least from the surface. Generally one end of the absorber is fixed (or relatively fixed compared to the water surface) while the other moves in a vertical motion, the resulting reciprocating action is used to pump a fluid or drive a linear generator, which in turn can provide usable power. Referencing our six degrees of freedom above, this device takes advantage of the heaving motion. Point absorbers are one of the most common design types in the industry today and PowerBuoy (left) is just one such example.

source:
https://www.tudelft.nl/ocean-energy/research/wave-energy/
http://theliquidgrid.com/the-tech-pool/wave-energy-converters/

3.4 Power


Wave power farm located north of the design, this is typically where the strongest waves are and it will not interfere with the arrival zone in the southern point of the design
North Sea Parliament
Break water: coastal defensive and border/ transitional zone between the North Sea and the state of exception
Arrival zone


buoy
NORTH SEA WATER LINE
vertical motion direction to generate energy
line
steering
piston
end stop
translator
stator
spring - end stop
mounting plate
High pressure water to generator in plant room
biology buoy
wave energy generator
dry mate connector
sub-network substation
wave hub tails
(connecting the buoy cables 33KV)
network-substation

3.5 Water

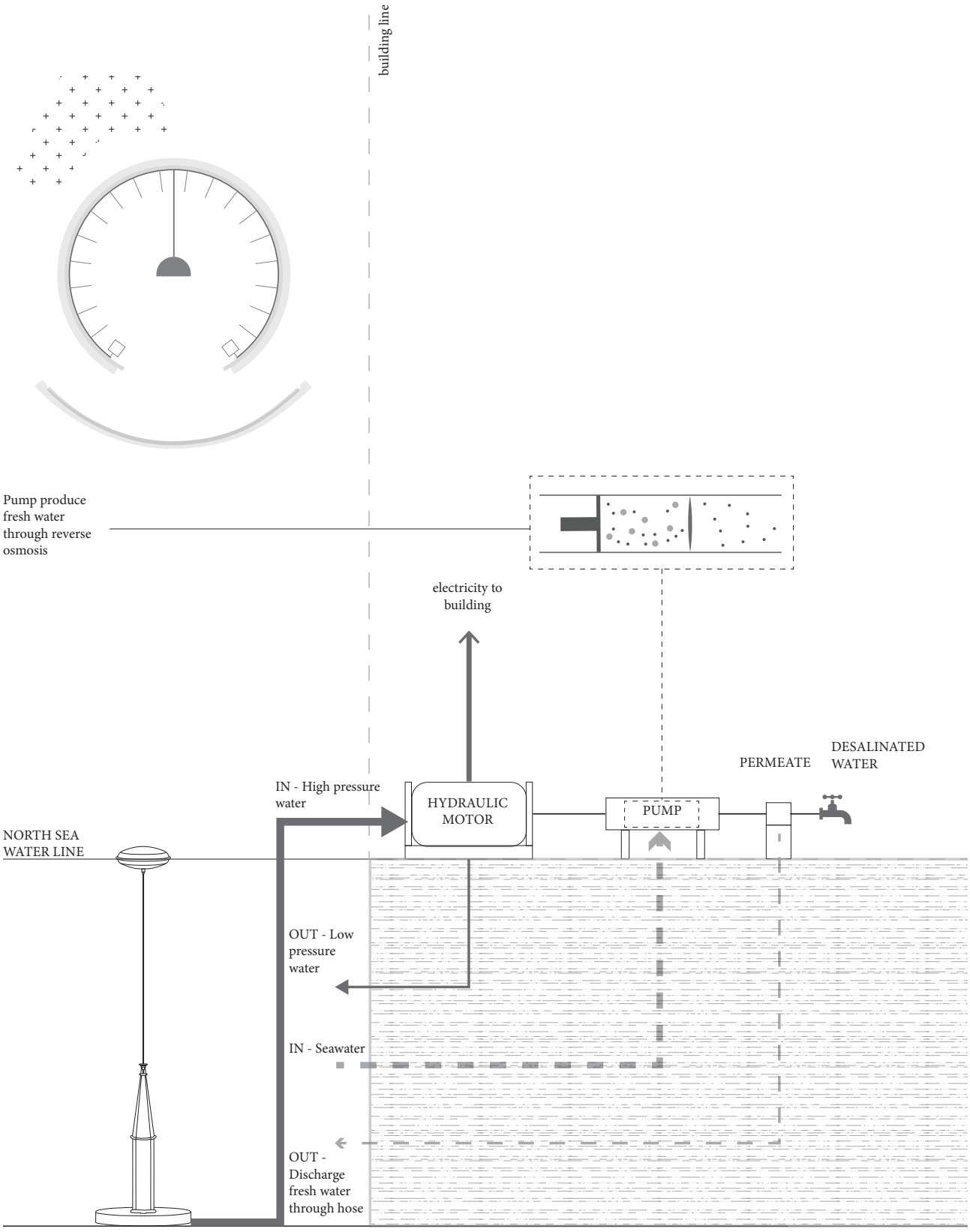
Wave energy to desalinated water

The motion of the ocean waves can be harnessed to produce freshwater, using a combined wave power and desalination system. If the system is autonomous, or stand-alone, it works without an external electric grid, which would be beneficial since many locations in need of freshwater have unreliable electric grids. Mainly, wave power can drive the desalination process in two ways: indirectly or directly. The power in the ocean waves can be converted to electricity to power the desalination plant (indirectly), or it can convert the movement into pressure and thereby directly run the process. The wave power-desalination process can roughly be divided into four different blocks to study further: the ocean is the source of energy and also the source for the final product; the wave power system converts the energy of the ocean waves in a suitable way; the desalination plant and finally, the storage and distribution of freshwater.

Process:
The desalination supply chain can be divided into four steps:
1. Intake of feed water and pretreatment
2. Desalination process
3. Water storage
4. Water distribution

source:
https://www.sciencedirect.com/science/article/pii/S0011916417314455

3.5 Water


building line
Pump produce fresh water through reverse osmosis
electricity to building
PERMEATE
DESALINATED WATER
IN - High pressure water
HYDRAULIC MOTOR
PUMP
NORTH SEA WATER LINE
OUT - Low pressure water
IN - Seawater
OUT - Discharge fresh water through hose
biology buoy
wave energy generator
Plant room in building

3.6 Grey Water system

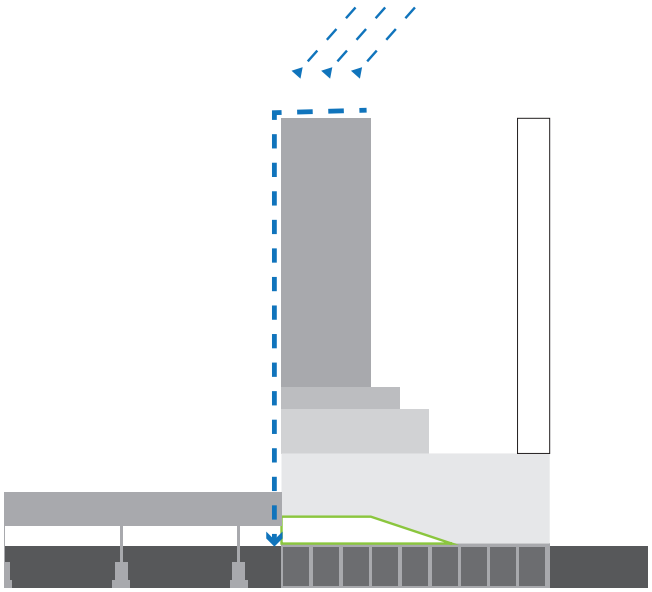
The building cannot rely on the traditional method to get drinkable the building tries to capture as much water as possible through rainwater. This will be go through a grey water system, recycled for a black water and filtered and final released back to the sea

An average person attending the building will use 40-50 gallons of water per day. With a maximum capacity of 500 people, this requires 12250000 gallons of water a day to stored.

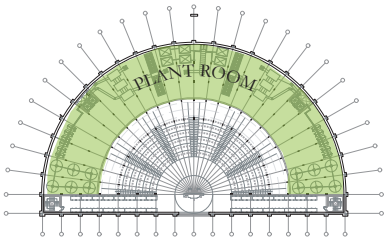
The building would require 2.5 storage tanks - 10x5x5m - constantly filled to supply the building at maximum capacity.

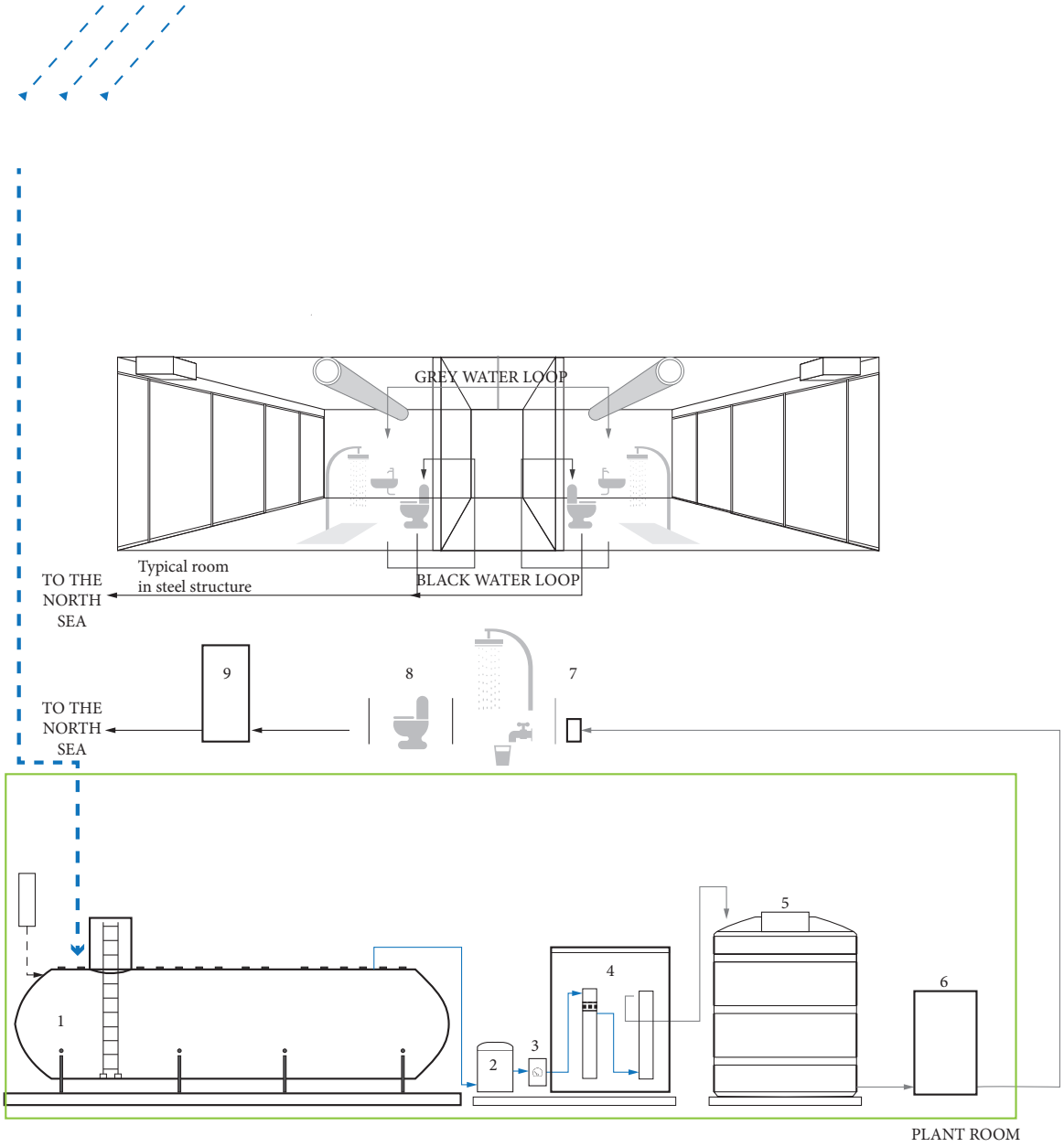
Process:
1. Rainwater is collected at from the roof and is stored in a large (10x5x5m) storage tank
2. The waster passes through a pressure tank, to help regulate the desired water pressure of 30-50psi.
3. The water mater helps to regulate the usage
4. The water passes through the sand sediment filter
5. The water is stored in the daily storage tank - used for the daily activities
6. Water pump transfer the water around the building
7. An additional water filter attached to all taps in the building, to ensure the water is drinkable to today's standard
8. Shower, tap (drinkable water), washing water is recycled/ reused as part of the black water system used for the toilets
9. The toilet water (black water) is passed though bio-reactors before being discharged back to the North Sea, this is to prevent damaging ecology and toxic water around the island.

source:
https://www.youtube.com/watch?v=pNXooT2FVXM



3.6 Grey water system





3.7 Climate scheme

Winter scenario

The Parliament becomes a precedent in the "ego vs eco" concept, an exemplary for other nations to follow from. Like most Parliaments today, members typically follow a dress code when taking part in form meetings. Here the Parliament asks attendees to take it one step further in a zero-waste philosophy. Items brought into the parliament has to leave with them - no different to wild-camping.

The building can not rely on a typical land-based energy consumption scenario. Instead it utilises its surroundings. Wave energy will power the whole building, it is a abundant resource surrounding the building. The energy will be transferred through the bridge and into the plant room.

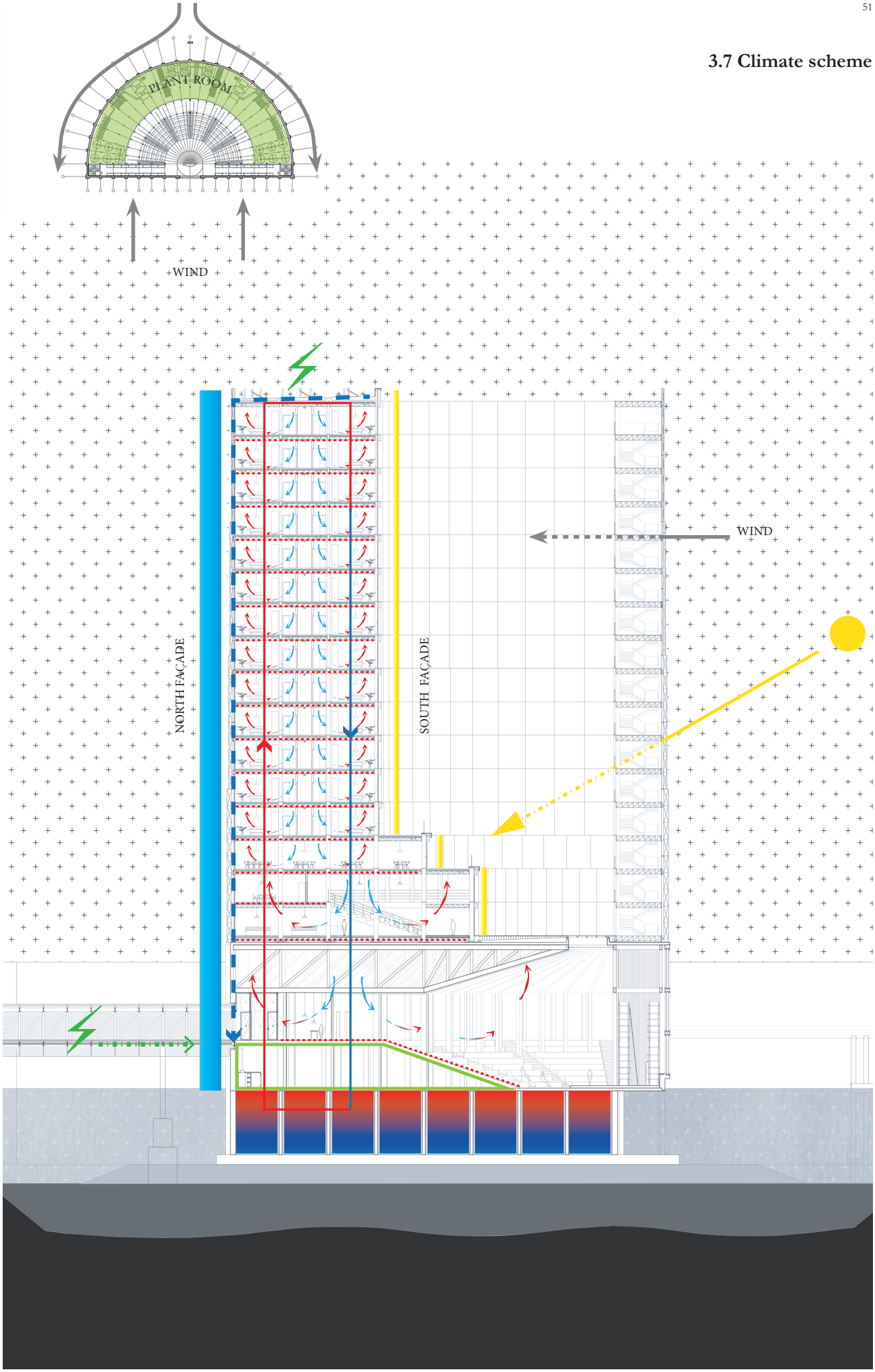
Heating/cooling; the building will have a low energy radiant underfloor heating system, the heat is supplied by the thermal storage tank (as part of the "water foundations" in the lower section of the caisson box. Pumps will be required to get the water to upper sections of the building. The solar storage tank heat will be supplemented by the solar collectors positioned on the roof. The uninterrupted sun trap and the glare from the water will help heat the water passing through. Note in winter, the solar storage tank will use more heating than it puts in.

Ventilation; in winter the building will rely on a seawater HVAC ventilation system, due to the winter conditions, it would be too unreliable for natural ventilation.

Water; rainwater collection from the roof will provide all the drinking water in the building, desalinated water and grey water (recycled drinking water) will provide the toilet, shower and washing functions. It is important the building captures and stores the water in the plant room to help provide for those attending. In the winter months, the parliament will be storing more rainwater than it uses, in preparation for the summer months.

source:
grey water: https://thetinylife.com/greywater-systems/
solar storage tank: http://www.solarpanelsplus.com/residential/solar-space-heating/
seawater HVAC ventilation system: http://www.bernoulli.se/applications/seawater-cooled-hvac-system
modular air handling units: https://www.johnsoncontrols.com/hvac-equipment/air-handling-units/ami-modular-air-handling-units

3.7 Climate scheme



VENTILATION FLOW DIAGRAM

	seawater temperature	
seawater -> water pump -> filter ->	<5.5ºC Free cooling	evaporator valve -> evaporator hex -> cool ventilated air to building
	5.5-11.5ºC Heat exchanger -> compressor chiller system	
	>11.5 Compressor chiller system	
return seawater to North Sea <- condenser	Compressor chiller system	air to water process <- returned used air from building

HEATING | COOLING FLOW DIAGRAM
(CLOSED LOOP SYSTEM)

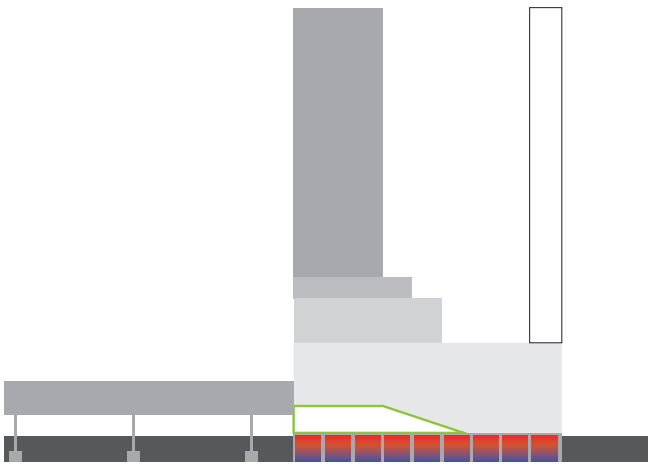
1. A solar space heating system works with your existing hydronic (hot water) based heating system. The solar collectors circulate a fluid, usually a corn glycol through the solar array, where it is heated, and then transferred back to the solar storage tank.

2. Heated fluid is circulated through the storage tank

3. Hot water that is used by your existing heating system - radiant floor system - is circulated through a heat exchanger in the storage tank.

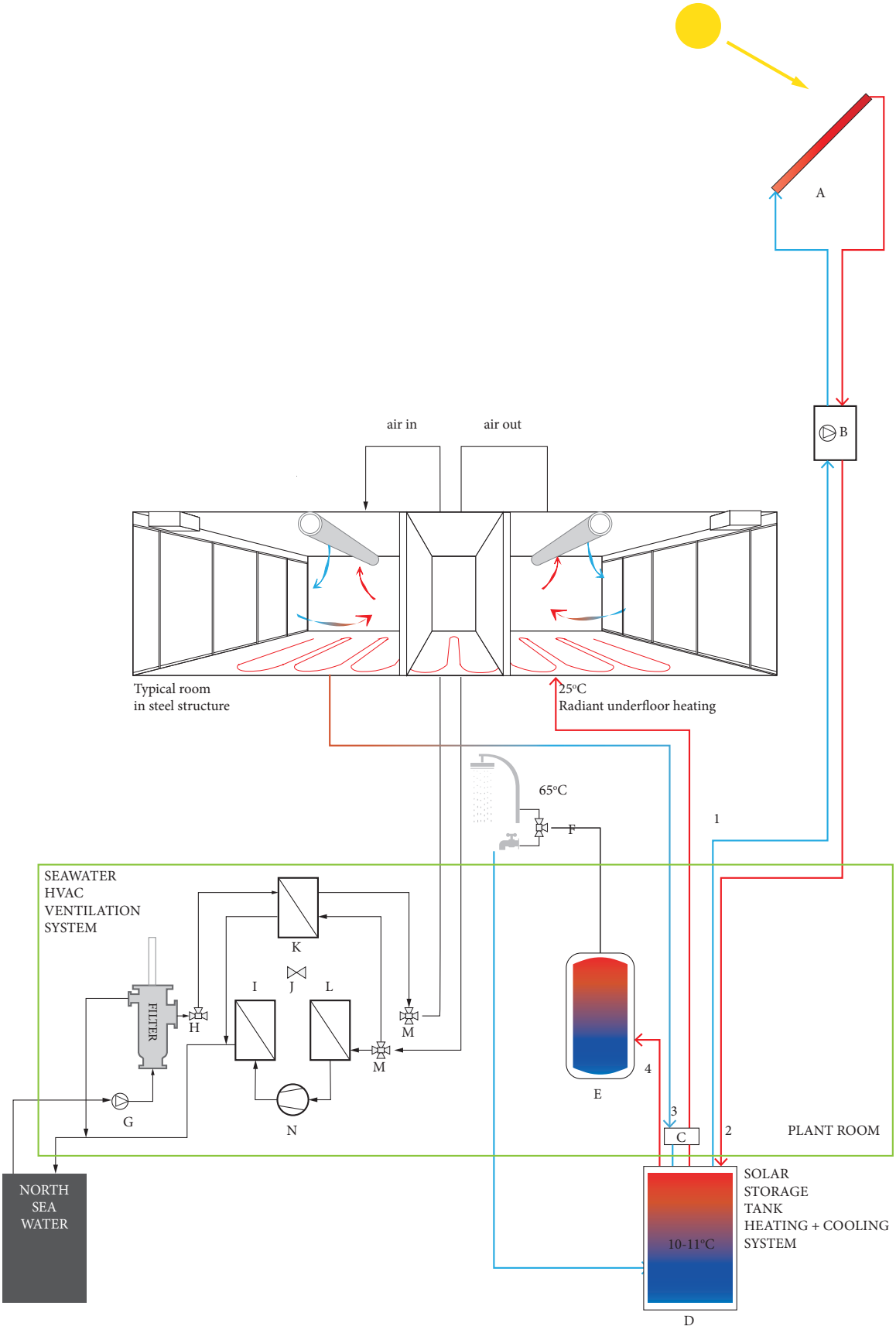
As the water passes through the heat exchanger, it is warmed, and then returned to your heating system.

4. In winter, an additional boiler maybe used because more heat is extracted than replaced by the solar collectors. This is to help provide domestic hot water e.g. showers and taps



A - Solar collector
B - Solar control/pump
C - Heat exchanger
D - Solar storage tank
E - Additional boiler for domestic heating
F - Mixing valve for hot water
G - Pump
H - Valve
I - Condenser HEX
K- Expansion `valve
L - Evaporator HEX
M - Valve
N - Compressor chiller system

3.7 Climate scheme



3.7 Climate scheme

Summer scenario

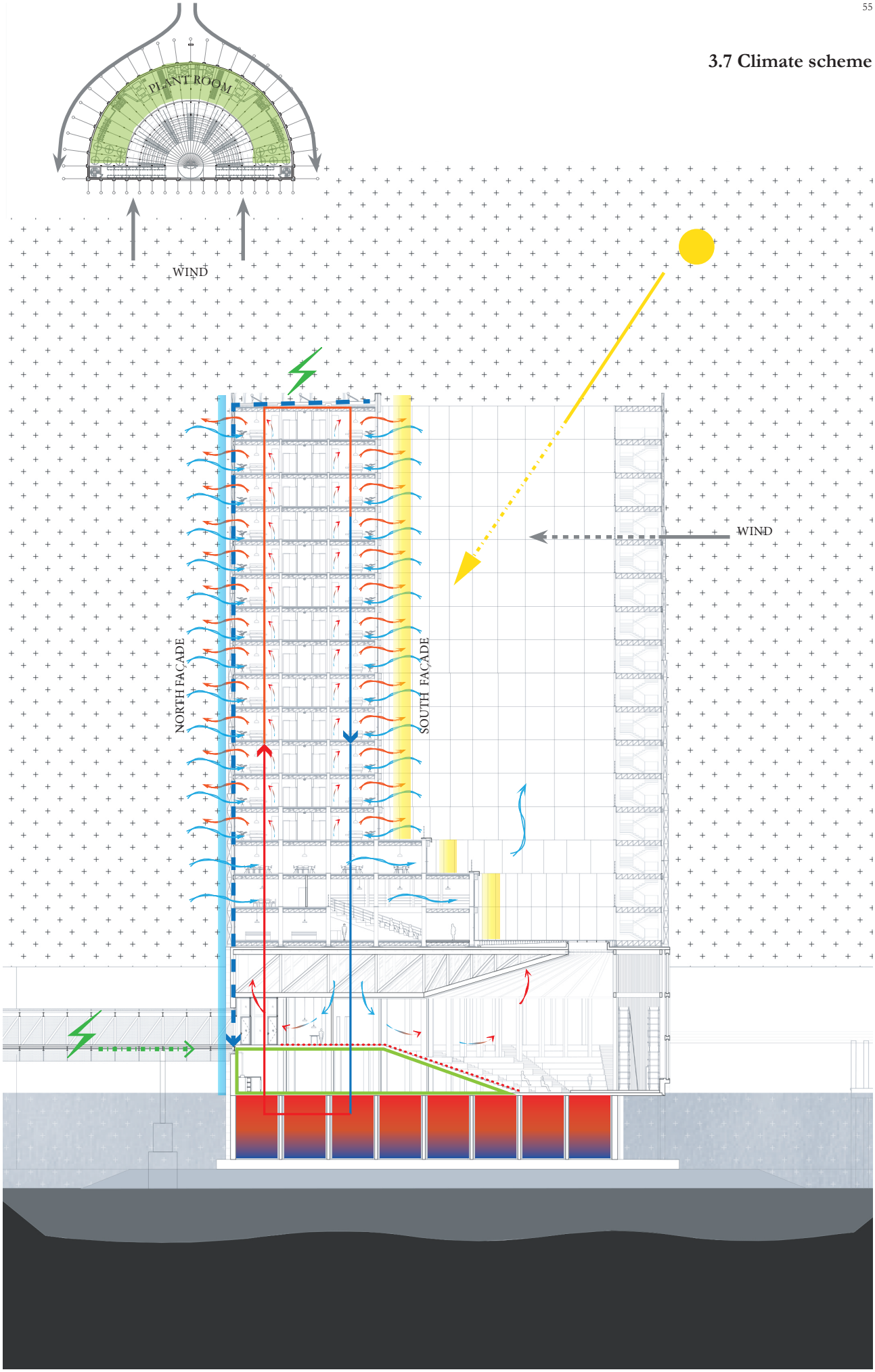
Heating/cooling; the building should not need underfloor radiant heating in the upper steel structures, as the sun should be able to provide enough convert. However, the caisson box will still need to maintain the radiant underfloor heating to ensure a comfortable room temperature. In the summer months the solar storage tank will be storing more heat than it uses, ready for the winter months.

Ventilation; in summer the building will rely natutal ventilation using the tilt/turn windows on the envelope and inner courtyard of the building. The inner courtyard will provide a cool space in the summer months in the mornings. However the caisson box will need the seawater HVAC ventilation system, due to lack of opening. it is impossible to have natural ventilation.

Water; rainwater collection from the roof will provide all the drinking water in the building, desalinated water and grey water (recycled drinking water) will provide the toilet, shower and washing functions. It is important the building captures and stores the water in the plant room to help provide for those attending. In the summer months the building will be using more collected rainwater than it uses.

source:
grey water: https://thetinylife.com/greywater-systems/
solar storage tank: http://www.solarpanelsplus.com/residential/solar-space-heating/
seawater HVAC ventilation system: http://www.bernoulli.se/applications/seawater-cooled-hvac-system
modular air handling units: https://www.johnsoncontrols.com/hvac-equipment/air-handling-units/ami-modular-air-handling-units

3.7 Climate scheme



VENTILATION FLOW DIAGRAM

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HEATING | COOLING FLOW DIAGRAM
(CLOSED LOOP SYSTEM)

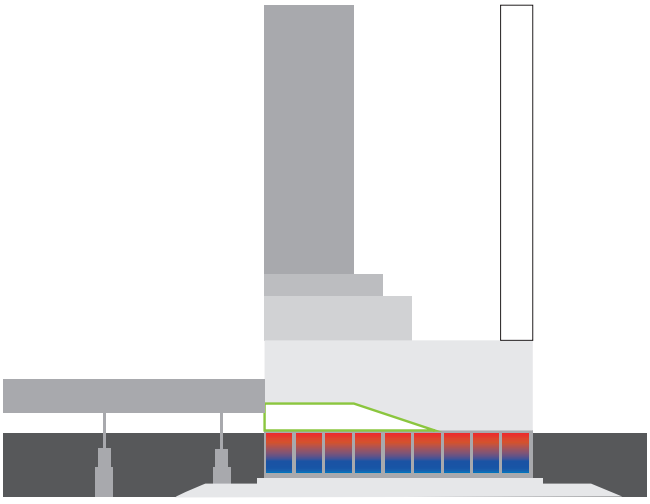
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2. Heated fluid is circulated through the storage tank

3. Hot water that is used by your existing heating system - radiant floor system - is circulated through a heat exchanger in the storage tank.

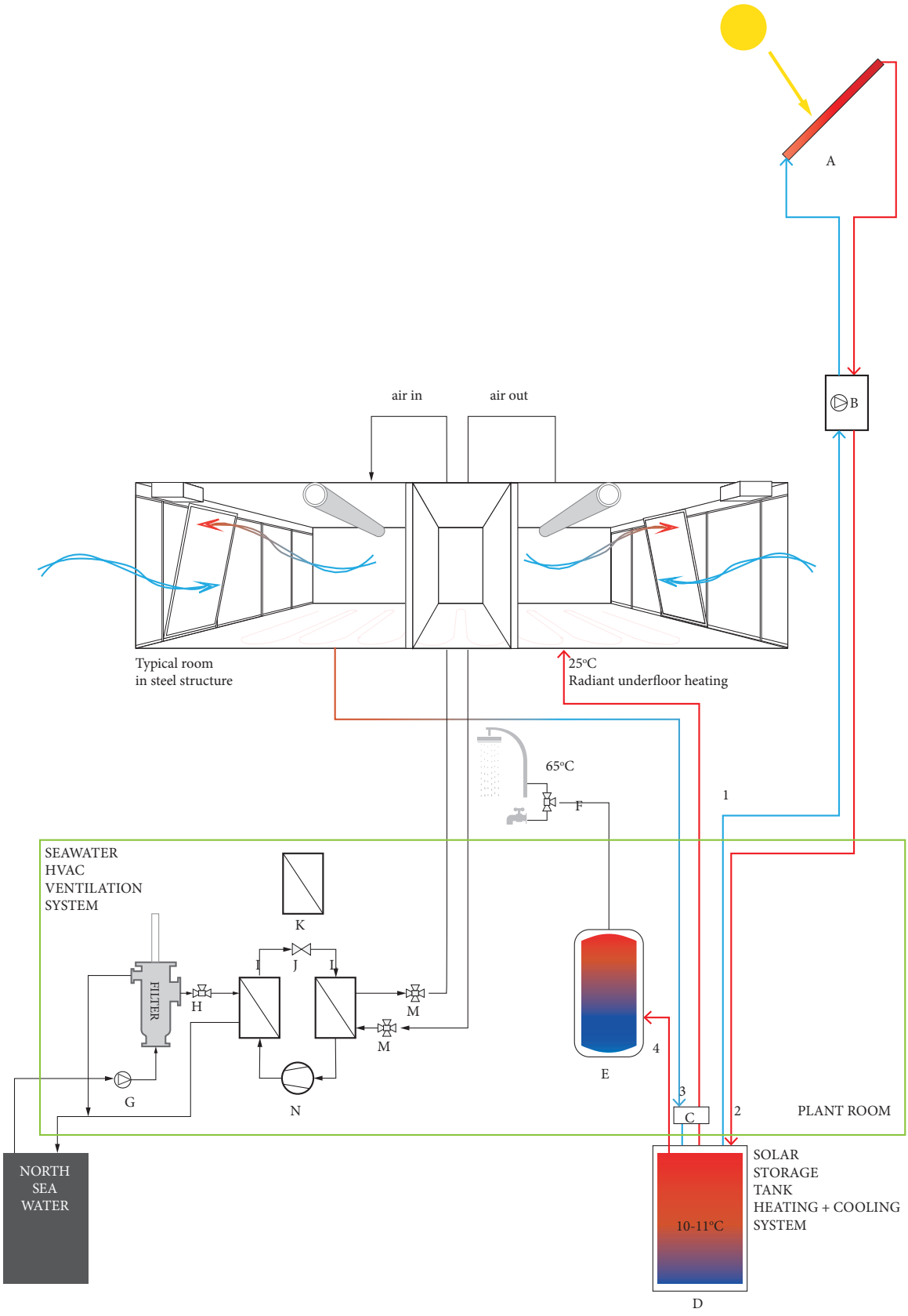
As the water passes through the heat exchanger, it is warmed, and then returned to your heating system.

4. In summer an added heat exchanger is often used with solar space heating systems to provide for domestic hot water as well. This is especially effective during the summer months, when the heating system is not active.



A - Solar collector
B - Solar control/pump
C - Heat exchanger
D - Solar storage tank
E - Additional boiler for domestic heating
F - Mixing valve for hot water
G - Pump
H - Valve
I - Condenser HEX
K- Expansion `valve
L - Evaporator HEX
M - Valve
N - Compressor chiller sytem

3.7 Climate scheme



3.8 Acoustic research

How does the assembly room deal with acoustic control?

The goal of the assembly room space is to project the sound without it becoming an echo chamber.

Precedent: Casa Da Musica, OMA

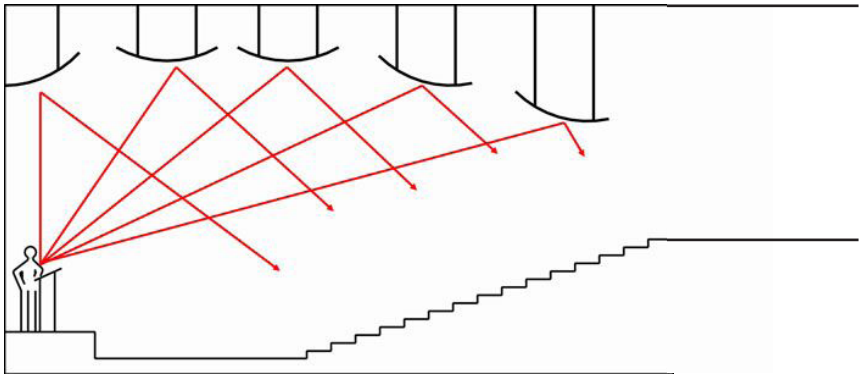
The concept for the curtains in Casa da Música, began through Petra Blaisse's advisory role as consultant to OMA on interior finishes and colour schemes. Following this process of consultation, Inside Outside was commissioned to design eleven curtains for the Main Concert Hall, the Small Concert Hall and the Rehearsal Rooms. Additionally, Inside Outside provided the design for the 'golden pellicle' applied to the wooden wall panelling of the Main Concert Hall. In the concert halls, curtains are steered by motor systems and are deliberately led to hollow walls or cavities above the auditoriums lowered ceilings for storage.

Nine of the eleven curtains are suspended over four massive, corrugated glass windows of the two concert halls, which look out over the city in each direction. These curtains can be used separately or in combination with one another, organizing light, visual and acoustic issues. The remaining two curtains cover walls in the underground rehearsal rooms and were designed to meet specific acoustic requirements. Windows are integrated into the textiles, to allow views from director booths and public areas into these spaces. All the curtains are colourless, which shifts emphasis to texture, structure, degrees of transparency, movement and the effects of layering. The sizes of the curtains vary from 22m x 15m to 65m x 8m.

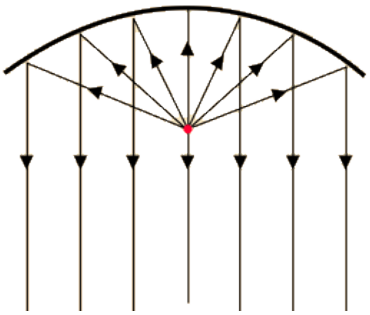
The austere looks of external materials were compensated in the interiors by a panoply of colour and texture. OMA was amazed with the fact that one can still find hand-manufactured materials of classic/traditional Portuguese architecture, like XVIII and late XIX century tiles or the gold-filigree (used in the rough plywood panels cladding the large auditorium). They were revisited and given a contemporary use.

Different sorts of ionised and aluminium plates clad circulation floors and walls hybridising horizontal and vertical planes. Natural and artificial light and views are spread in the interiors not only as function but as decoration as well.

3.8 Acoustics research

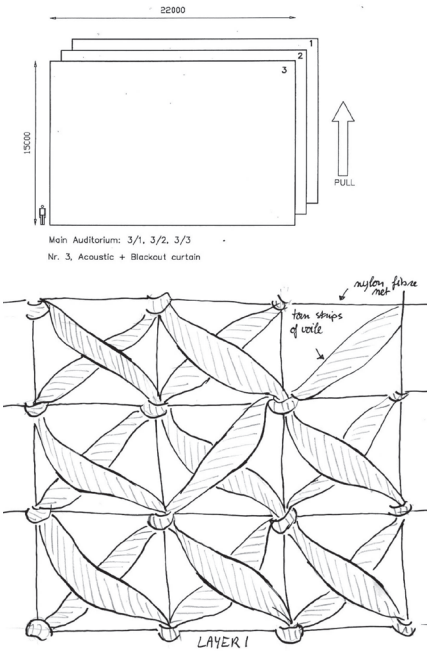


sound rays into the assembly room space (section)

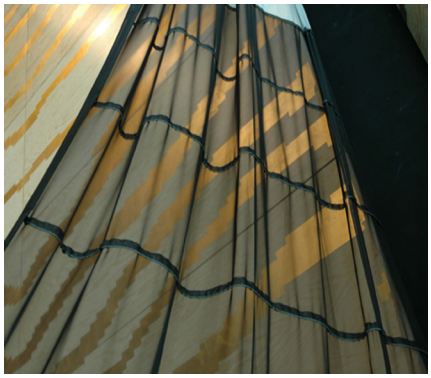


sound rays into the assembly room space (plan)





Research Precedent: *Casa da Musica, Porto | OMA*



curtain -textiles



plywood wall panels and cushions seats



fabric walls

4. Drawings

4. Drawings

Drawings List

Site| 1:2000@a2

Harbour construction:

Harbour dock | 1:20 @a1

Breakwater section | 1:500 @a3

Entrance bridge details | 1.20 @a1

North Sea Parliament architecture:
+5m Site plan | 1:2000 @a2

Plans | 1:500 @a4
Caisson box foundation plan
Assembly room plan
Entrance plan
Office 1 plan | open conversation spaces
Office 2 plan | closed conversation spaces
Dining plan
Typical hotel plan

Elevations | 1:2000 @a3
Site south elevation
Site north elevation
Site east elevation

| 1:500 @a3
South elevation - before the breakwater
South elevation - after the breakwater

Sections | 1:500 @a3
South section - Fourth wall
South section - Stage

| 1:500 @a4
East section

Entrance bridge | 1:20 @a1

Perforated screen | caisson box | 1:20 @a1

Inner courtyard | 1:20 @a1

Details | 1:10 | 1:5 @a4

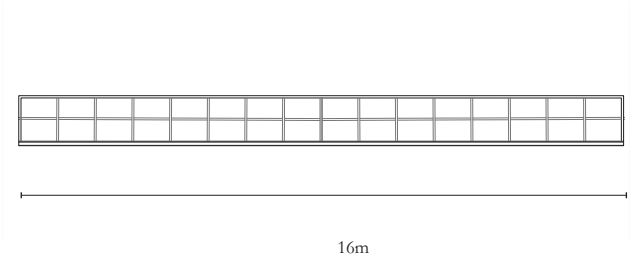
North Sea Parliament |
Site plan
Scale: 1.2000@a2

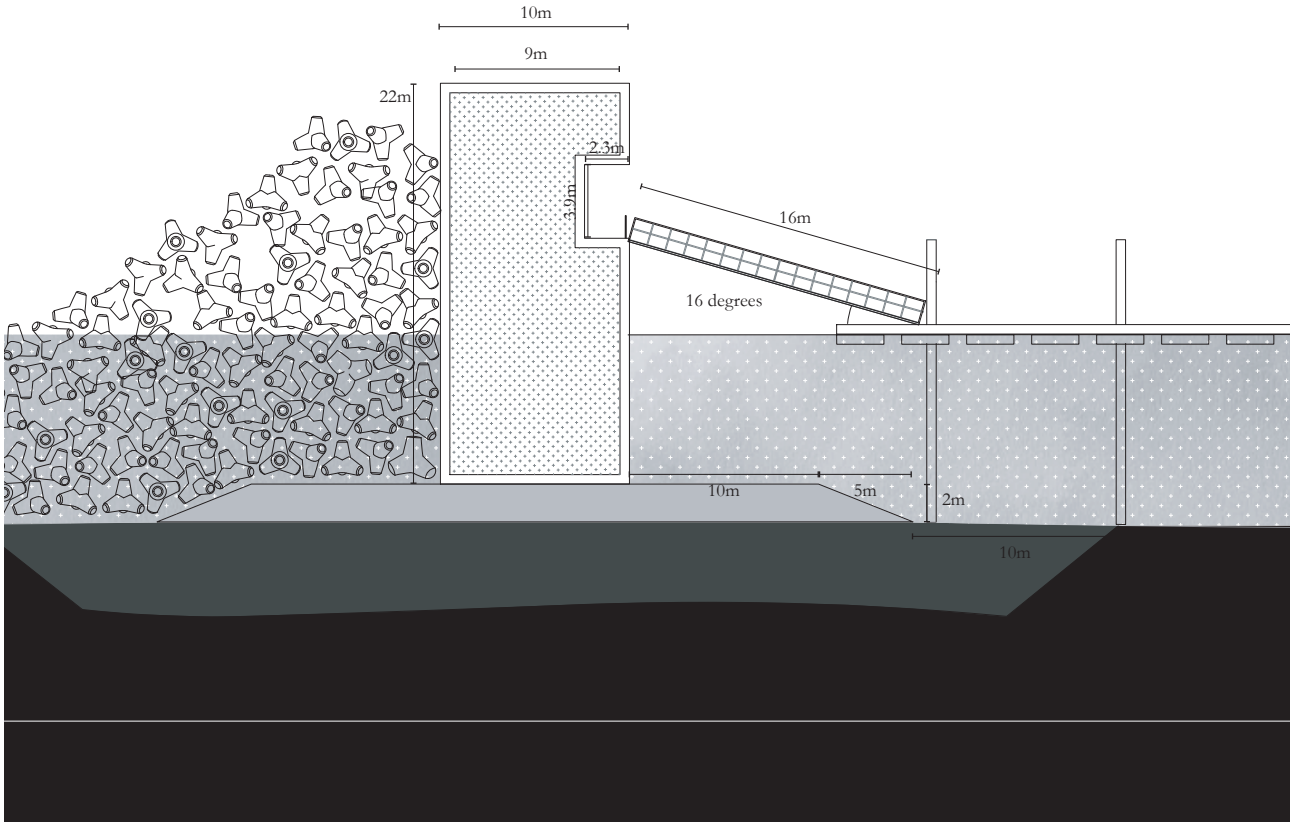
N

0 100m

site plan
1:2000@a2



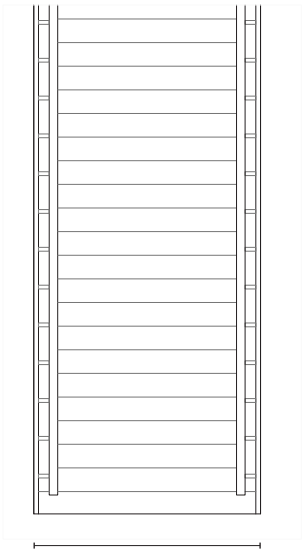


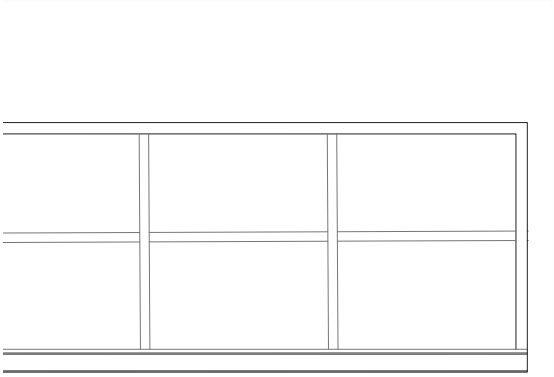


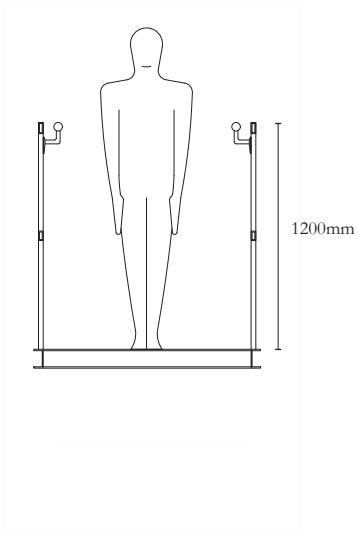
North Sea Parliament |
Harbour dock walkway
Scale: 1.20@a1 (right)
Scale: 1.100@a1 (top)

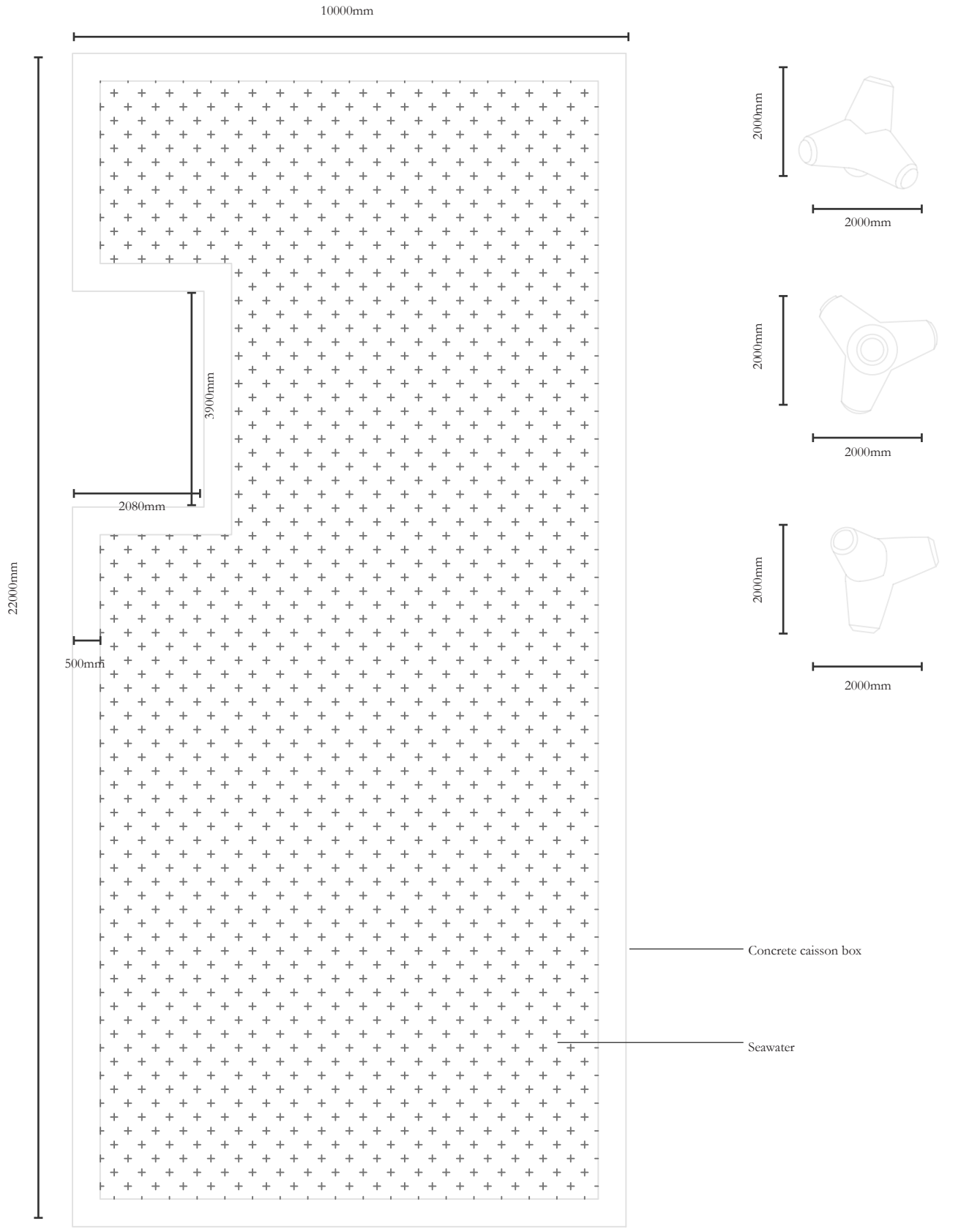
N

harbour dock
1:20@a1







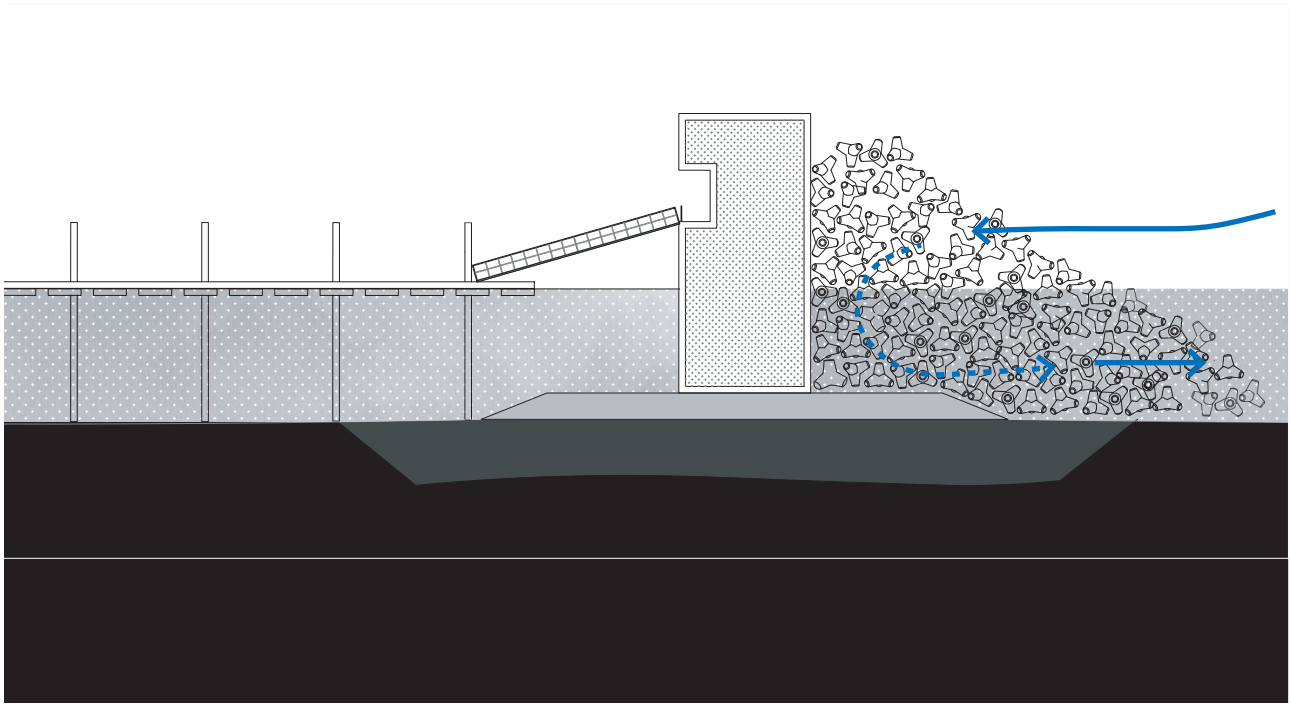


North Sea Parliament |
Breakwater section + Protection
Scale: 1.100@a3

N

0 2m

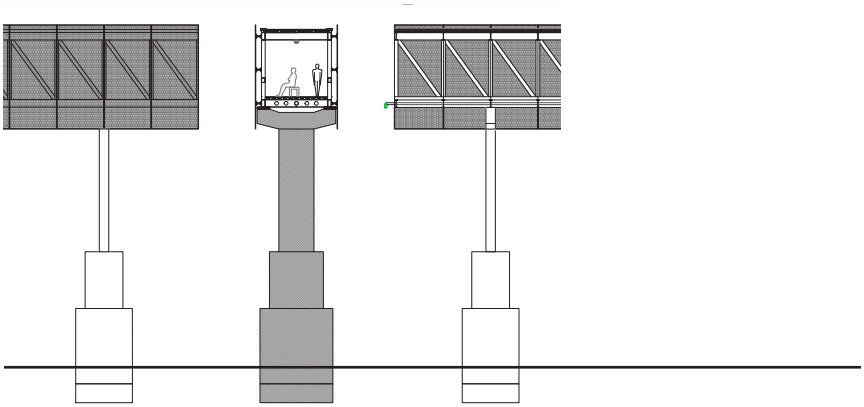
breakwater section
1:500@a3



North Sea Parliament |
Breakwater section
Scale: 1.500@a3

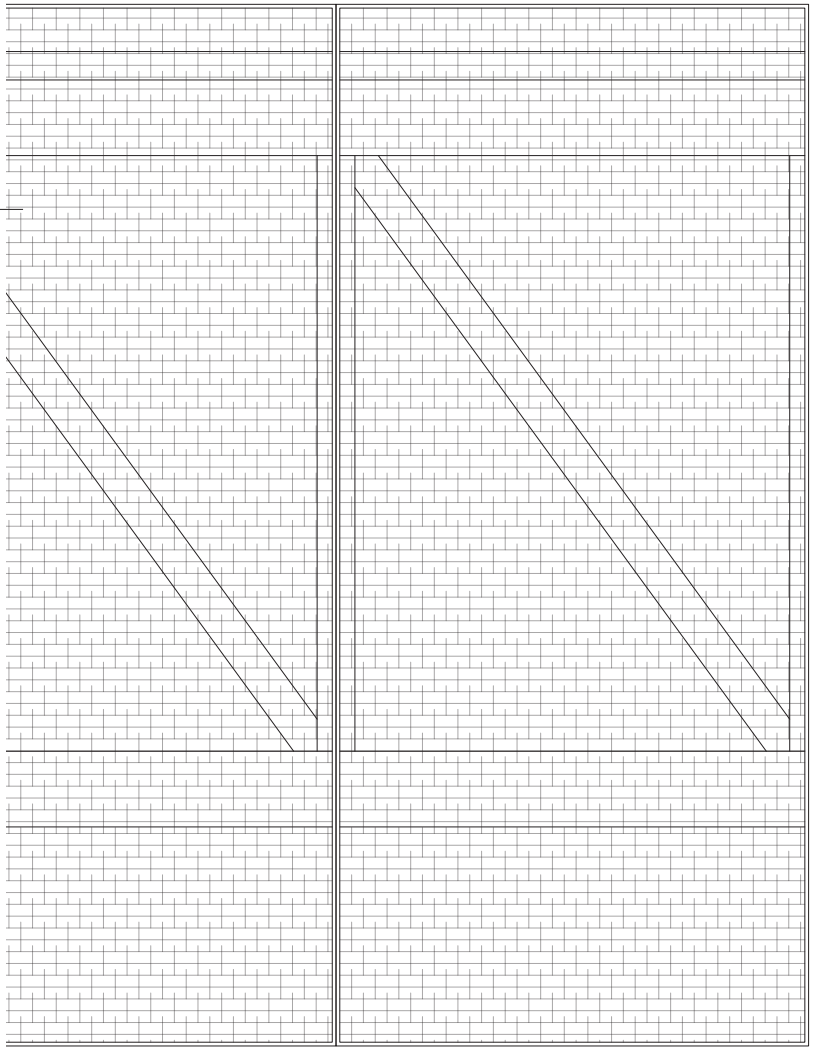
N

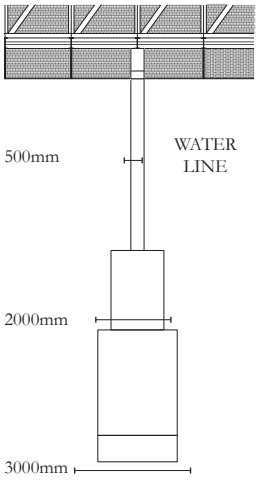
0 10m



Elevation fragment

Perforated facade (same as parliament) attached onto truss bridge





SEABED

Spread footing foundation

North Sea Parliament |
Harbour bridge to parliament

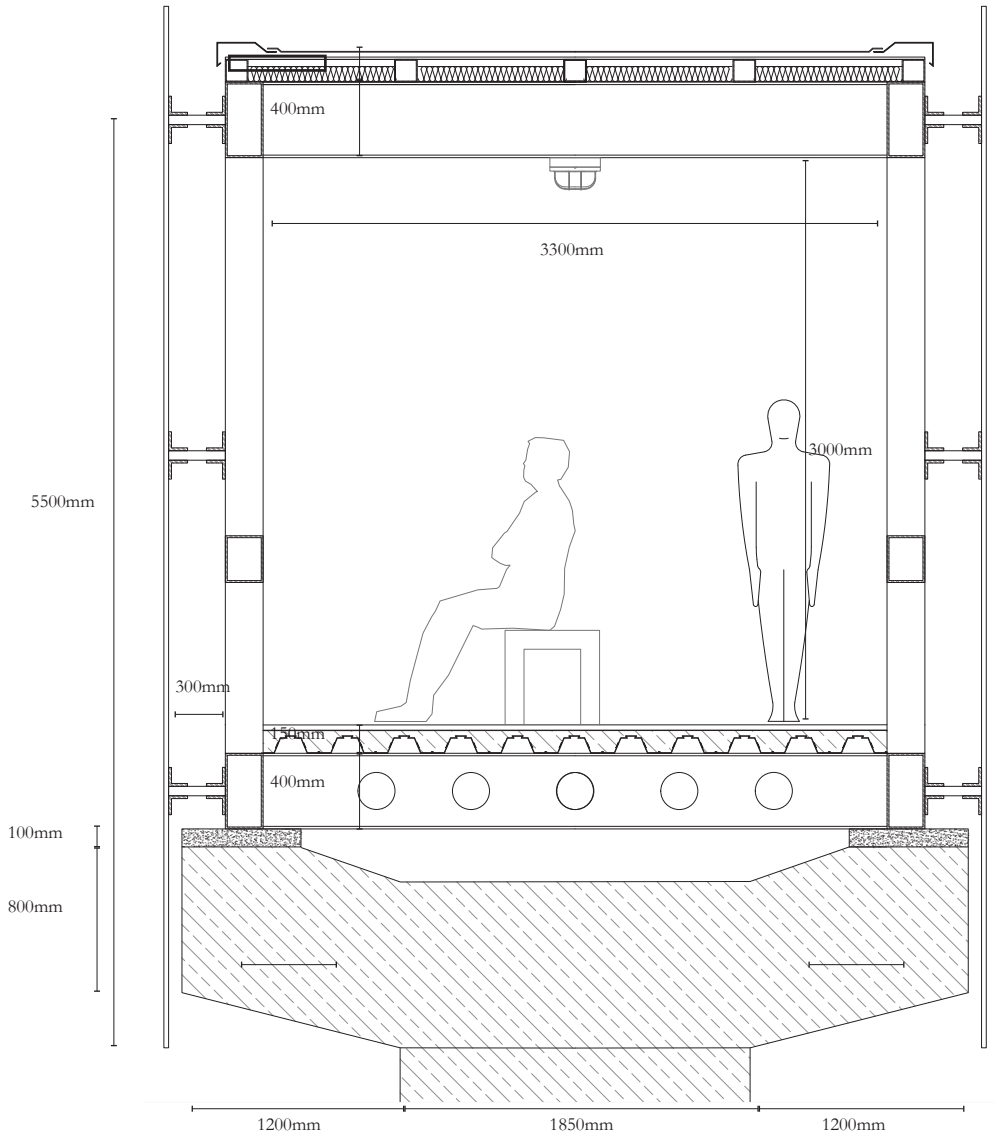
Scale: 1.20@a1

Scale: 1.200@a1 (top elevation + section)

N

0 1m

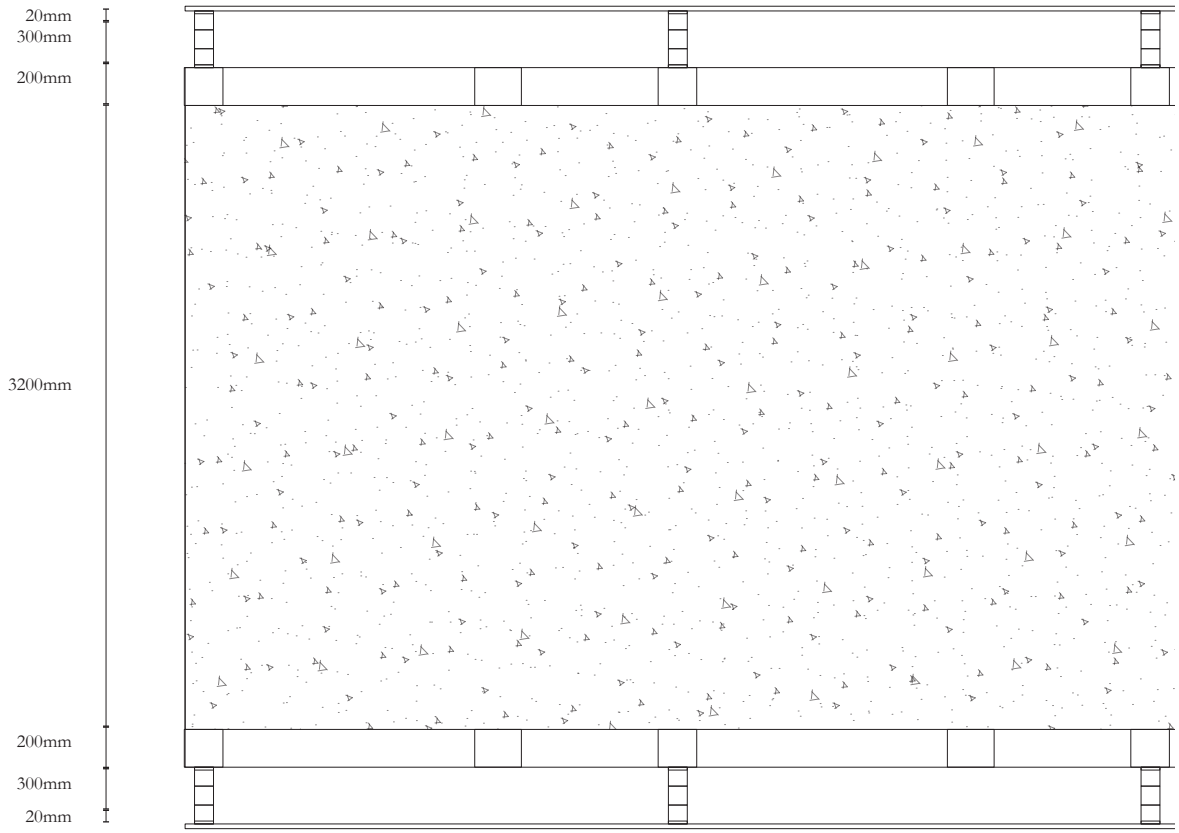
entrance bridge details
1:20 @a1



Roof plan

Section

Pan fragment of truss bridge

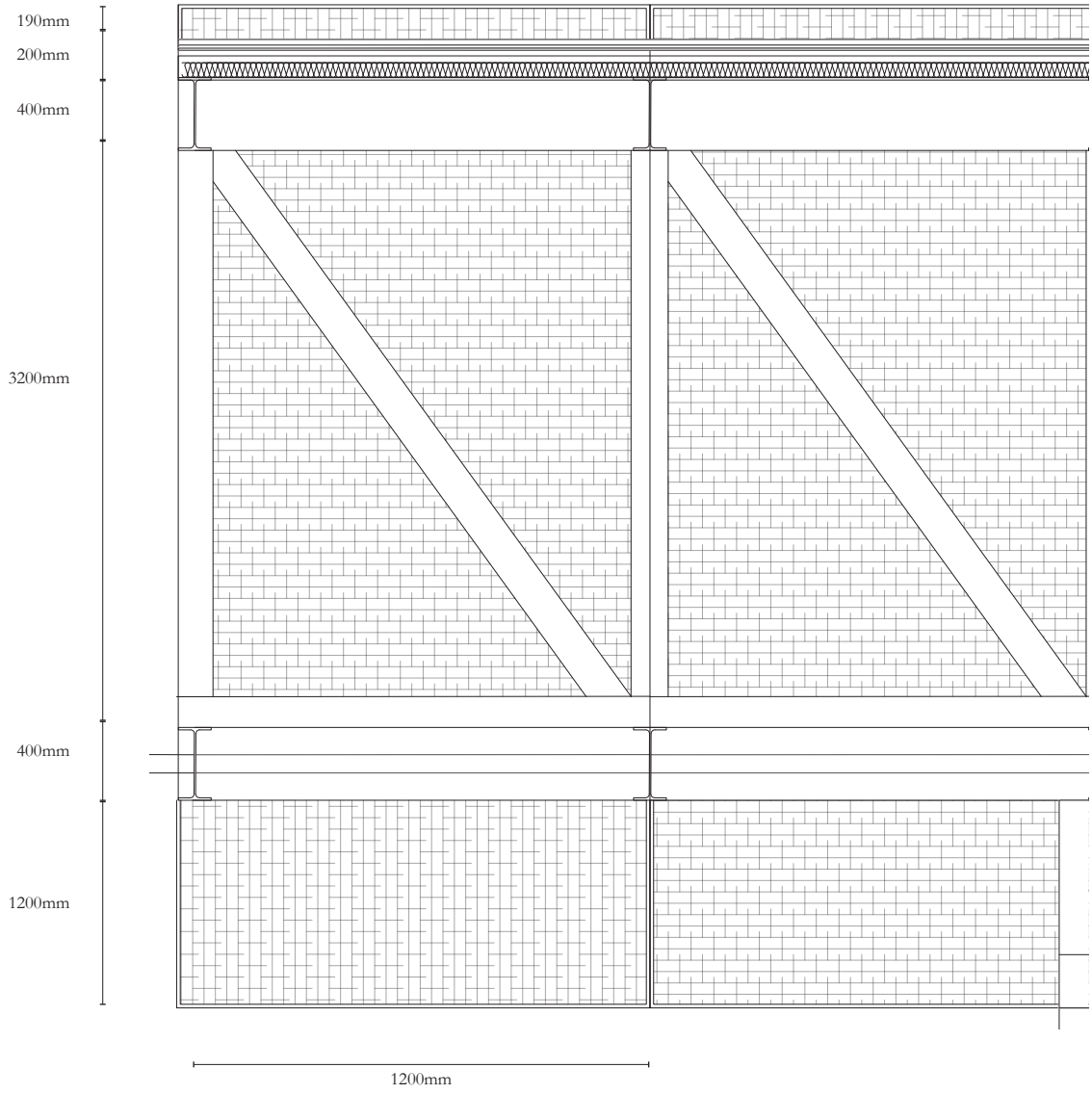


North Sea Parliament |
Harbour bridge to parliament
Scale: 1.20@a1

N

0 1m

Section fragment of truss bridge

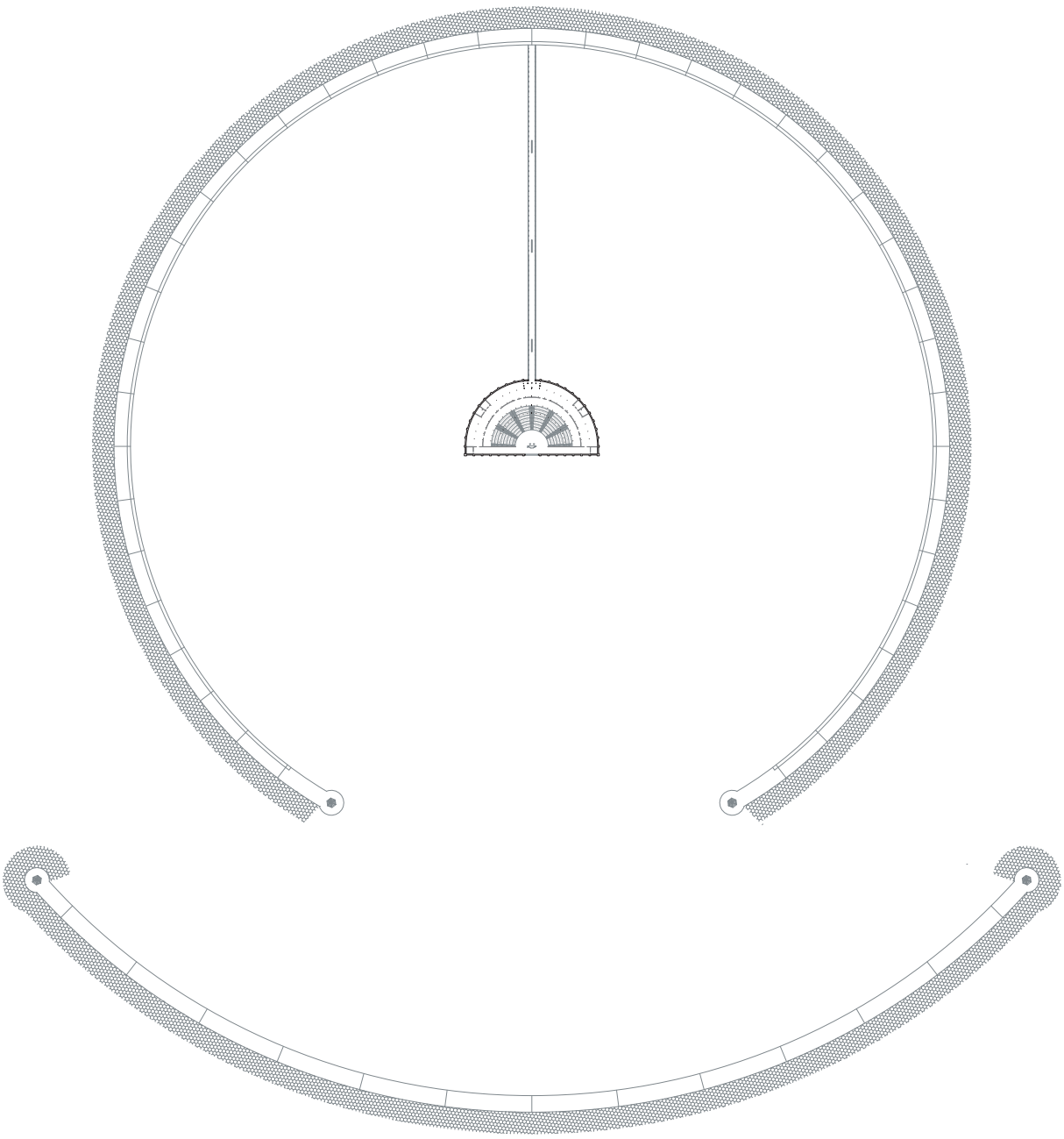


North Sea Parliament
Ground site plan
Scale: 1.2000@a2

N

0 100m

+5m site plan
1:2000@a2



A - Open caisson box compartments
B - Closed caisson box compartments

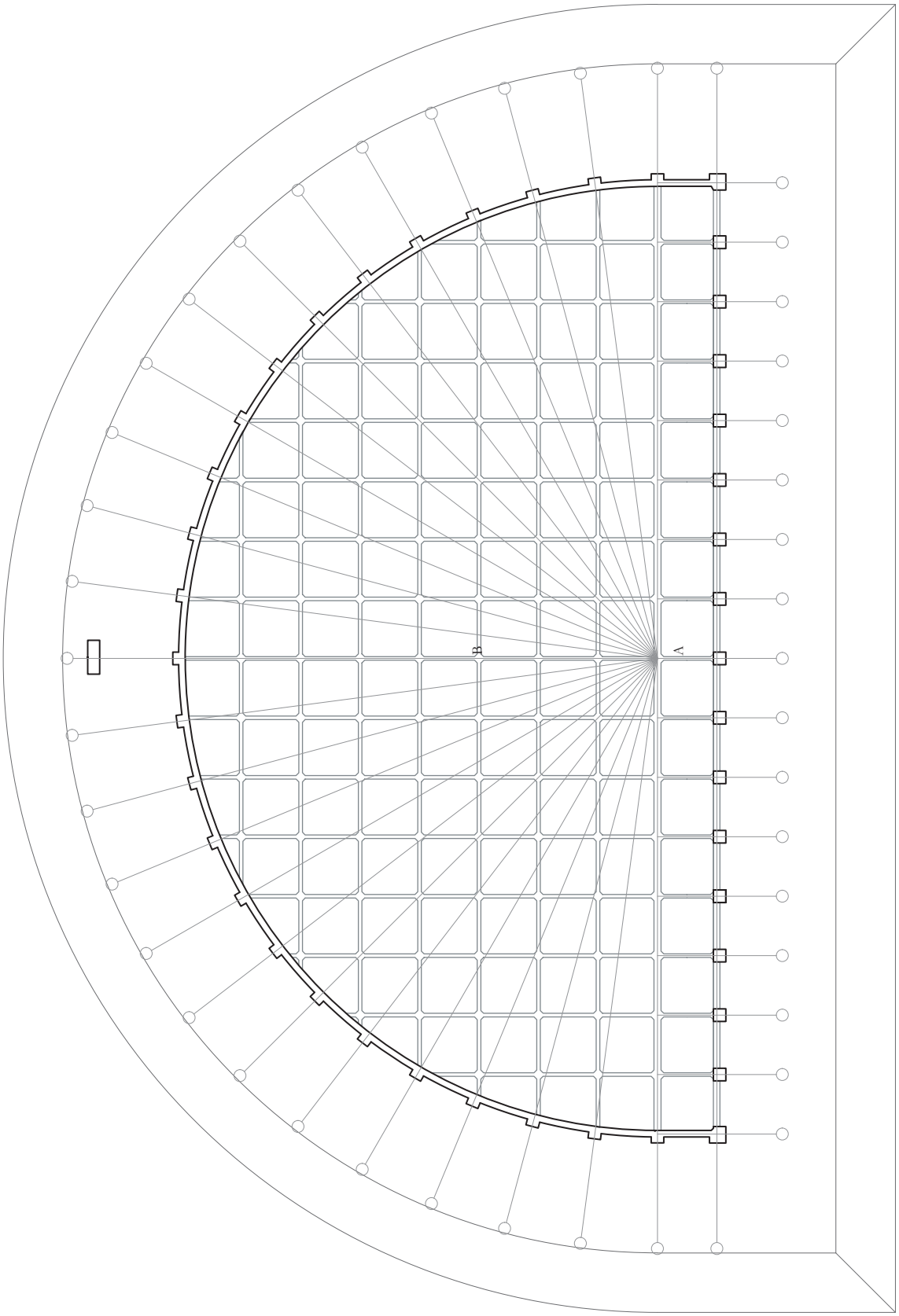


North Sea Parliament | Plan
-10m Caisson box foundation plan
Scale: 1.500@a4

N

0 5m

plan
1:500@a4



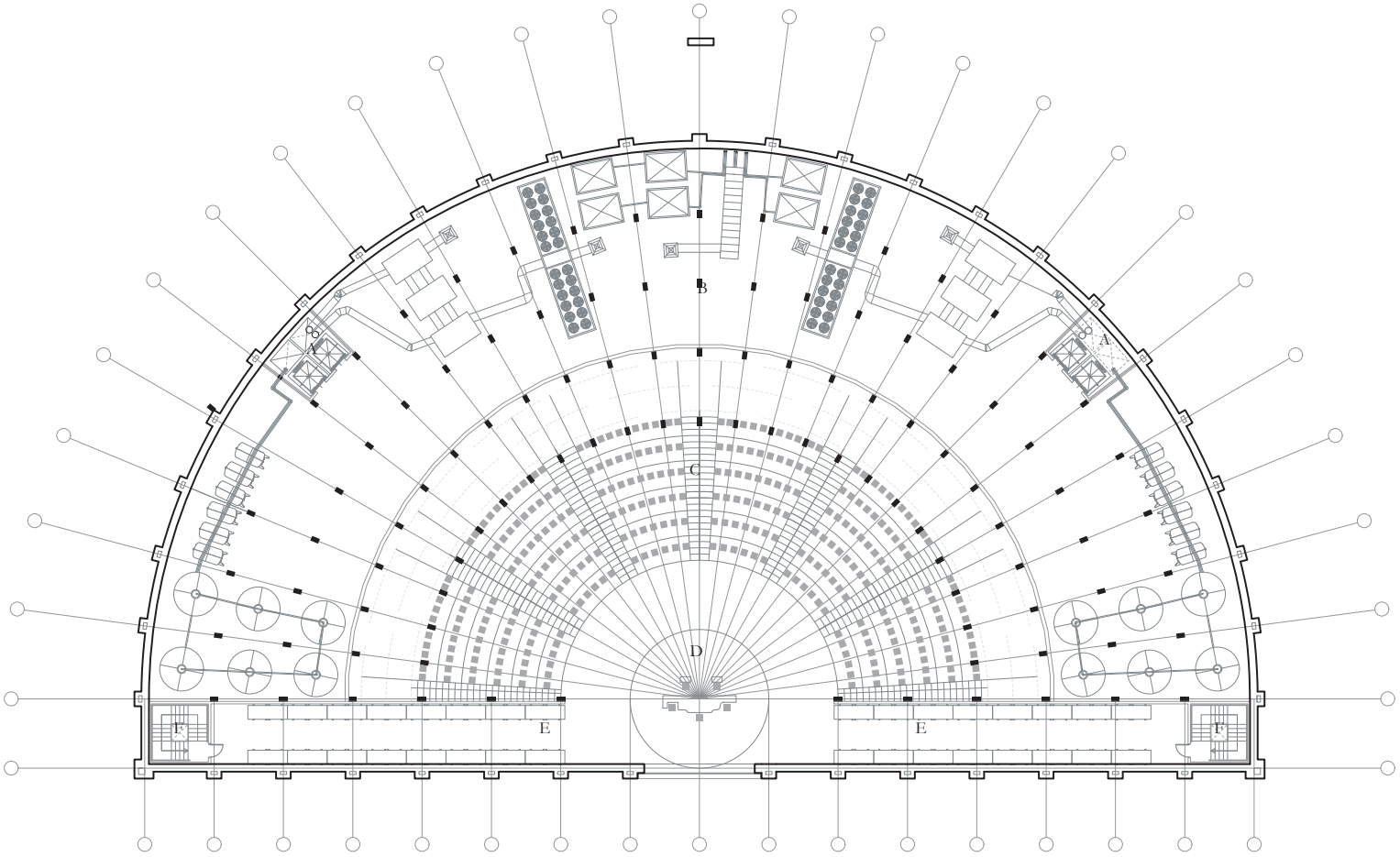
A - Core
B - Plant room
C - Assembly stairs
D -Stage
E- Backstage
F- Stairs

North Sea Parliament | Plan
0m Assembly room plan
Scale: 1.500@a4

N

0 5m

plan
1:500@a4



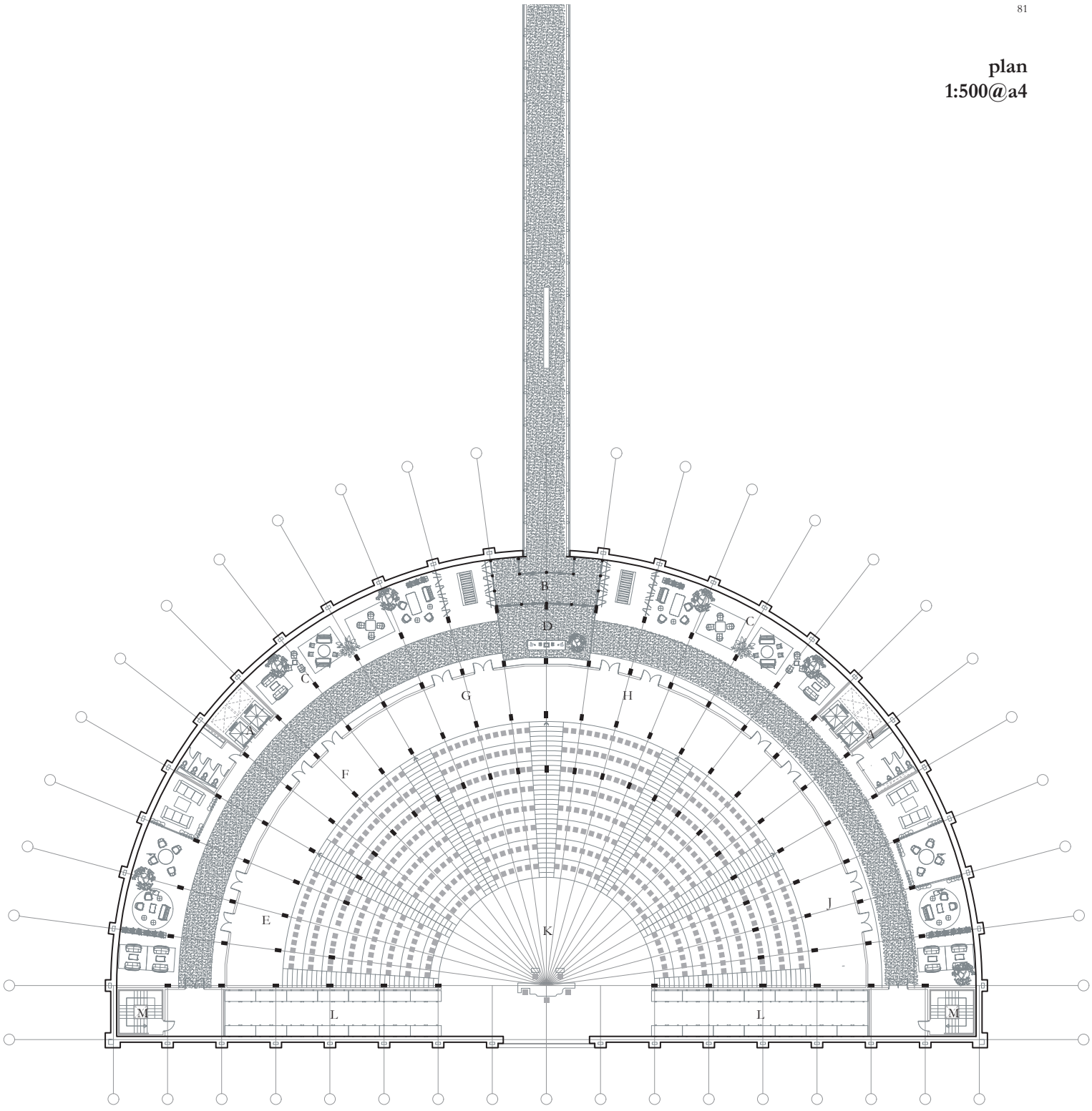
A - Core
B - Entrance lobby
C - amenity
D - Informal conversation corridor
E - Extractivism entrance and seating zone
F - Energy entrance and seating zone
G - Logistics entrance and seating zone
H - Ecology entrance and seating zone
I - Protein entrance and seating zone
J - Migration entrance and seating zone
K - Stage
L - Back stage
M - Stairs

North Sea Parliament | Plan
+5m Entrance plan
Scale: 1.500@a4

N

0 5m

plan
1:500@a4



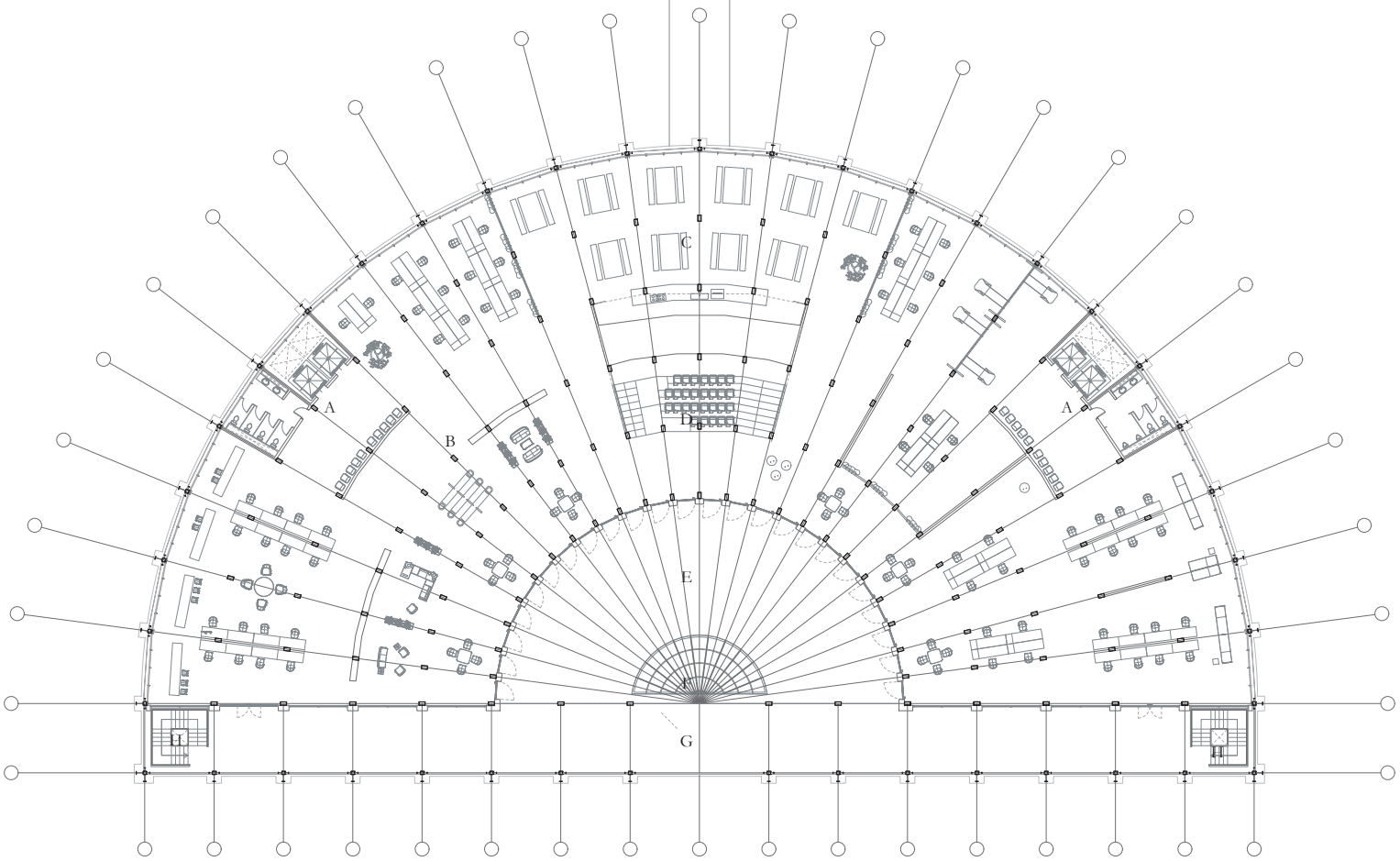
A - Core
B - Open plan work space shared amongst all claims
C - Kitchenette, eating zone
D -Stairs/mini performance stairs
E - Courtyard
G - Screen
H - Stairs

North Sea Parliament | Plan
Office plan | Open conversation spaces
Scale: 1.500@a4

N

0 5m

plan
1:500@a4



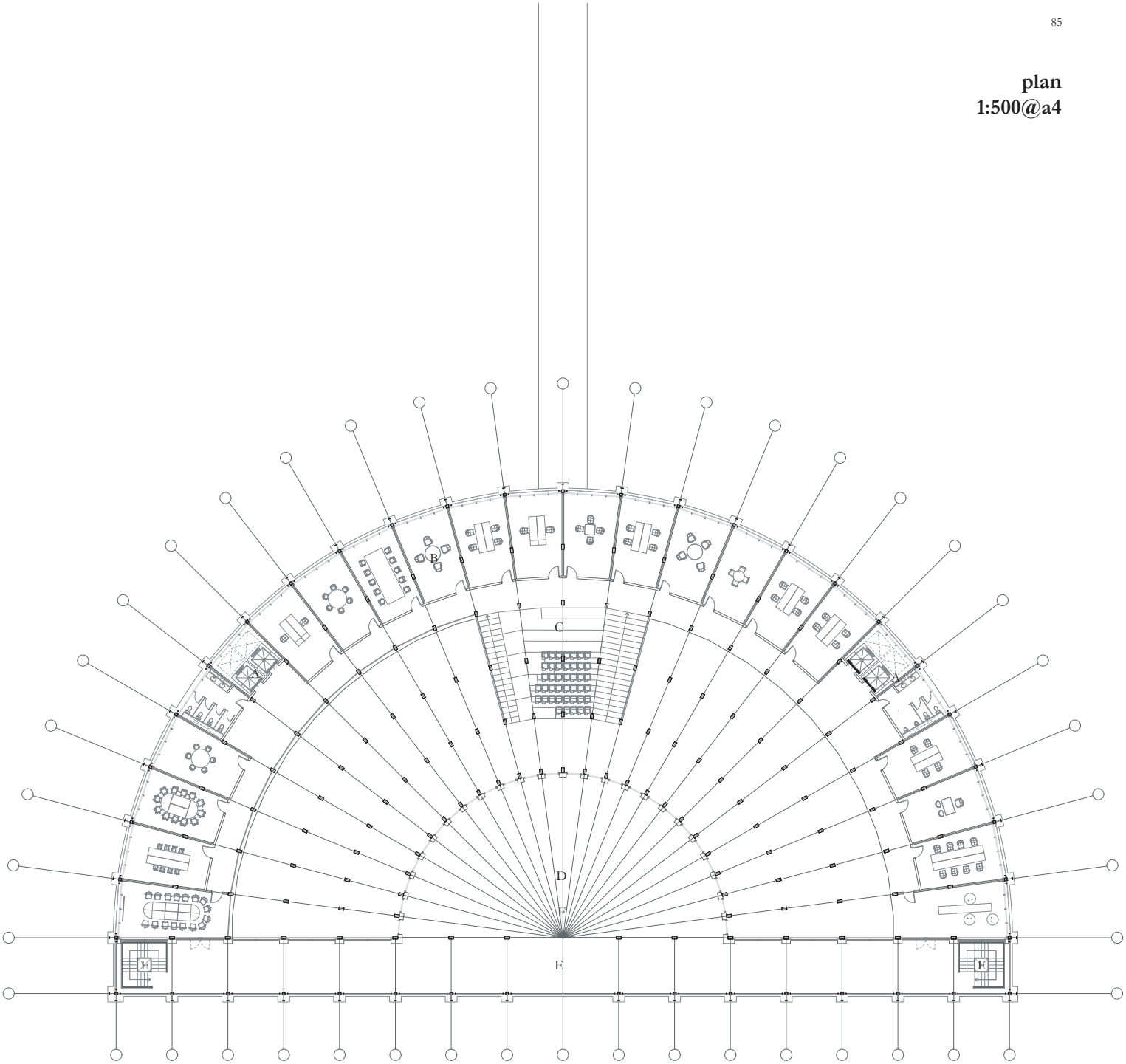
A - Core
B - Closed offices for claims
C -Stairs/mini performance stairs
D - Courtyard
E - Screen
F - Stairs

North Sea Parliament | Plan
Office plan | Closed conversation spaces
Scale: 1.500@a4

N

0 5m

plan
1:500@a4



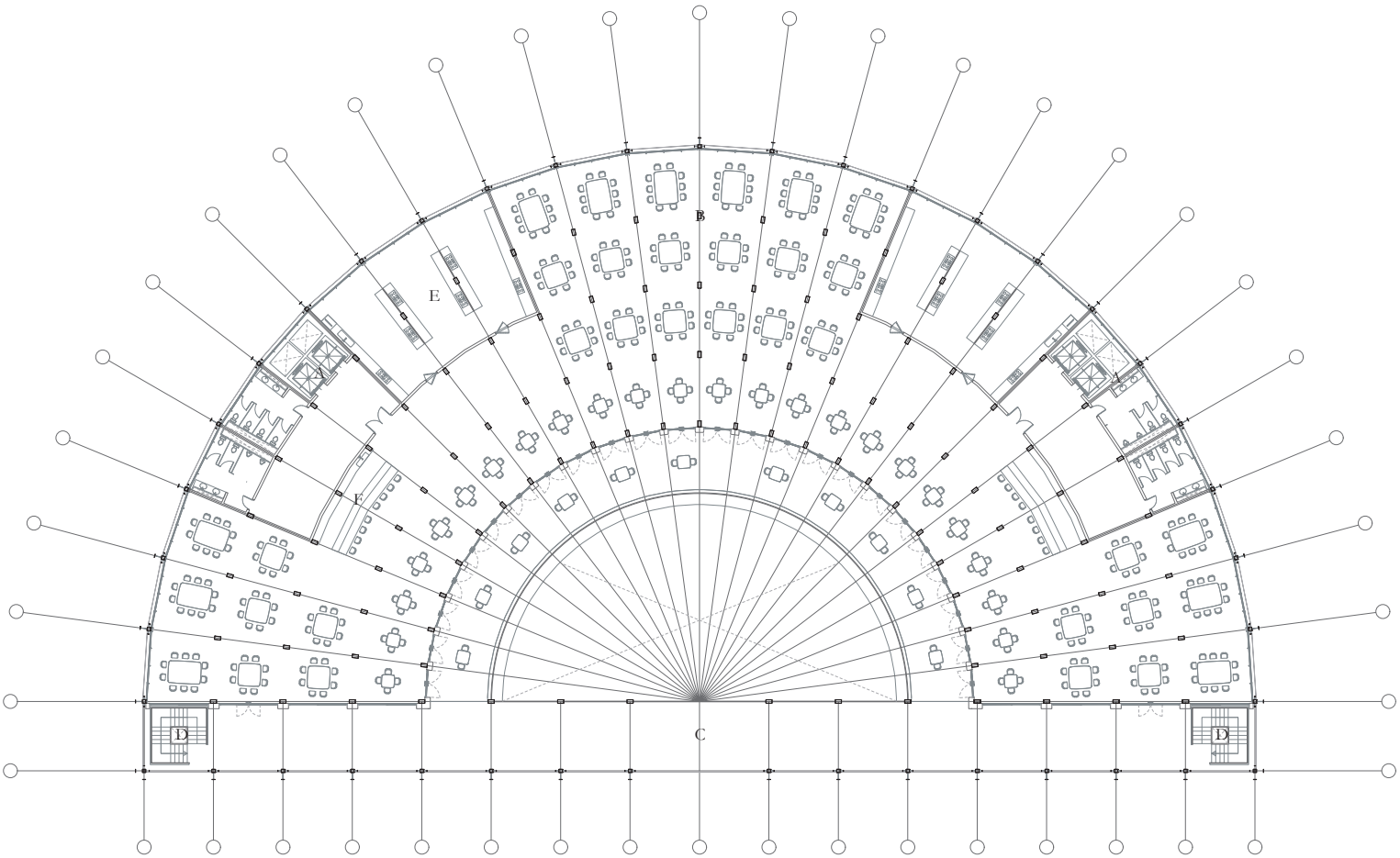
A - Core
B - Dining
C - Screen
D - Stairs
E - Kitchen
F - Bar

North Sea Parliament | Plan
Dining plan
Scale: 1.500@a4

N

0 5m

plan
1:500@a4



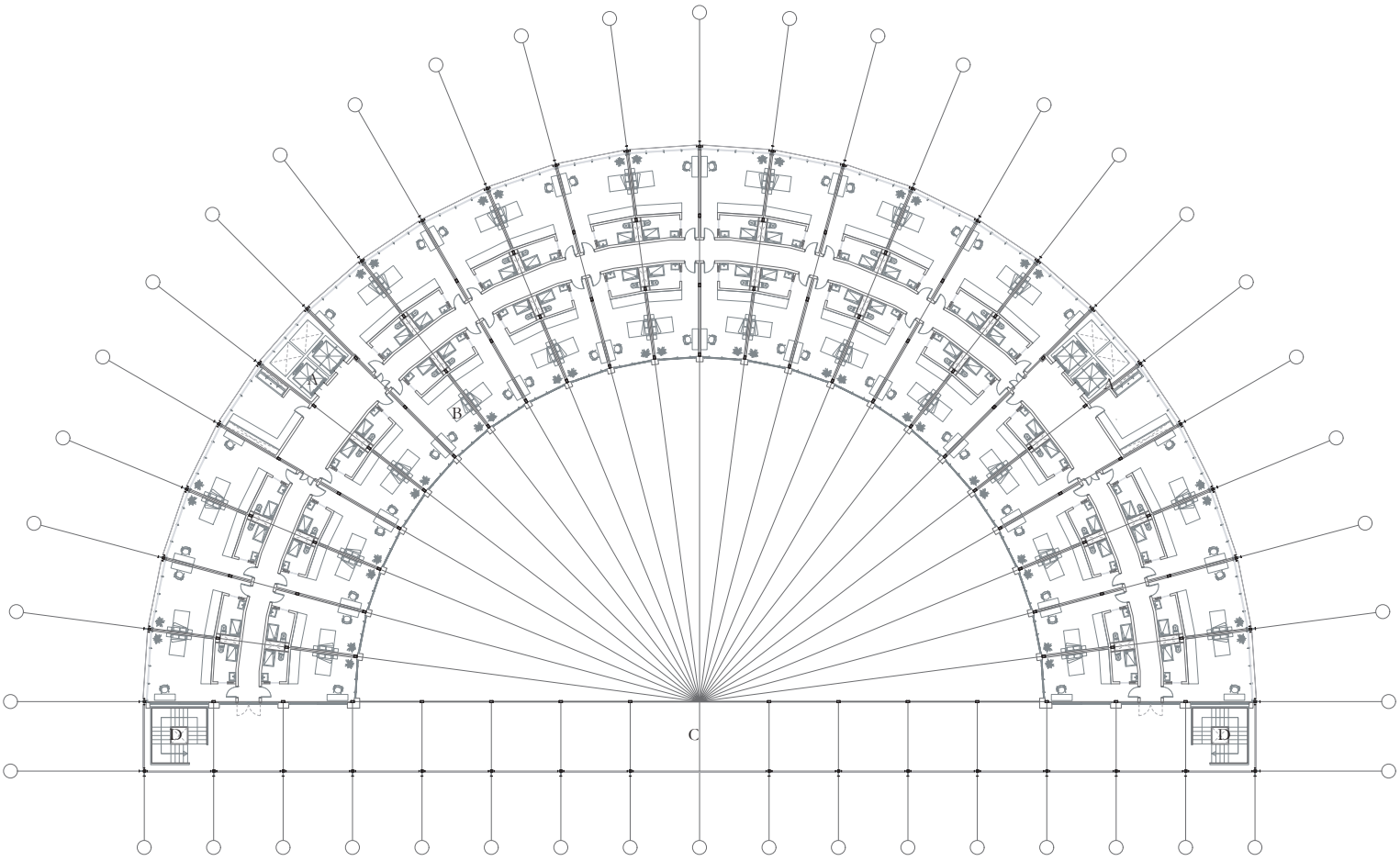
A - Core
B - Hotel rooms
C - Screen
D - Stairs

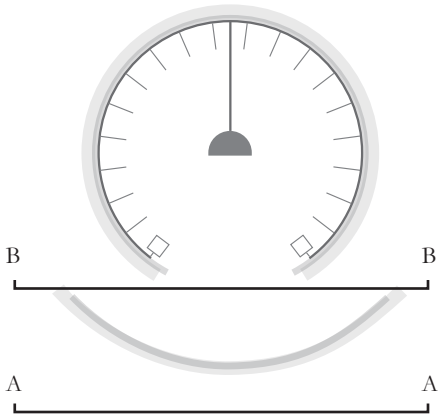
North Sea Parliament | Plan
Typical hotel plan
Scale: 1.500@a4

N

0 5m

plan
1:500@a4





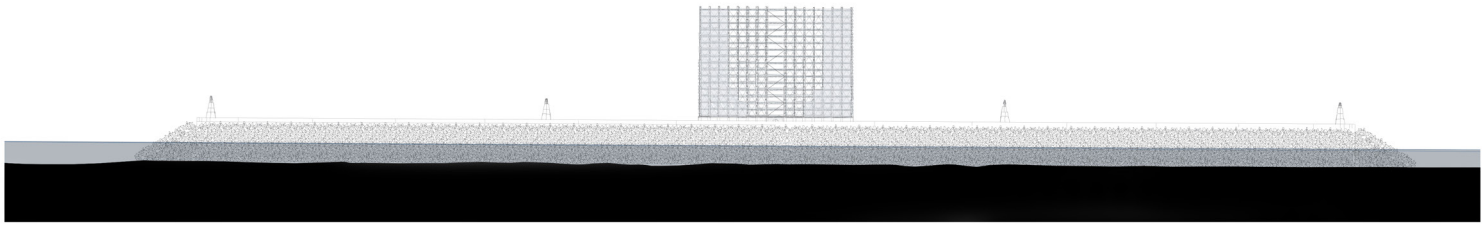
North Sea Parliament
South elevation
Scale: 1.2000@a3

N

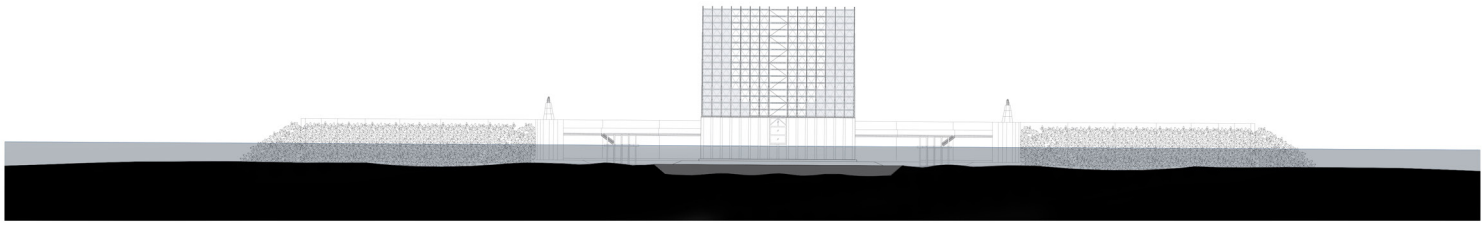
0 20m

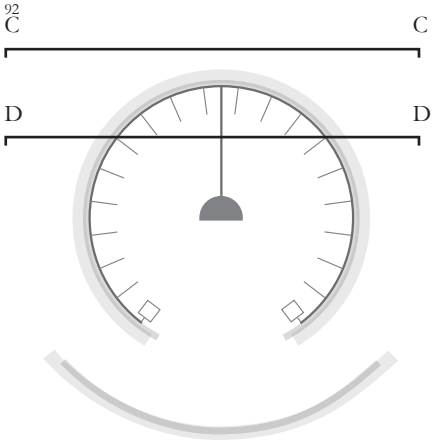
site elevation
1:2000@a3

A-A



B-B





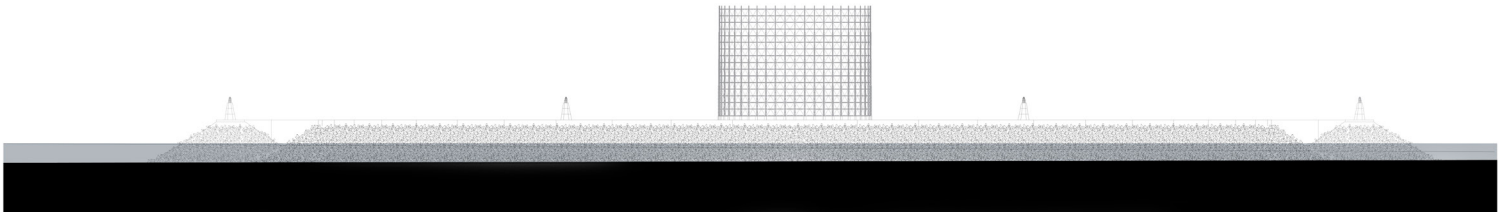
North Sea Parliament
North elevation
Scale: 1.2000@a3

N

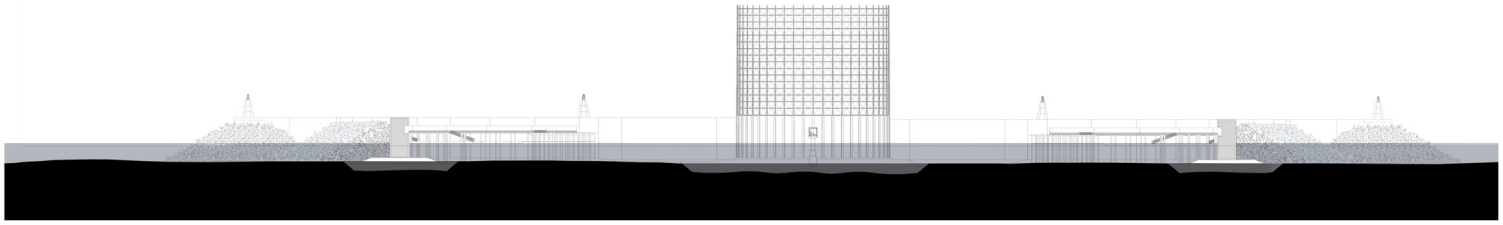
0 10m

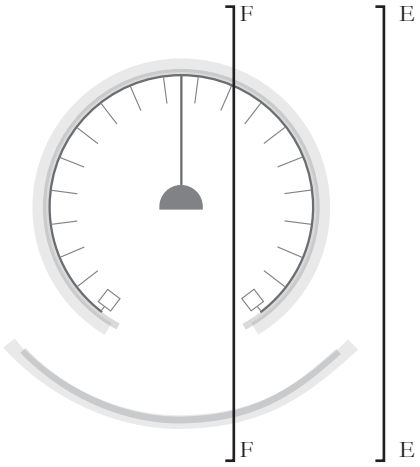
site elevation
1:2000@a3

C-C



D-D





North Sea Parliament
East elevation
Scale: 1.2000@a3

N

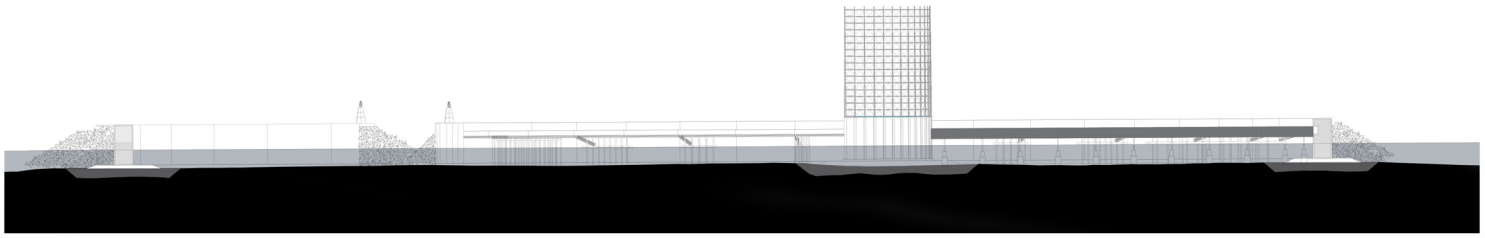
0 20m

site elevation
1:2000@a3

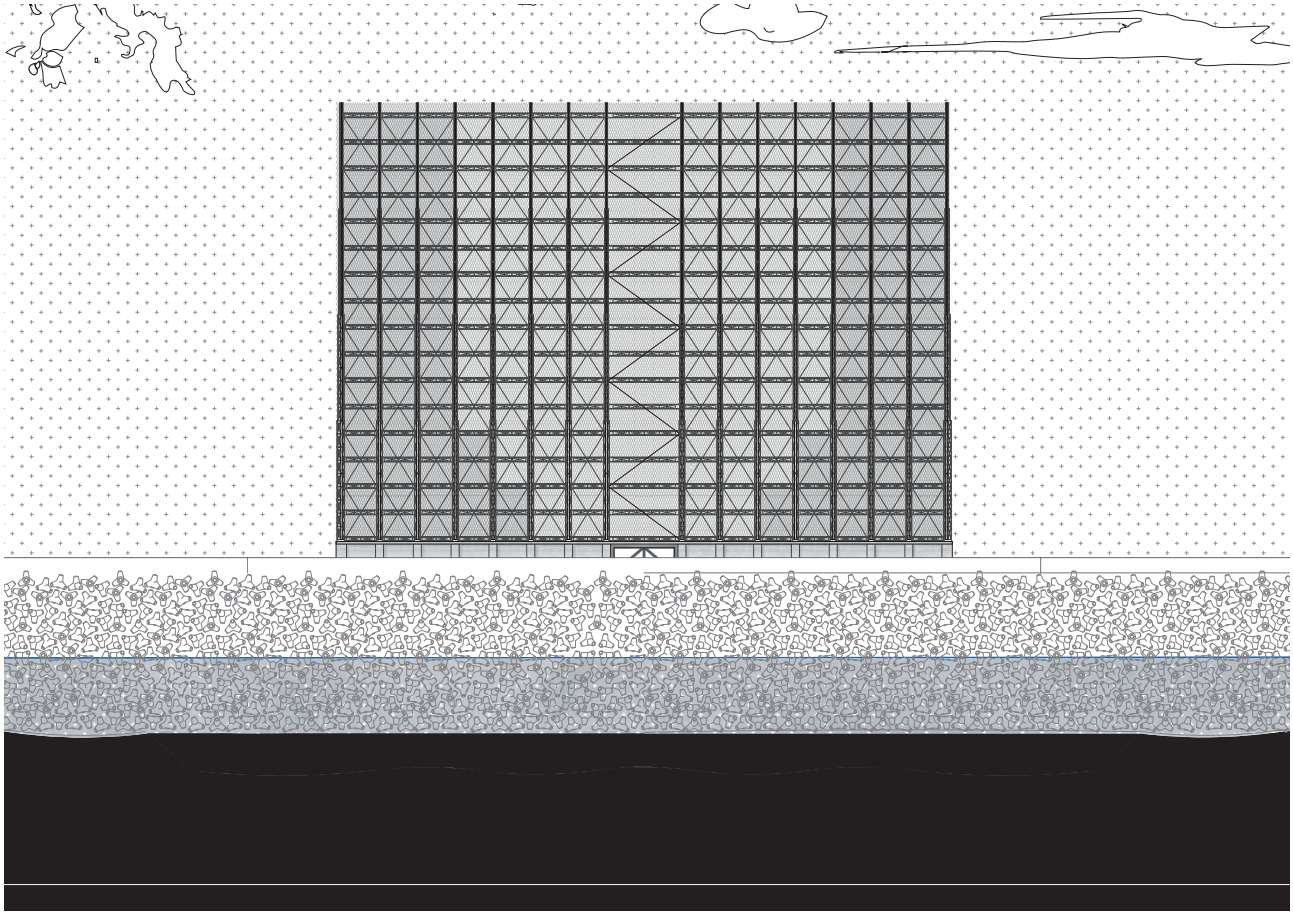
E-E



F-F







North Sea Parliament

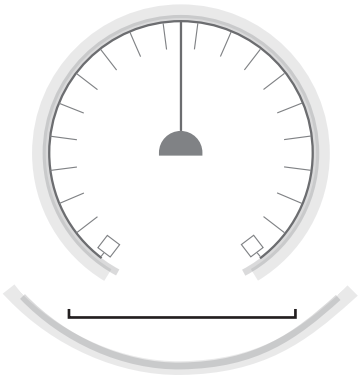
South elevation - before the breakwater

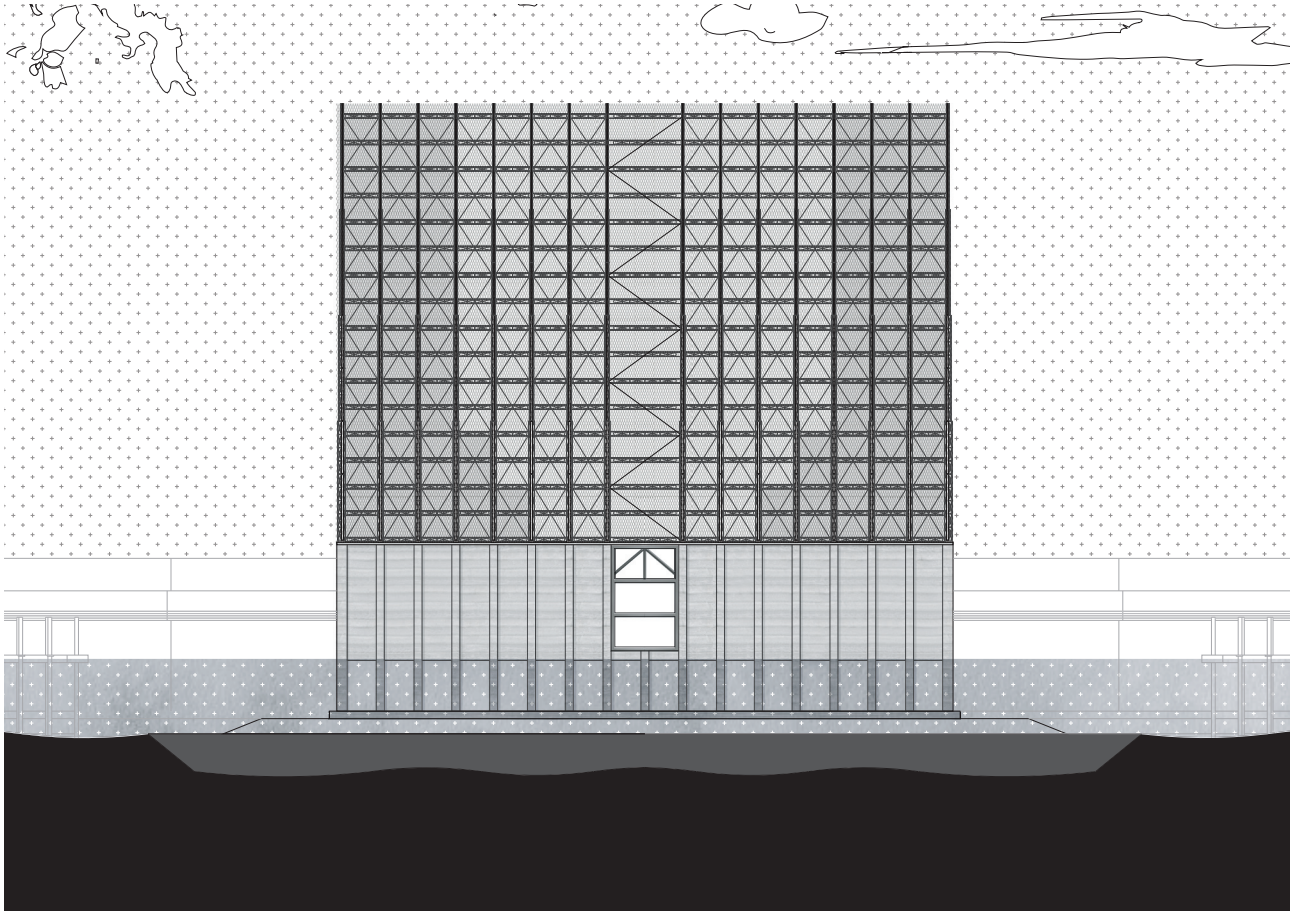
Scale: 1.500@a3

N

0 10m

elevation
1:500@a3

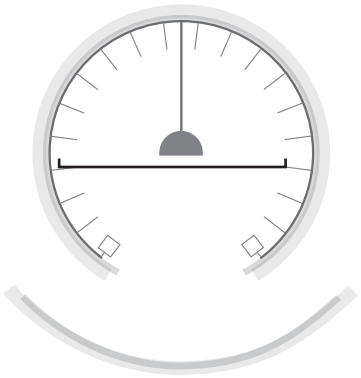


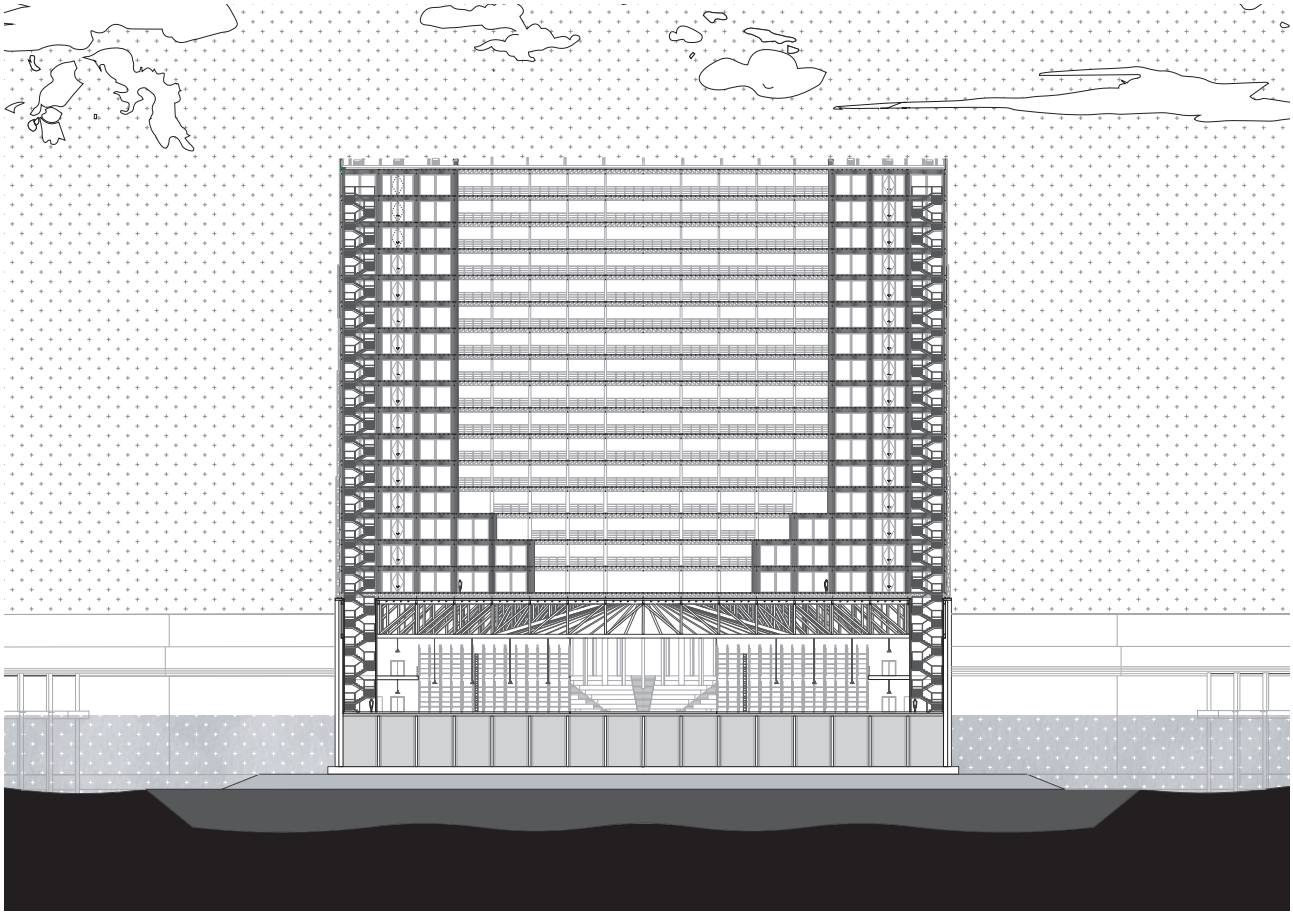


North Sea Parliament
South elevation - after the breakwater
Scale: 1.500@a3

N

0 10m





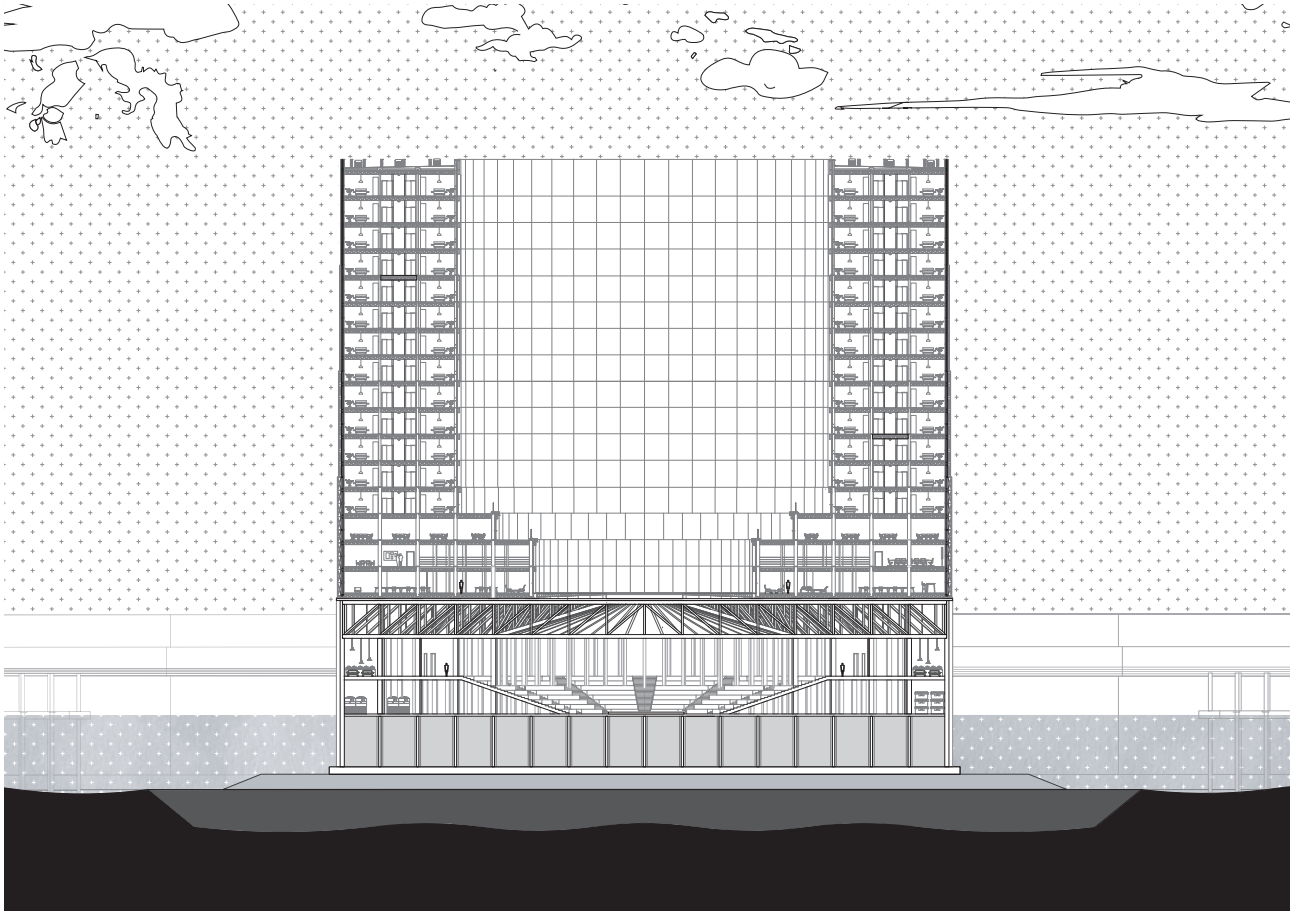
North Sea Parliament
South section - Fourth wall
Scale: 1.500@a3

N

0 10m



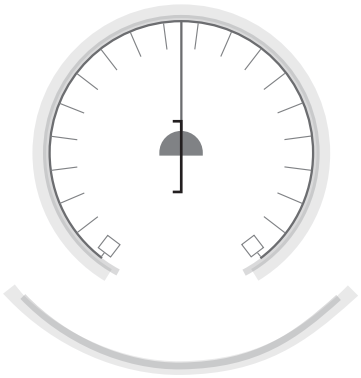
section
1:500@a3



North Sea Parliament
South section - Stage
Scale: 1.500@a3

N

0 10m

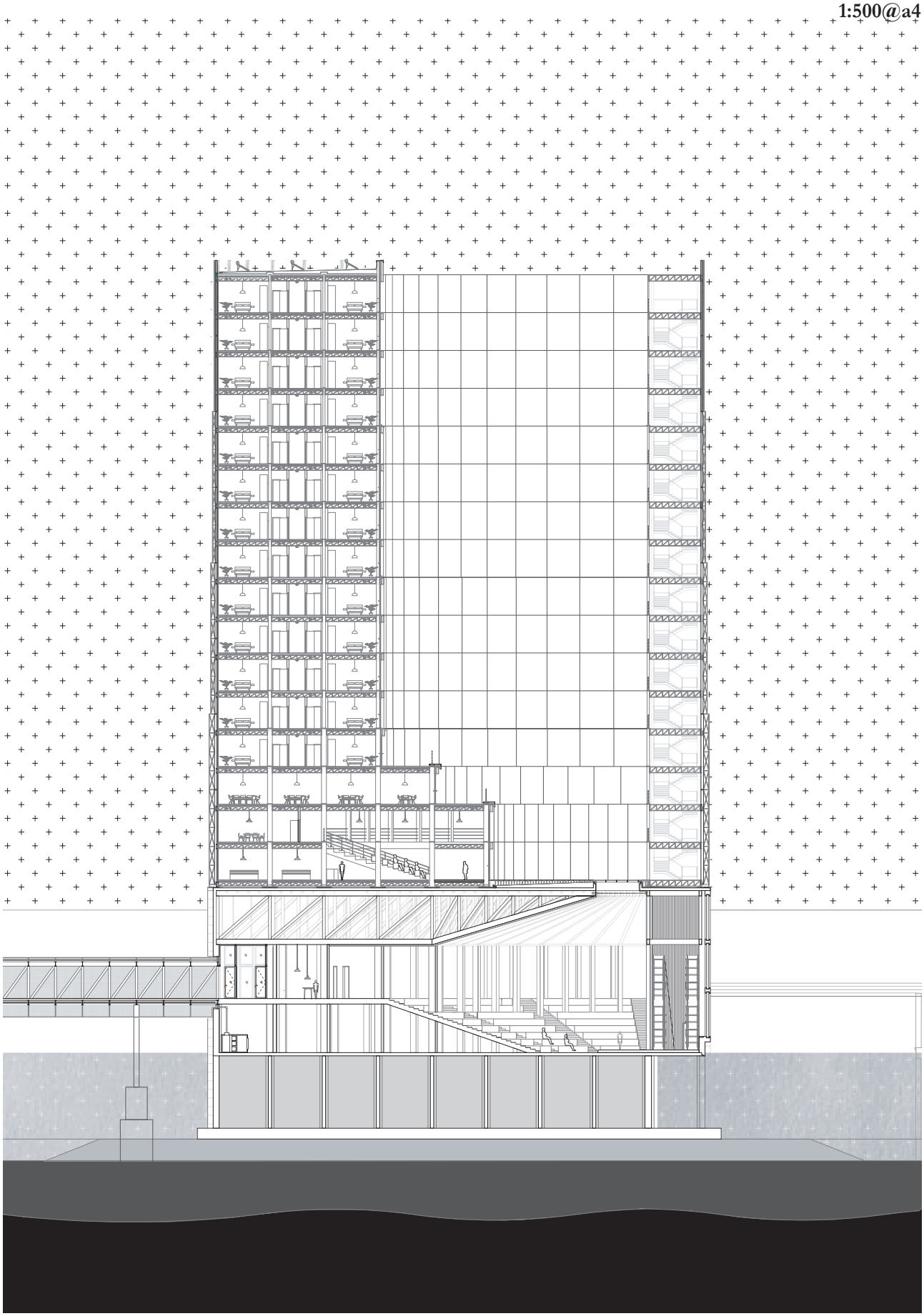


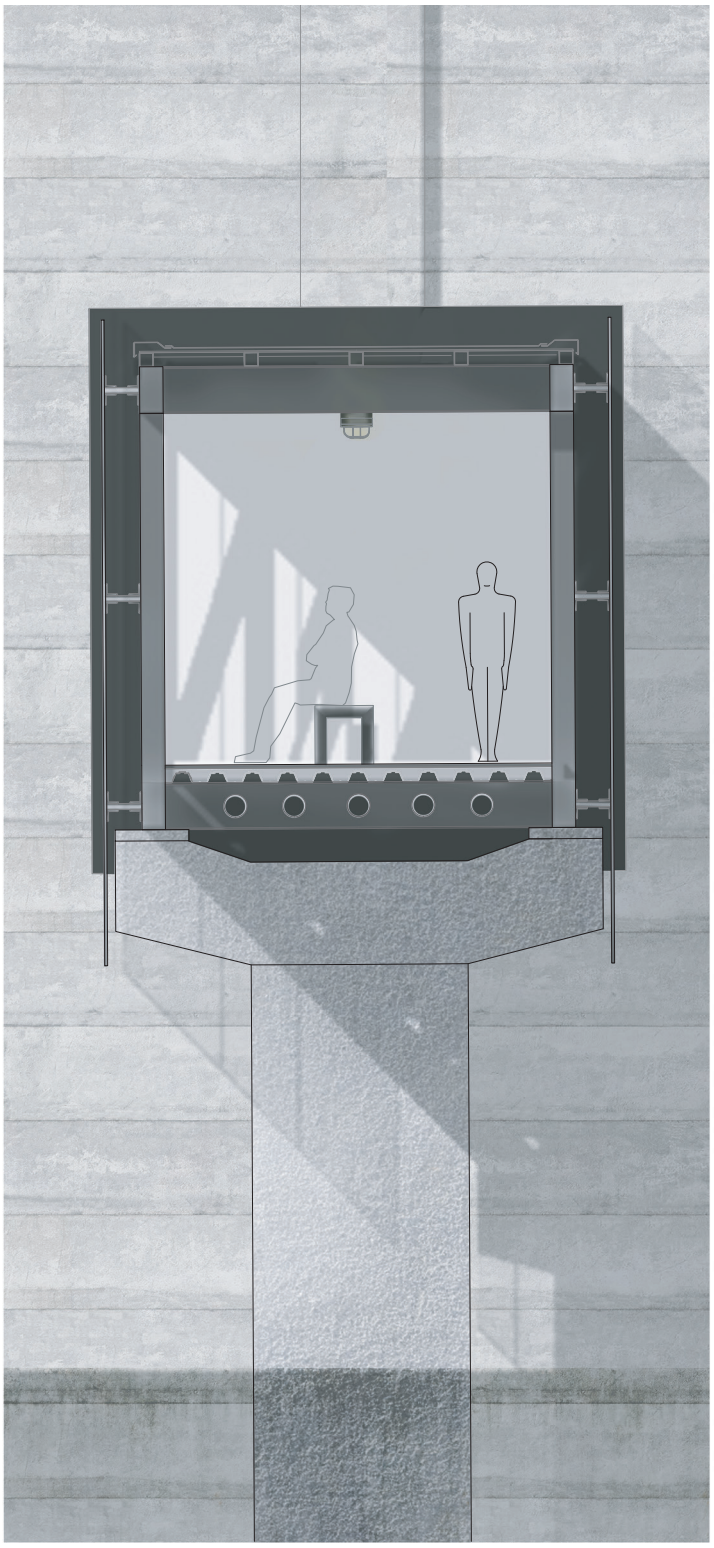
North Sea Parliament
East section
Scale: 1.500@a4

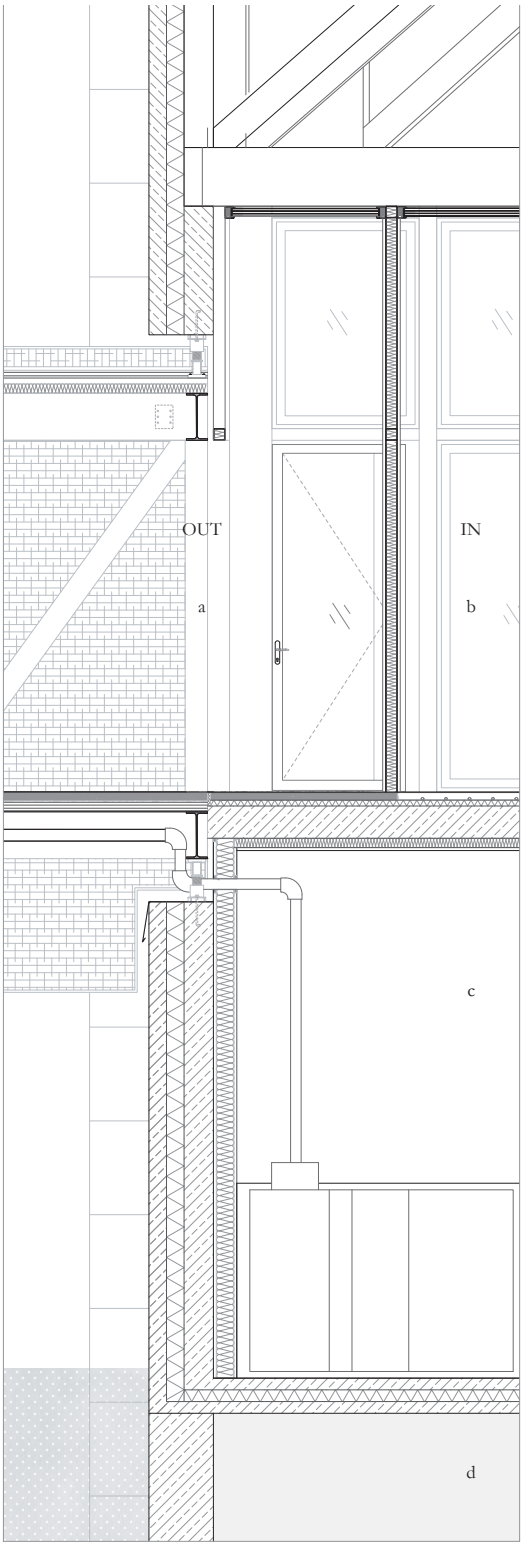
N

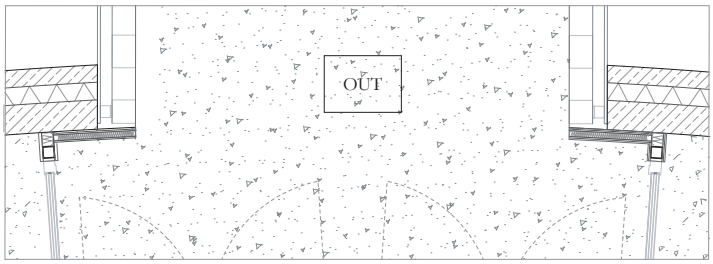
0 10m

section
1:500@a4






OUT
IN
a
b
c
d


OUT

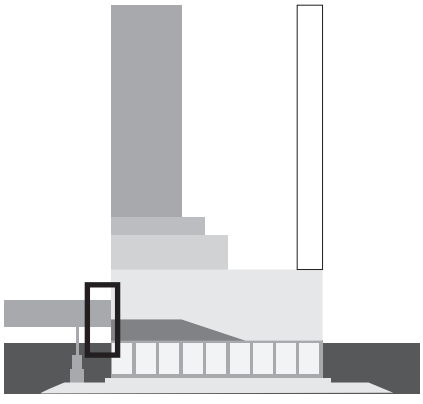
Entrance bridge
1.20@a1

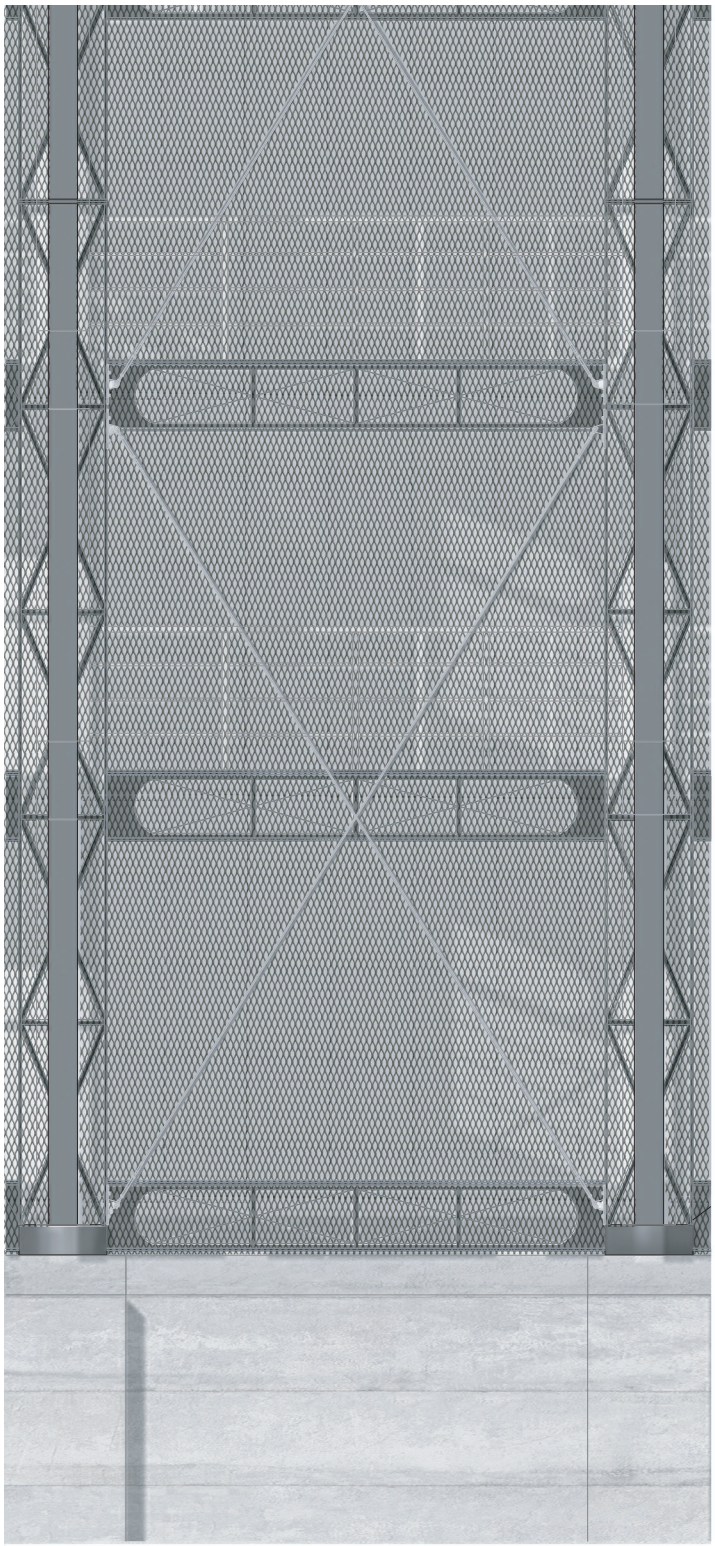
a - Entrance bridge
b - Inner Foyer
c - Plant room
d - Water foundation

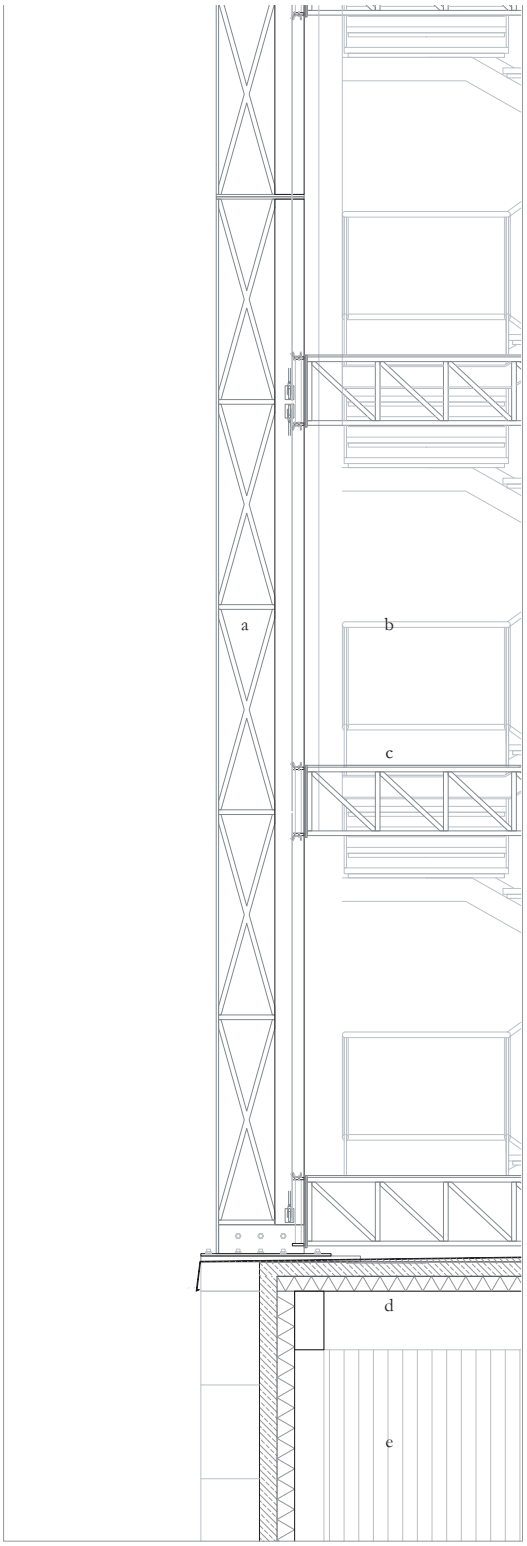
North Sea Parliament
Entrance bridge
Scale: 1.20@a1

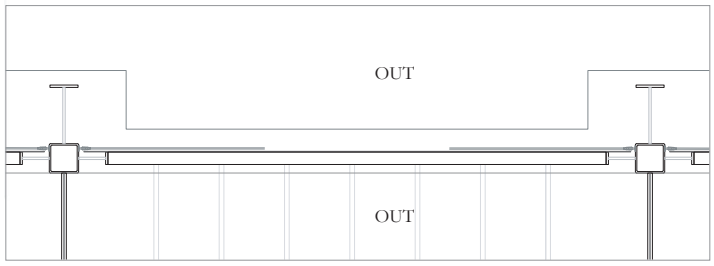
N

0 1m






a
b
c
d
e


OUT
OUT

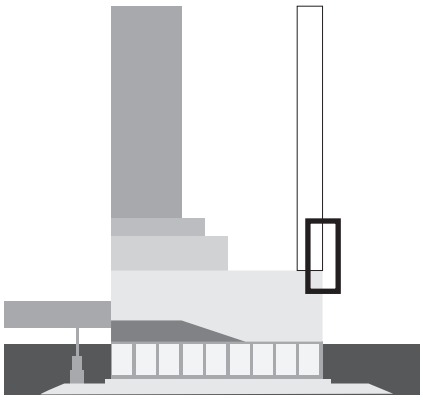
Perforated screen | caisson box
1.20@a1

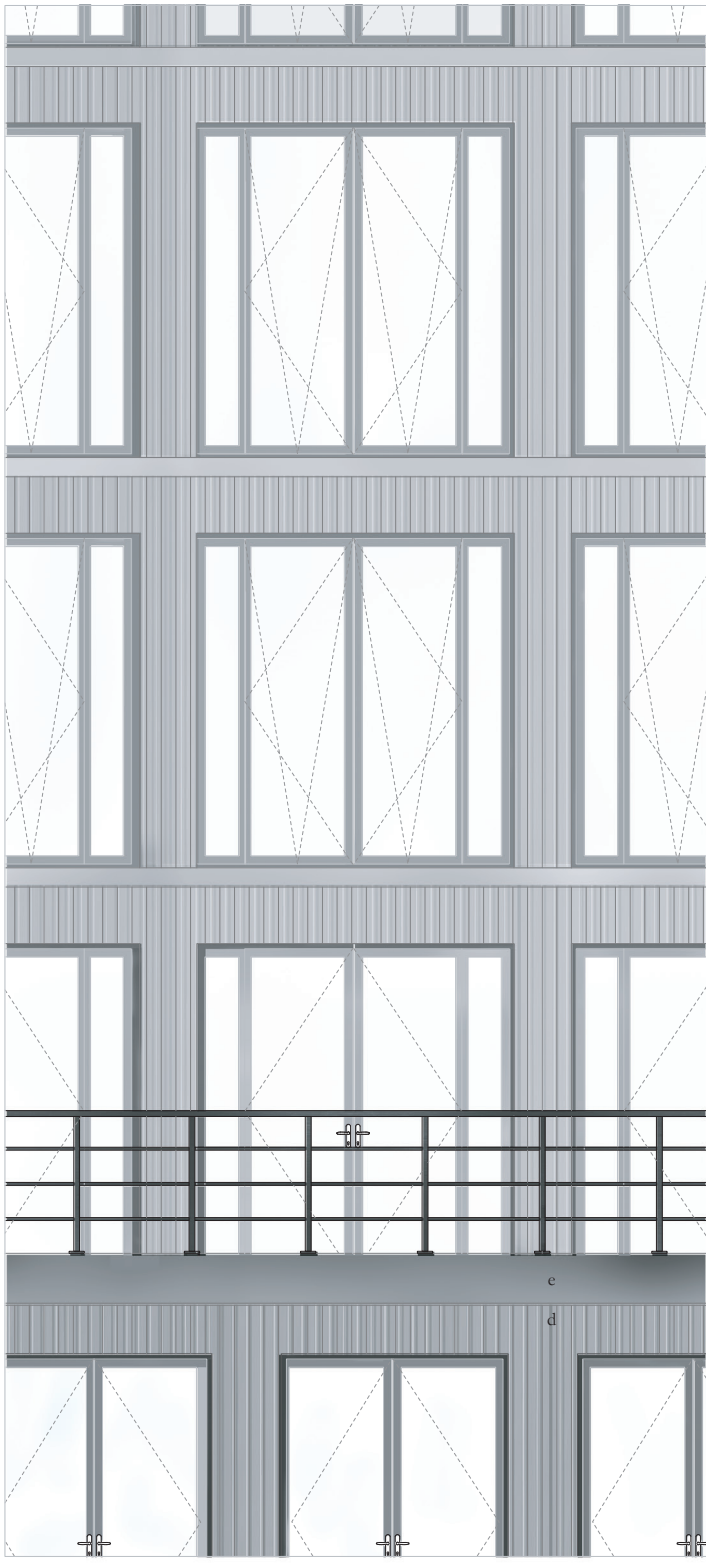
a - Gasholder column
b - Screen stairs
c - Screen perforated metal deck
d - Assembly truss
e - Screen Stairs encasement to seal the outside stairs from interior caisson box space

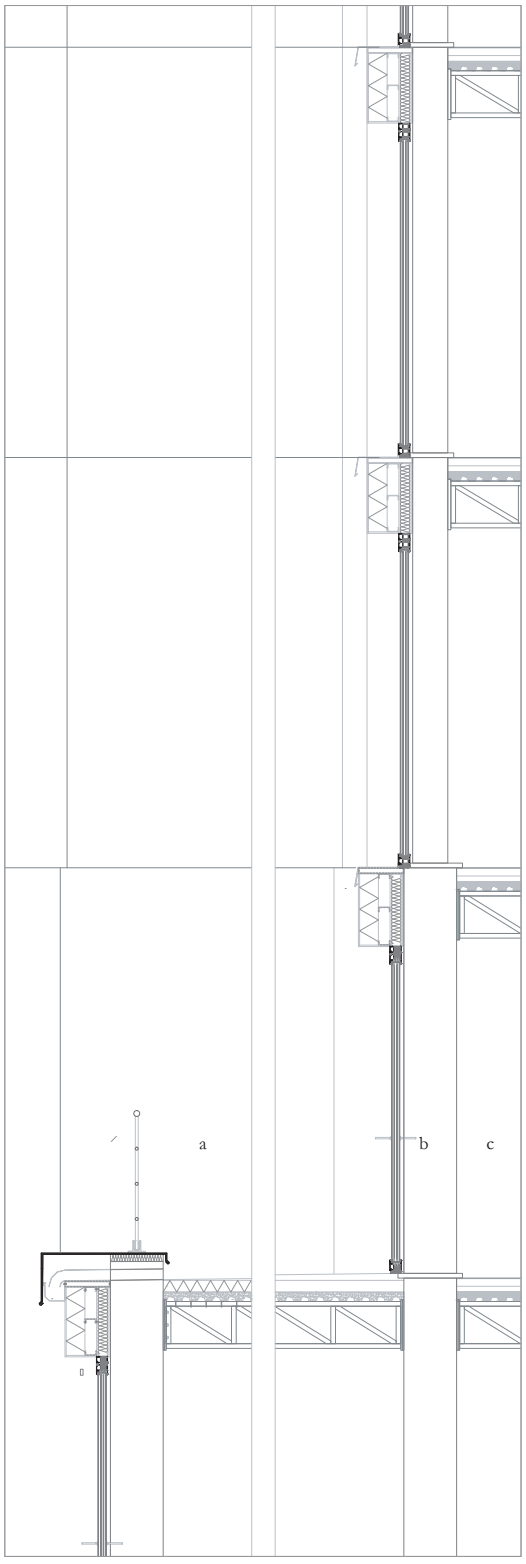
North Sea Parliament
Perforated screen | caisson box
Scale: 1.20@a1

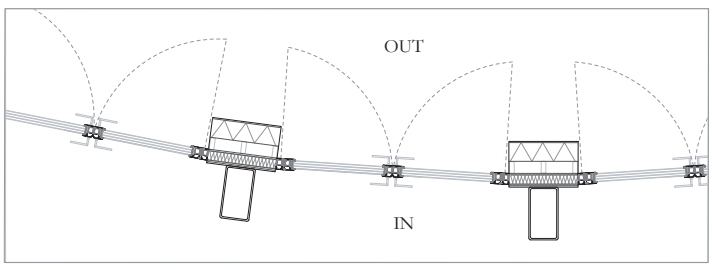
N

0 1m




e
d


a
b
c


OUT
IN

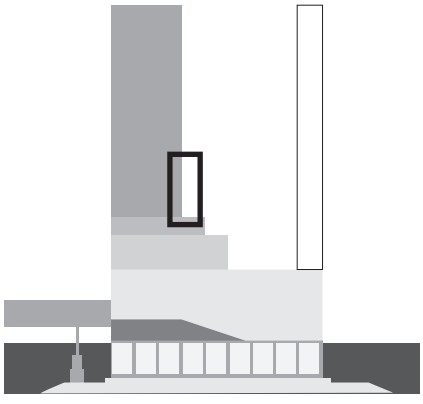
Inner courtyard
1.20@a1

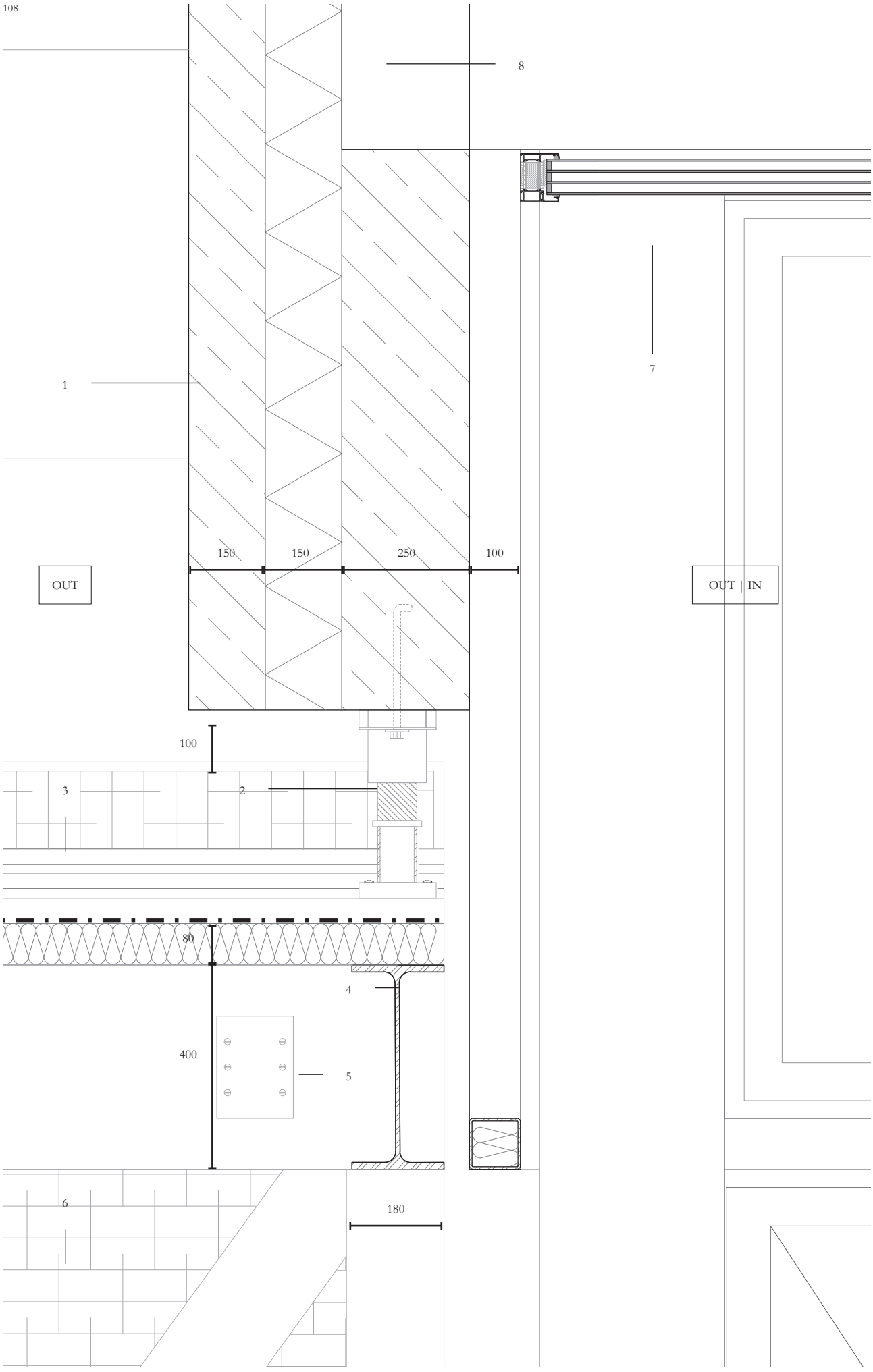
a - Balcony
b - Steel structure column
c - Interior space - hotel
d - Corrugated metal façade
e - metal trim - to hide gutter

North Sea Parliament
Inner courtyard
Scale: 1.20@a1

N

0 1m




8
7
1
150
150
250
100
OUT
OUT | IN
100
3
2
80
4
400
5
6
180

detail 01
1.10@a4

North Sea Parliament | Detail
Caisson box: footbridge connection detail

1 - Caisson box
150 mm reinforced concrete
150 mm rigid insulation
250 mm reinforced concrete

2 - Loading jack (connection between footbridge and caisson box)

3 - Cold flat roof
Preformed edge detail
Waterproof membrane
15 mm plywood sheet
Steel box joists
12.5 mm gypsum board

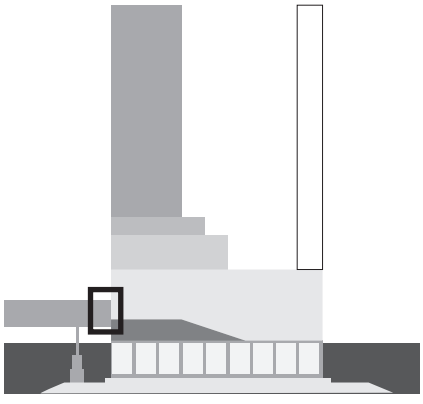
4 - 400x18 0mm I beam

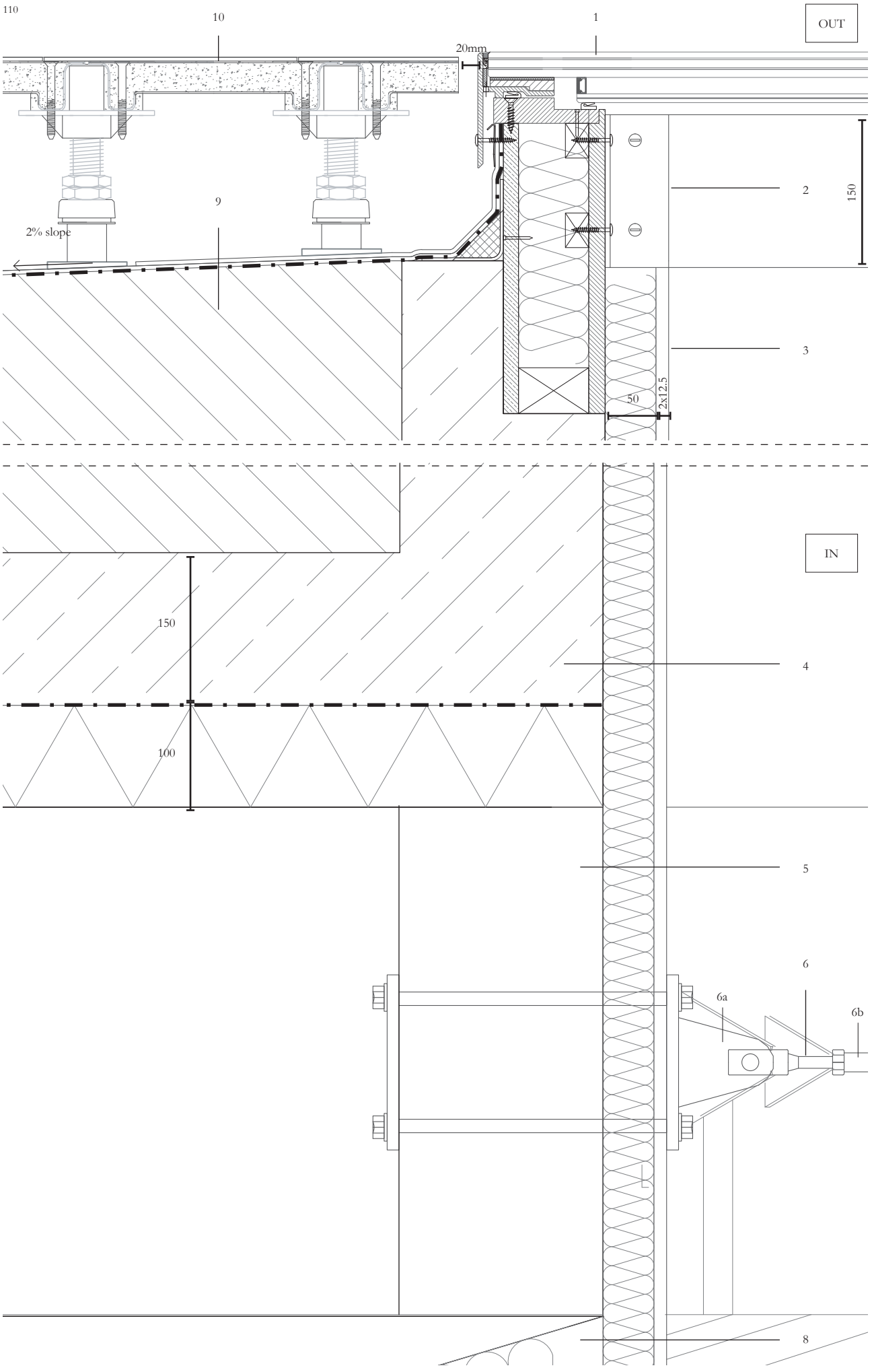
5 - Loading jack connection plate

6 - Perforated mesh panel

7 - Glass vestibule lobby (thermal transition space between outside footbridge and inside caisson box) quad-pane insulated glass panel in steel framed box

8 - 5000 mm height cantilevered assembly truss




10
1
OUT
20mm
9
2% slope
2
150
3
50
2x12.5
IN
150
4
100
5
6
6a
6b
8

detail 02
1.10@a4

North Sea Parliament | Detail
Caisson box: roof window

1 - Glass walk-on roof, triple glazed pane laminated stepped glass unit with 6mm double glazed panel attached

2 - Structural glass fin to support glass walk on assembly room roof (1)

3 - 50mm soft insulation
2x12.5 mm plasterboard

4 - Reinforced concrete caisson box "cap"
150 mm reinforced concrete
Waterproof membrane
100 mm rigid insulation

5 - 5000 mm height cantilevered assembly truss

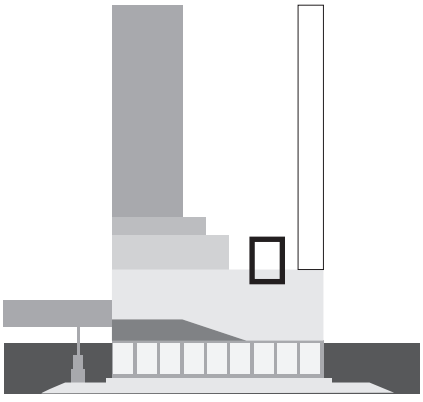
6 - Tension rod (additional support to tie lock the assembly trusses to the screen and prevent unwanted horizontal movement)
6a - Turn buckle set
6b - S bracket

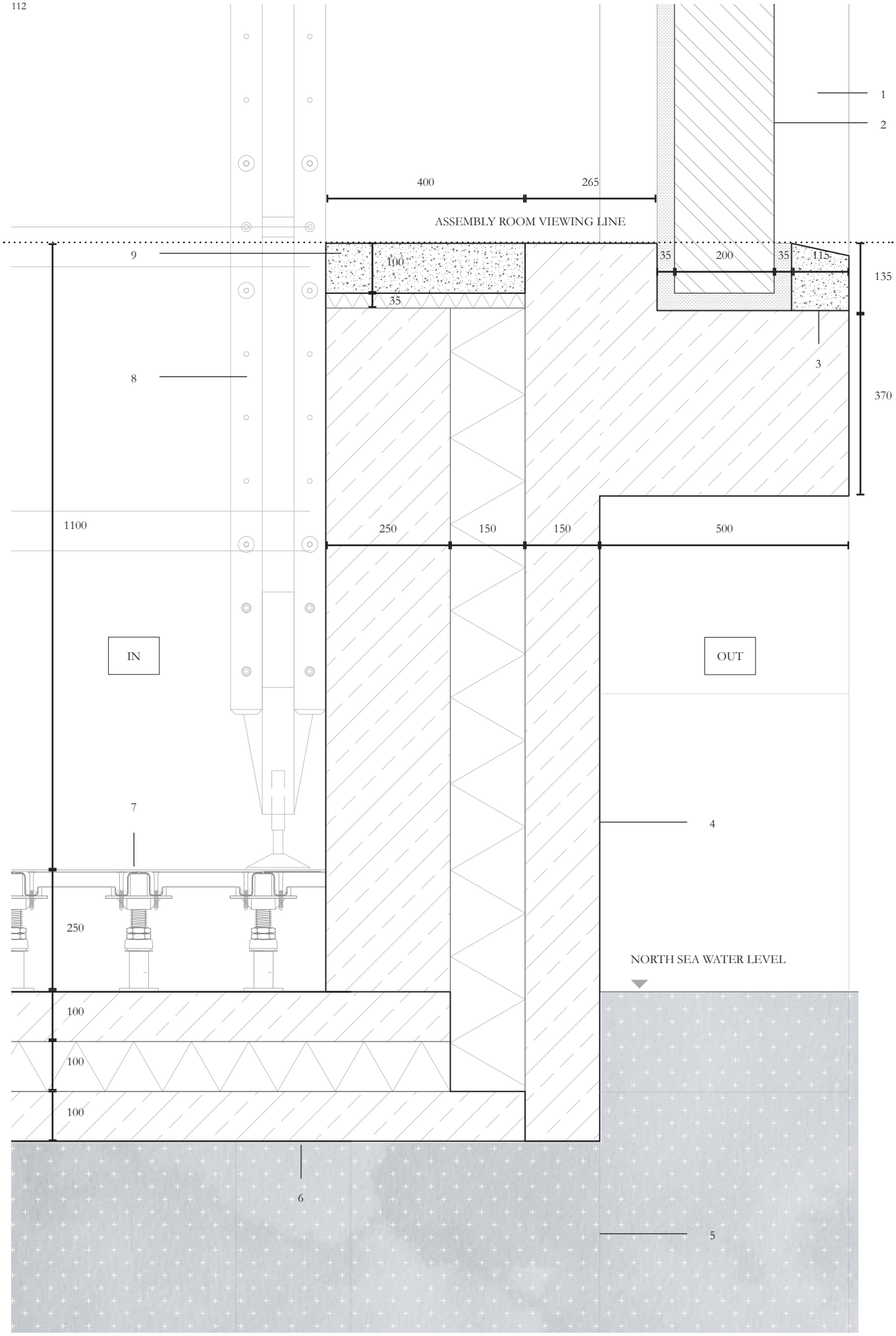
7 - Assembly room interior ceiling
120 mm soft insulation
2x12.5 mm plasterboard

8 - Acoustic insulation for assembly room

9 - Caisson box roof
Concrete infill for grading of incline at 2%
Roof membrane
Waterproof membrane

10 - Raised exterior floor, with 20 mm gap for water to run off to gutter. Rain water to be collected for grey water cycle.




1
2
400
265
ASSEMBLY ROOM VIEWING LINE
9
100
35
35
200
35
115
135
3
8
370
1100
250
150
150
500
IN
OUT
7
4
250
NORTH SEA WATER LEVEL
100
100
100
6
5

detail 03
1.10@a4

North Sea Parliament | Detail
Caisson box: assembly room window

1 - Caisson box outer edge

2 - Assembly room window
- 200 mm acrylic glass
- 30 mm sealant
- 5 mm epoxy resin, to waterproof concrete

3 - Concrete window sill, to be added after installation of assembly window

4 - Caisson box wall build-up
- 250 mm reinforced concrete
- 150 mm insulation
- 150 mm reinforced concrete

5 - Open caisson box foundation compartment

6 - Caisson box floor build-up
- 100 mm reinforced concrete
- 100 mm rigid insulation
- 100 mm reinforced concrete

7 - Raised access “stage” floor

8 - Backstage bookcase

9 - Interior window sill
- 100 mm concrete window sill
- 35 mm insulation

Installation of assembly room window (on floating dock)

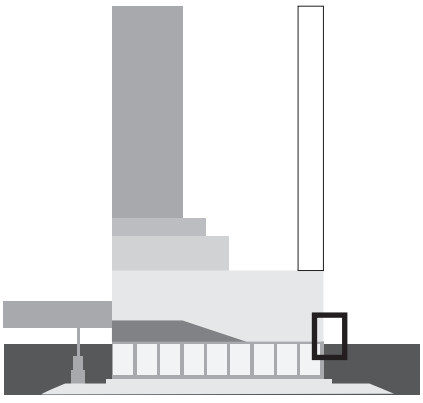
1. Check the concrete is completely dry

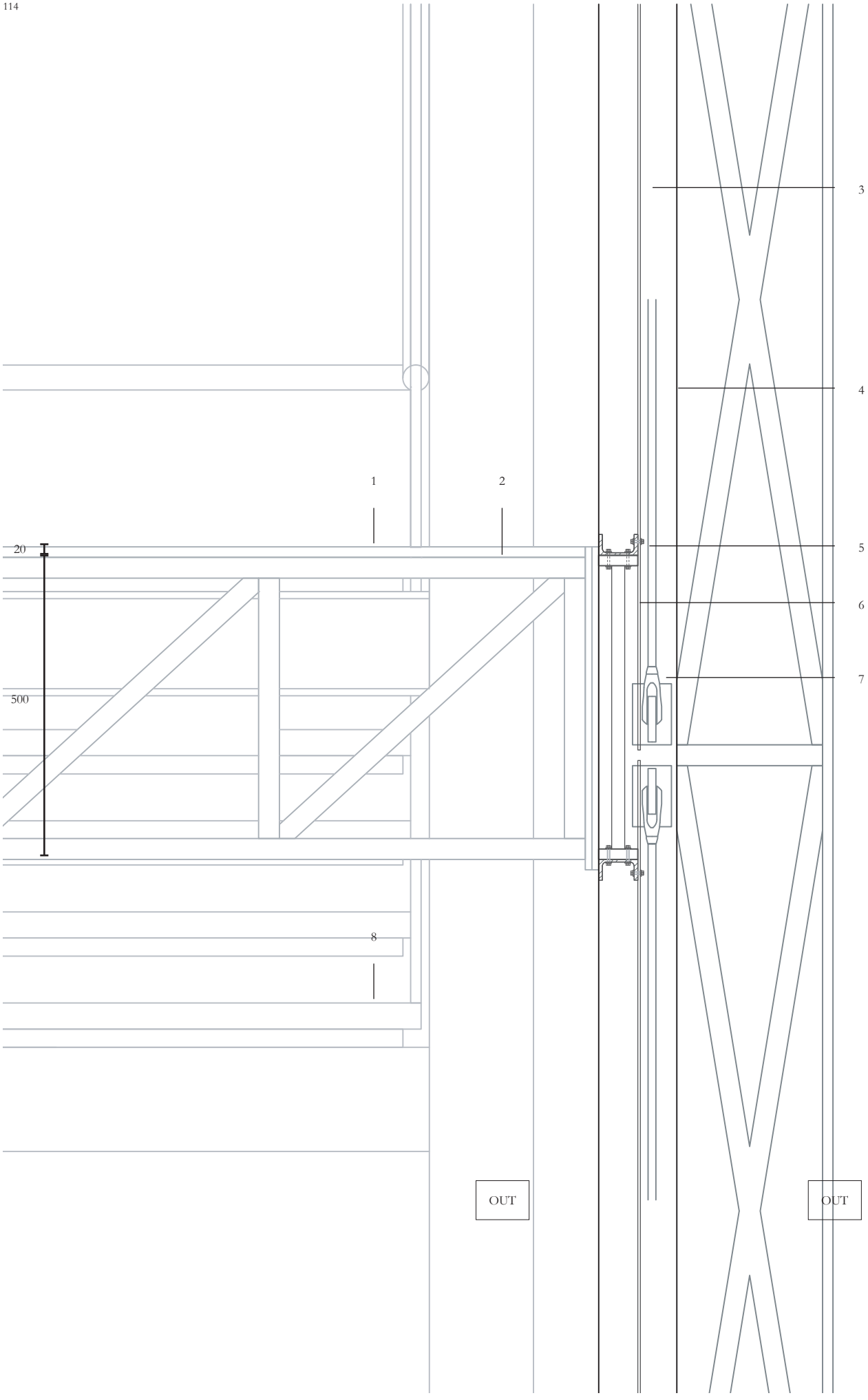
2. Apply 5mm if epoxy waterproof treatment on the surface frame of the window, let this dry completely

3. Check the waterproof coating is correct, lift the acrylic glass panel into place, if the bottom of the slot is not completely flat, adjust with a pad then fill the sealant between the concrete and acrylic glass.

4, After 1 week the window is waterproof

5. Add the window sill to finish the exterior.




1
2
3
4
5
6
7
8
20
500
OUT
OUT

detail 04
1.10@a4

North Sea Parliament | Detail
Steel structure: screen balcony

1 - 20 mm perforated steel deck

2 - 500 mm gasholder screen pratt truss, secondary structure

3 - 5 mm perforated metal mesh façade panel

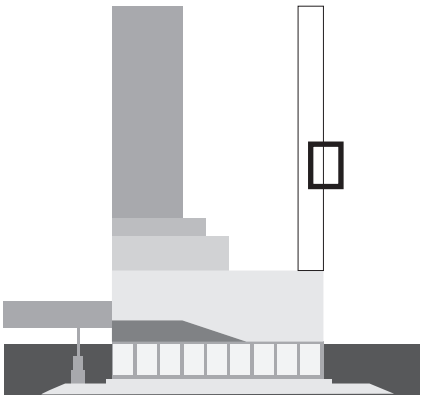
4 - 7000 mm gasholder structure column

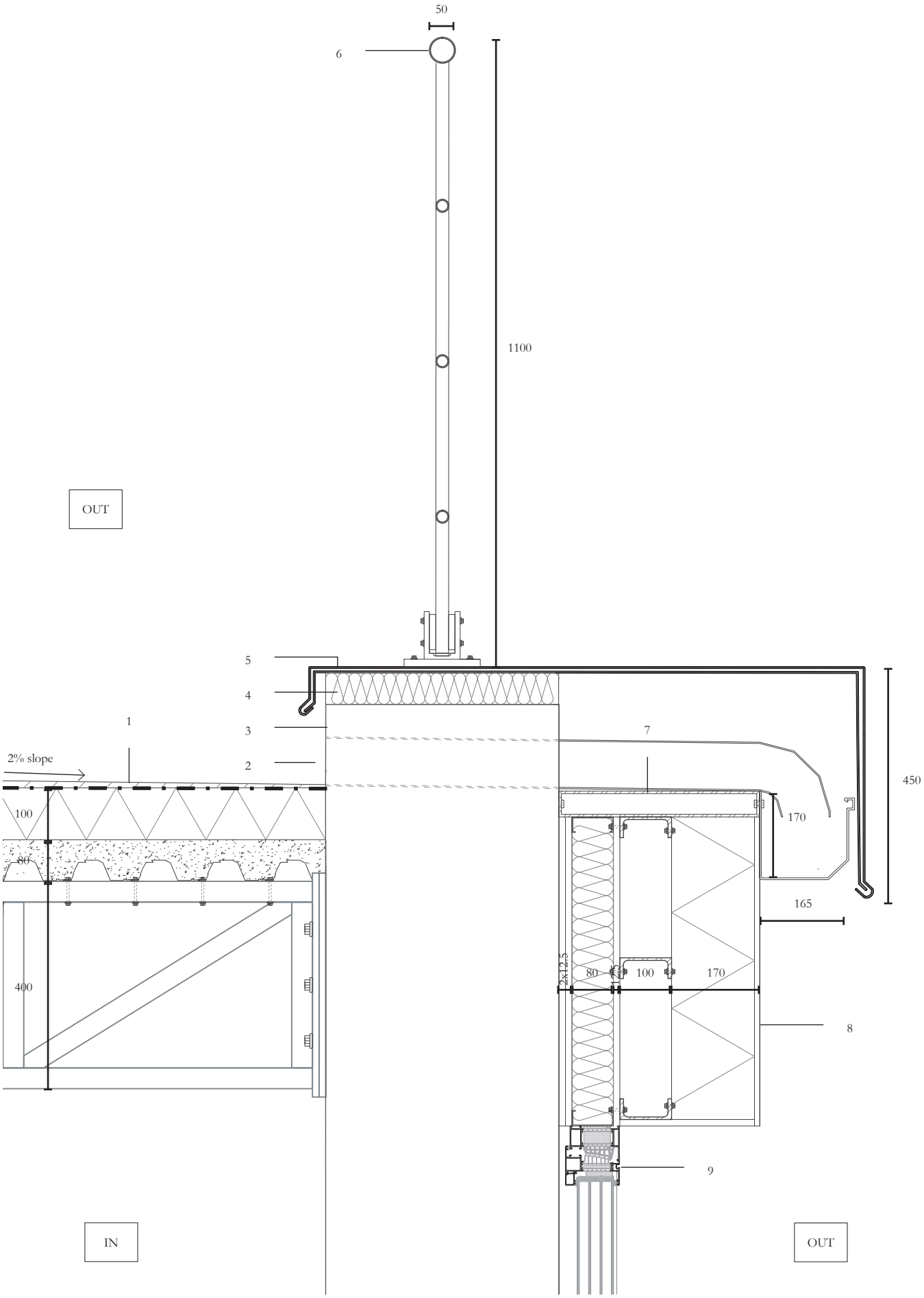
5 - 40x75 mm c channel fixing to perforated façade and gasholder truss

6 - 500 mm I beam open web design, gasholder truss secondary structure

7 - 15 mm tension rod cable between each gasholder column

8 - Stairs




50
6
1100
OUT
5
4
3
2
1
2% slope
100
80
400
7
450
170
165
2x12.5
80
100
170
8
9
IN
OUT

detail 05
1.10@a3

North Sea Parliament | Detail
Steel structure: Courtyard balcony

1 - Balcony roof build up
Concrete infill for grading of incline at 2%
Waterproof membrane
100 mm rigid insulation
80 mm reinforced concrete deck
400 mm pratt truss

2 - ø 90 mm rainwater pipe (attached to RHC)

3 - Rectangular hollow column (RHC), size varies between levels

4 - 60 mm insulation cap

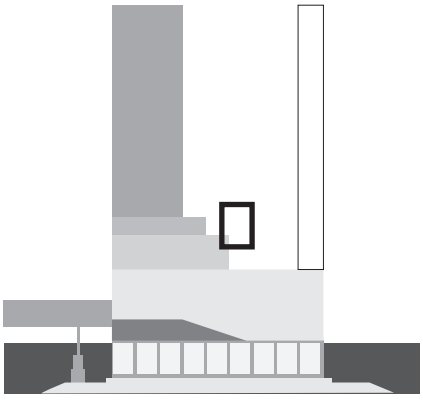
5 - Aluminium galvanised parapet coping

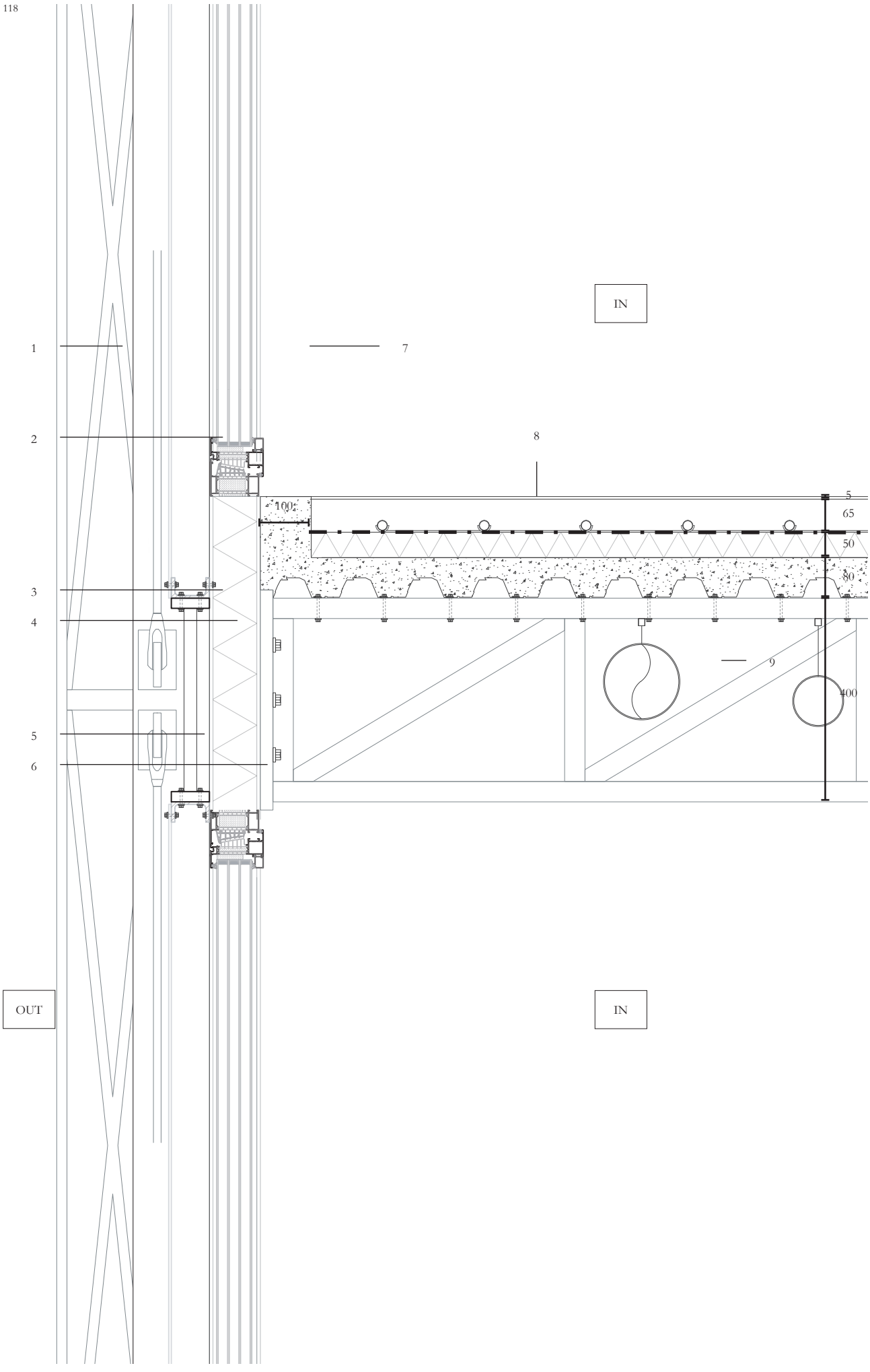
6 - 1100 mm steel tube balcony

7 - Steel box to attach for gutter support

8 - Typical exterior courtyard wall build-up
2x12.5 mm plasterboard
80 mm soft insulation
100 mm c channel façade fixing

9 - Outward swing door
M3-104 passive aero quad
70 mm quad pane insulative glass with 3 E-coatings
Sound protection
Draft and water resistance
High thermal insulation for passive house




IN
1
7
2
8
100
5
65
50
80
3
4
9
400
5
6
OUT
IN

detail 06
1.10@a4

North Sea Parliament |Detail
Steel structure: floor-wall section detail

1 - 7000 mm gasholder column, primary structure

2 - 5 mm perforated metal mesh façade panel

3 - 40x75 mm c channel fixing to perforated façade and gasholder truss

4 - 400 mm gasholder typical pratt truss, secondary structure

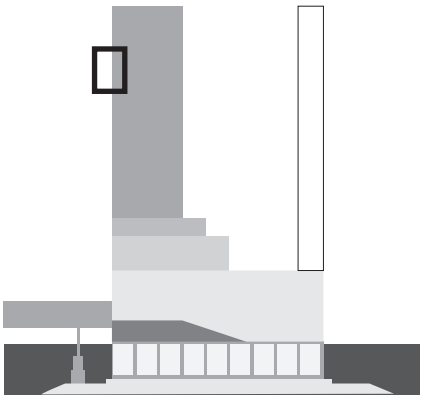
5 - Tension rod

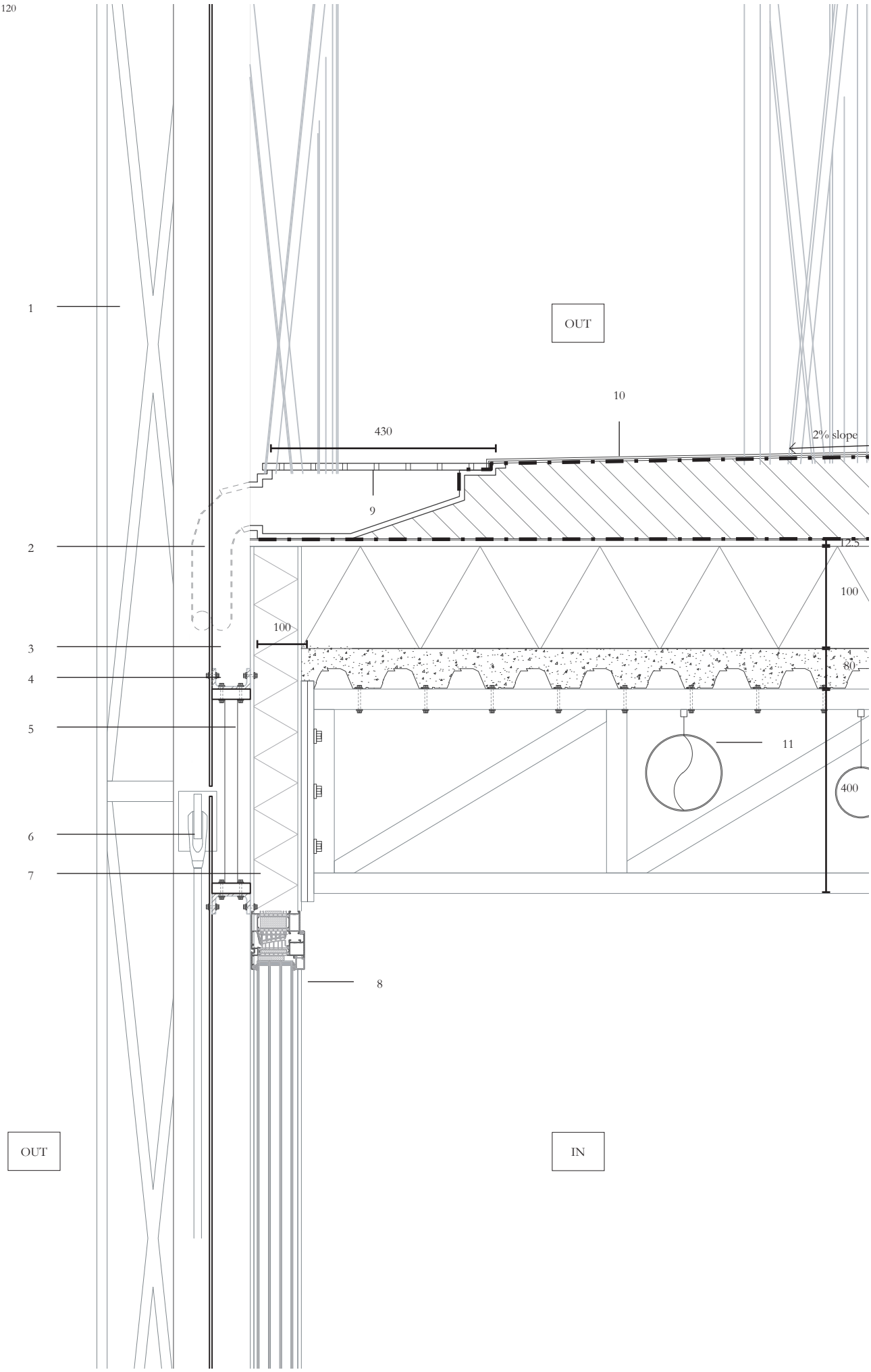
6 - Window structure
- 100 mm I column
- 100 mm insulation connection

7 - Quad pane insulative glass tilt/turn window

8 - Typical floor build up
- 5 mm finish material
- 65 mm screed
- ø 25 mm UFH pipes
- Cliprail
- Waterproof membrane
- 80 mm reinforced concrete deck
- 400 mm pratt truss

9 - Service ducts




1
2
3
4
5
6
7
8
9
10
11
OUT
OUT
IN
430
2% slope
12.5
100
100
80
400

detail 07
1.10@a4

North Sea Parliament |Detail
Steel structure: Roof detail

1 - 7000 mm gasholder column, primary structure

2 - ø 80 mm rainwater collection pipe, placed within the gasholder columns to the caisson box for the building's grey water cycle

3 - 5 mm perforated metal mesh façade panel

4 - 40x75 mm c channel fixing to perforated façade and gasholder truss

5 - 400 mm gasholder typical pratt truss, secondary structure

6 - Tension rod

7 - Window structure
- 100 mm I column
- 100 mm insulation connection

8 - Quad pane insulative glass tilt/turn window

9 - 430 mm rainwater collection gutter

10 - Typical roof build up
- Roof membrane
- Waterproof membrane
- Concrete infill for grading of incline at 2%
- Waterproof membrane
- 12.5 mm gypsum board
- 200 mm rigid insulation
- 80 mm reinforced concrete deck
- 400 mm pratt truss

11 - Service ducts

