



THE LIVING BARRIER

The architectural adaptation of existing flood barriers
on Zeeland's new biodiversity synergy.



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The Delegate examiner: Hugo Ledoux

AR3AE100 | Architectural Engineering | Second life





**The further innovative stage and future adaptation of
“The Delta Works”**
dealing with the acceleration of the rising sea level.

An aerial photograph of the Delta Works dam structure in the Netherlands. The dam is a long, straight structure with a series of concrete pillars and gates, crossing a wide river. The water on the right side of the dam is turbulent and white with foam, while the water on the left is dark and calm. The dam has a road on top with several cars visible. The sky is clear and blue.

“THE DELTA WORKS”

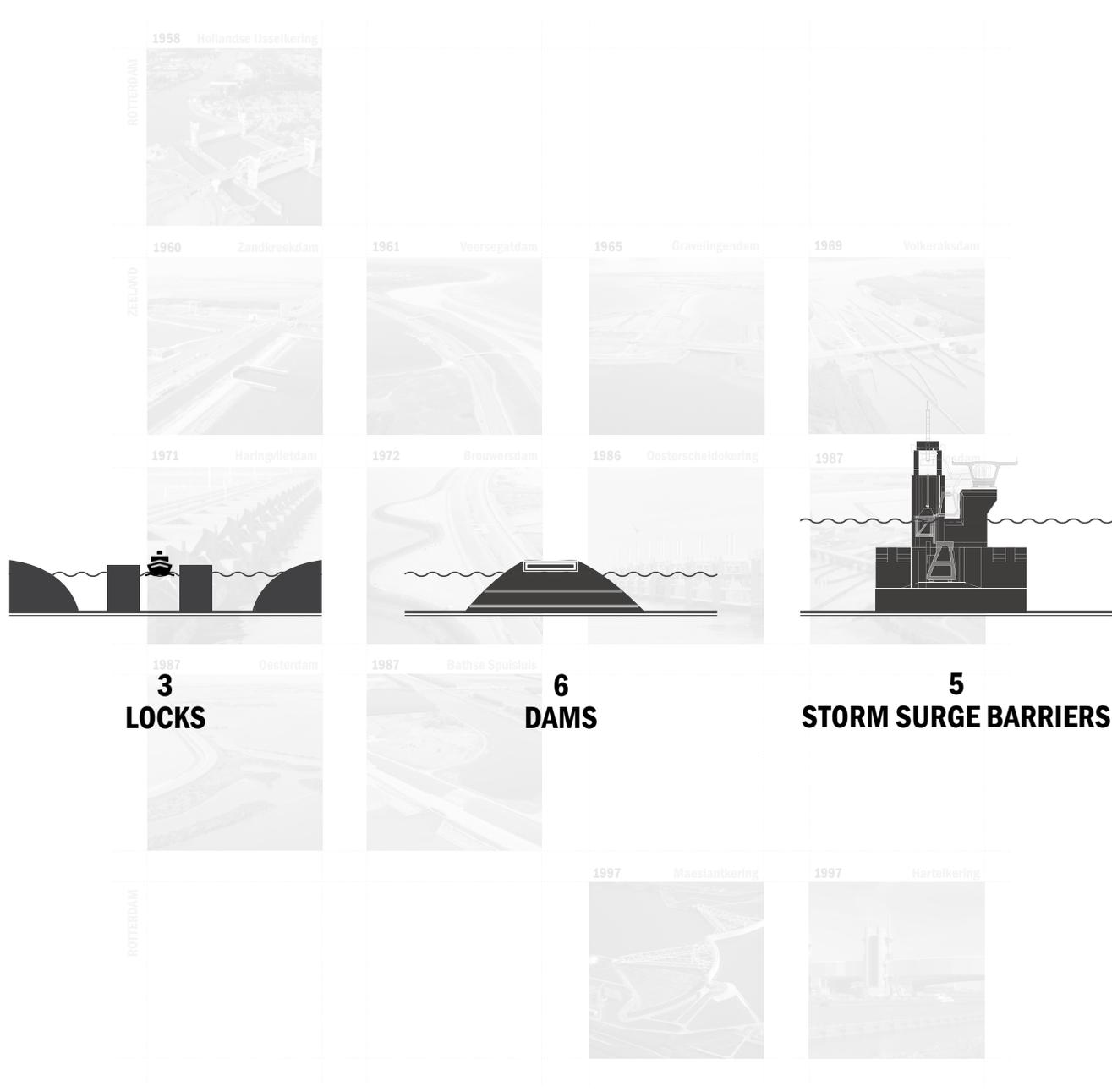


The Land below sea level

Flood prone level if the Netheriands was not protected by dikes and dams.

“The Flood Disaster of 1953”





“14 Flood barriers”

The massive project, with 3 locks, 6 dams and 5 storm surge barriers, was completed in 1997

THE DELTA WORKS IN THE DELTA AREA

For 70 years, the Delta Works has successfully protected the Netherlands against floods, which is a huge achievement in Dutch history and established a global reputation for water management and hydraulic engineering.

1954 Hollandse IJsselkering



1957 Zandkreekdam



1957 Volkerakdam



1958 Veersegatdam



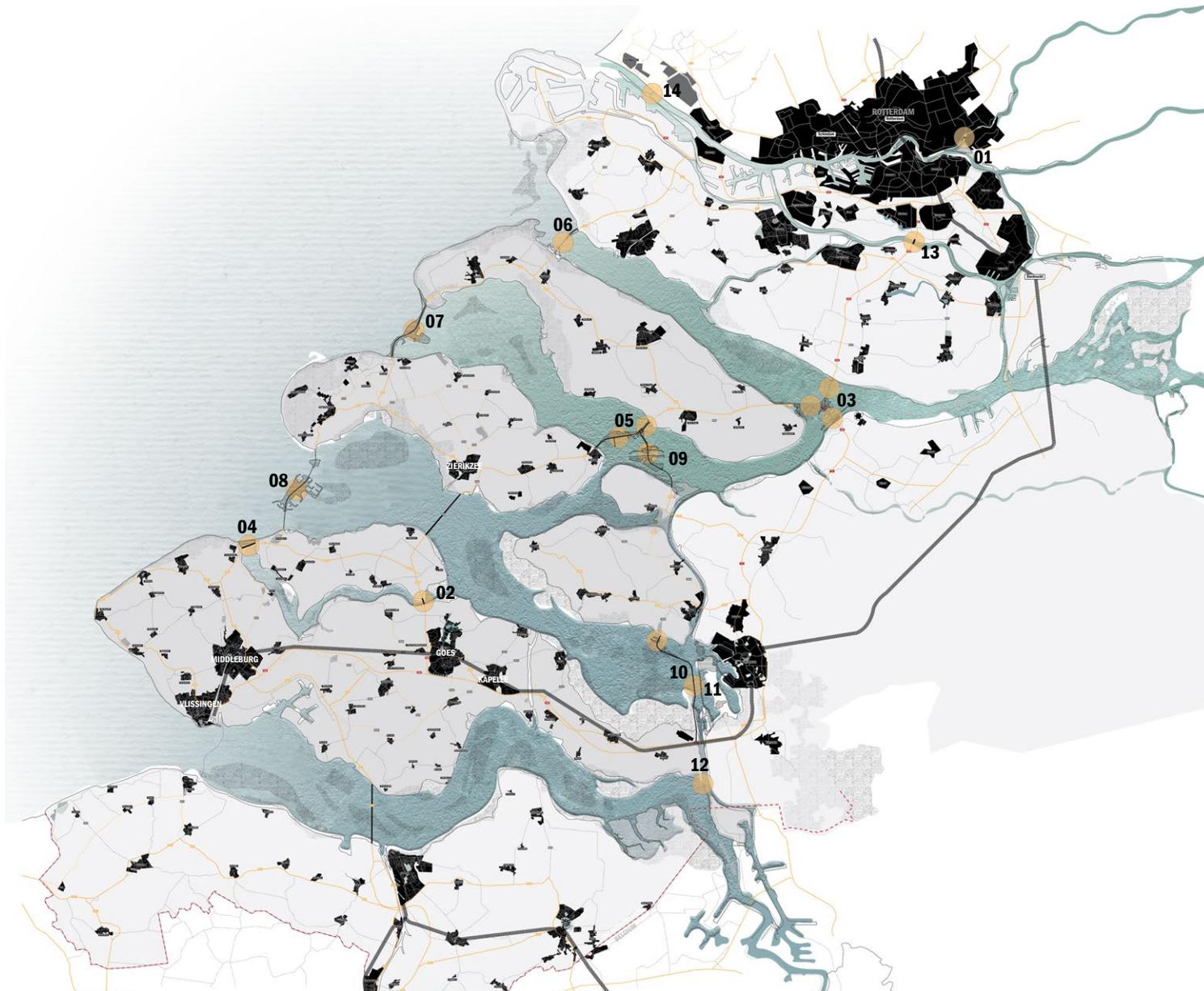
1958 Gravelingendam



1956 Haringvlietdam



1963 Brouwersdam



1967 Oosterscheldekering



1976 Philipsdam



1979 Oosterdam



1980 MARKIEZAATSKADE



1980 Bathse Spuisluis



1991 Hartelkering

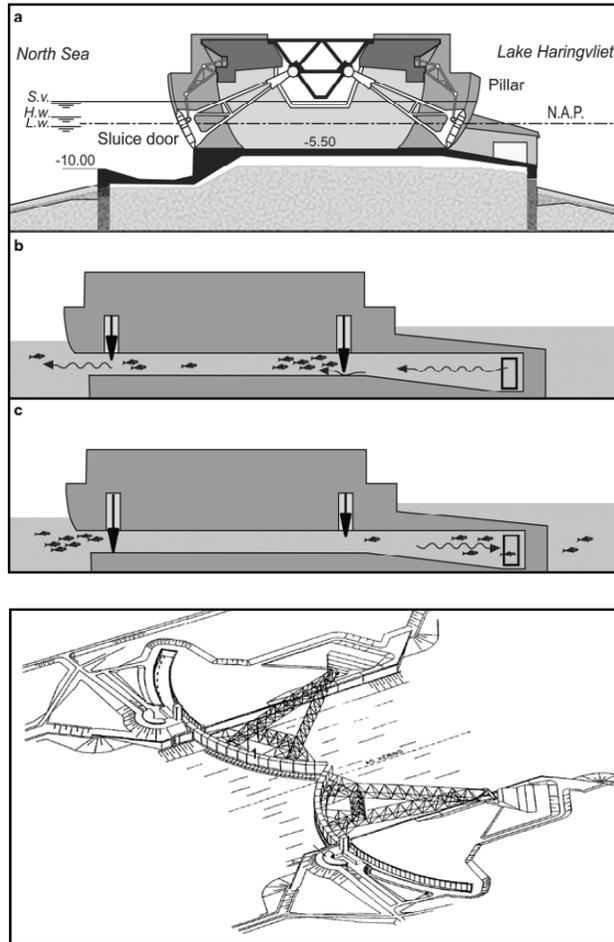
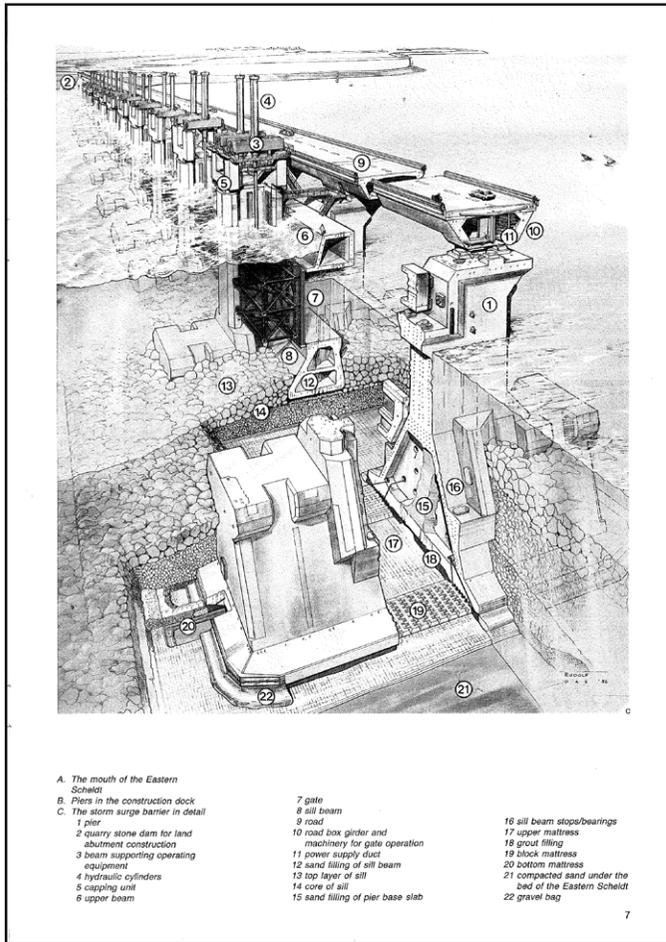


1991 Maeslantkering



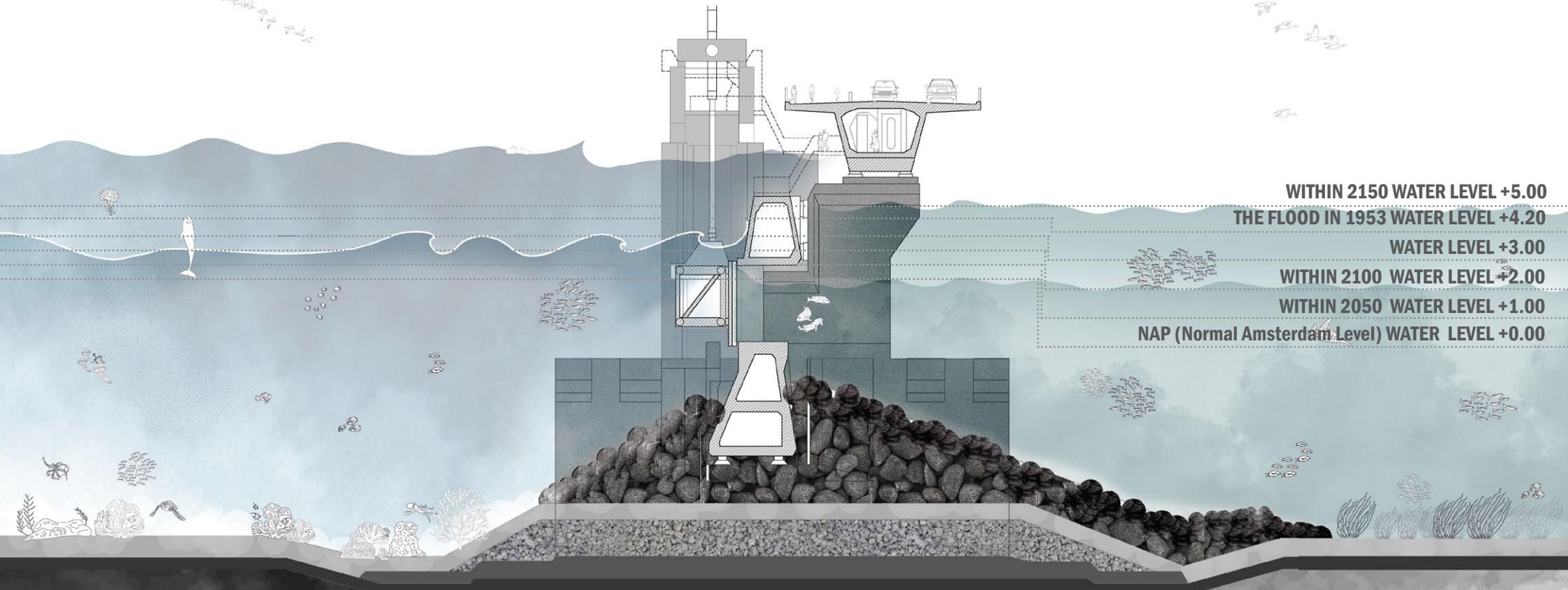
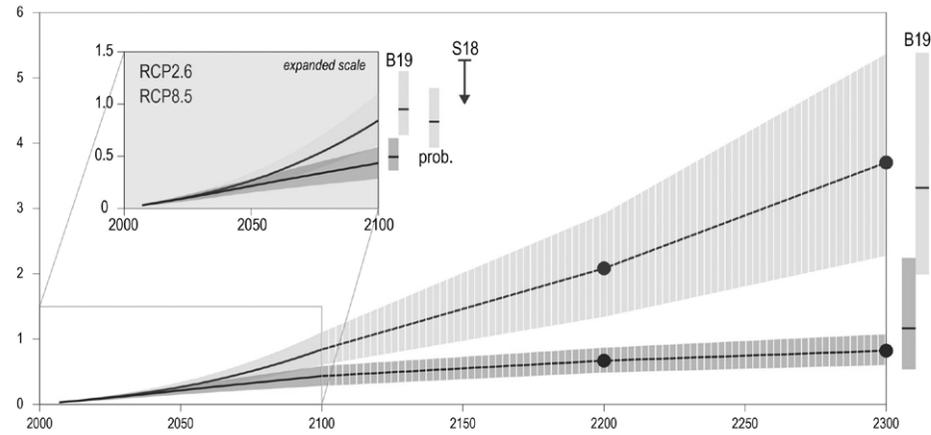
THE DELTA WORKS

Environmental concern and the design of the barriers



Movable door gate for the fish migration and the water passage

IPCC REPORT: SEA LEVEL RISE

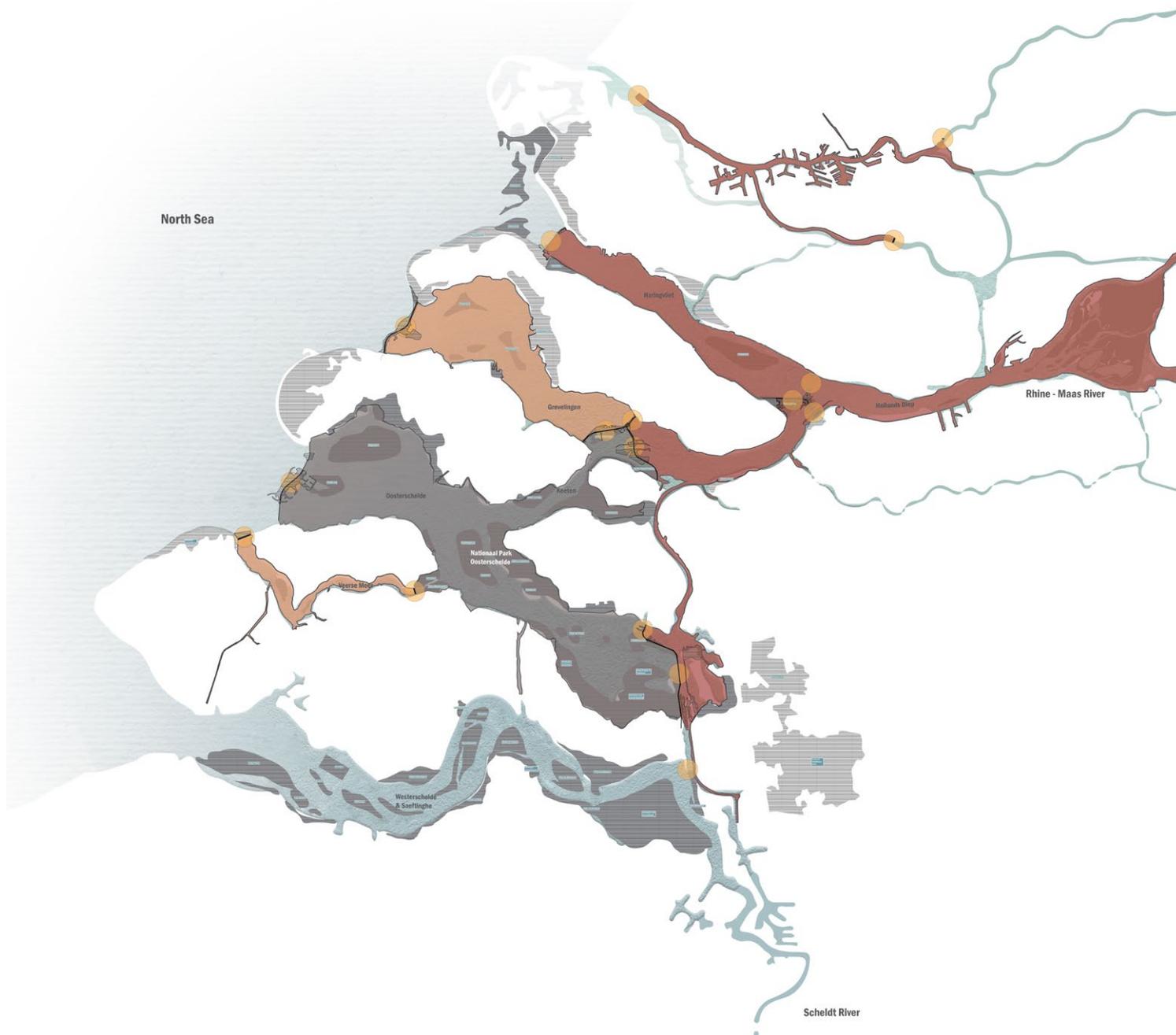


WITHIN 2150 WATER LEVEL +5.00
THE FLOOD IN 1953 WATER LEVEL +4.20
WATER LEVEL +3.00
WITHIN 2100 WATER LEVEL +2.00
WITHIN 2050 WATER LEVEL +1.00
NAP (Normal Amsterdam Level) WATER LEVEL +0.00

Future flood prone level in relation with Oosterscheldekering

THE PERMANENT CLOSURE OF ESTUARIES

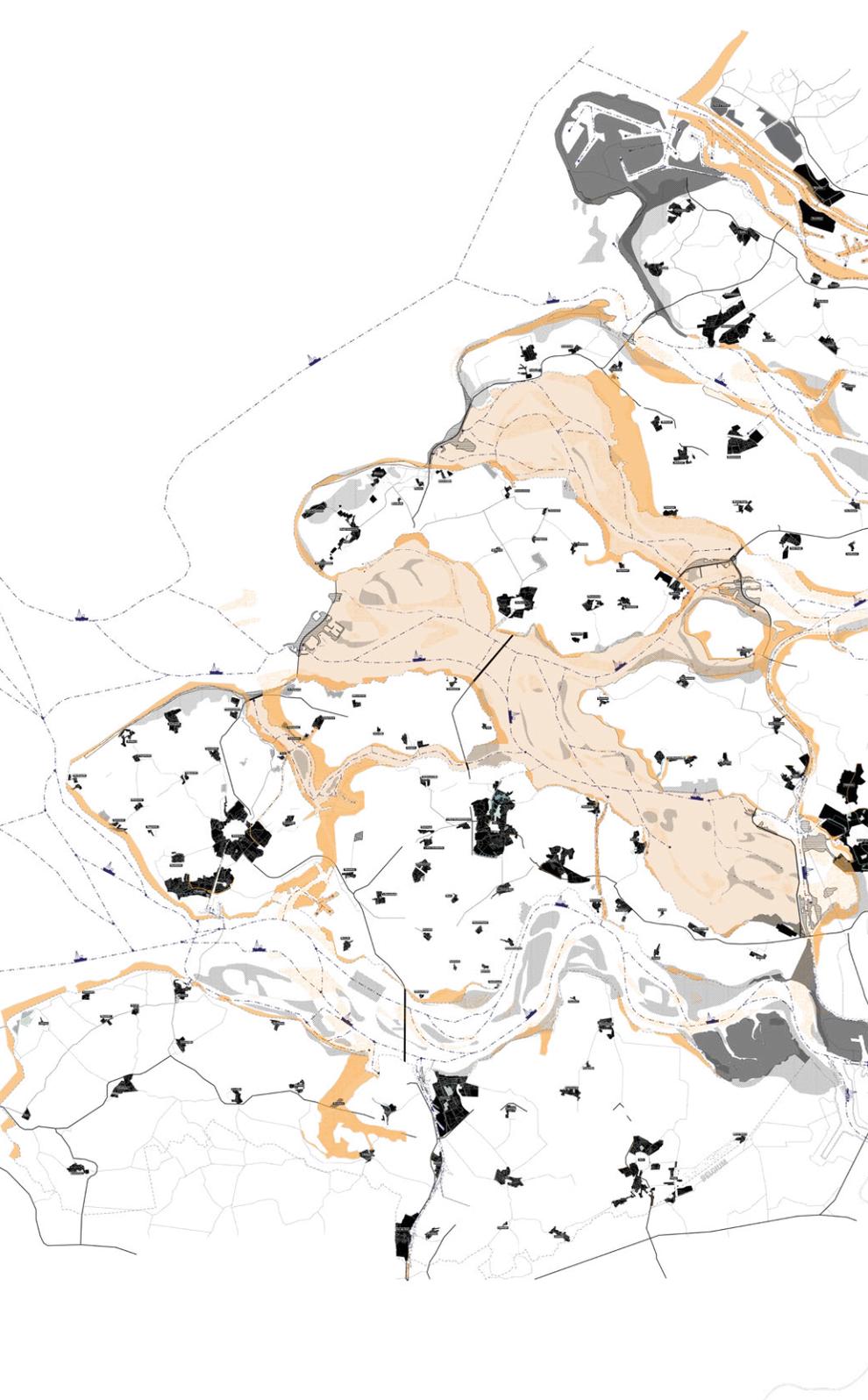
THE END OF ECOLOGICAL LIFE CYCLE



ZEELAND | COASTAL REGIONS

An estuary is an area where a freshwater river meets the ocean, resulting in brackish water.

- Productive ecosystems, Seagrass meadows
- Breeding areas
- Nursery grounds for a wide variety of organisms
- Passages for fish migration.
- Provides food and occupation for human, such as Fisheries.



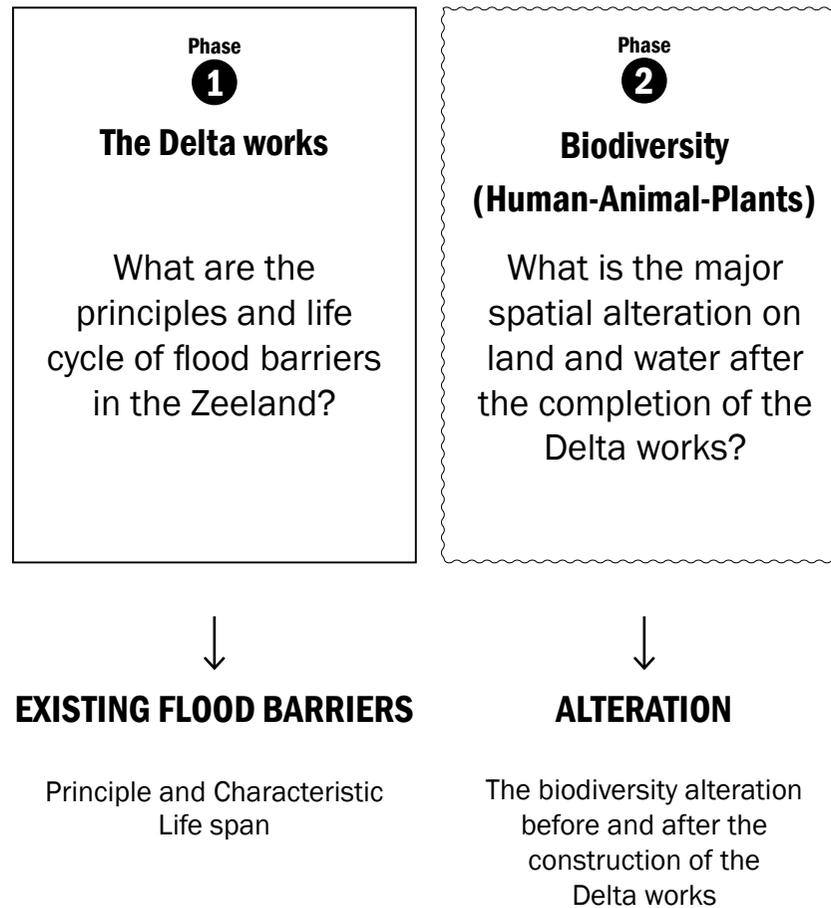
CONTENT

- 01 THE RESEARCH METHODOLOGY**
 - RESEARCH CONCLUSION
 - FROM RESEARCH TO DESIGN
- 02 MULTIFUNCTIONALITY**
 - URBAN SCALE
 - ARCHITECTURE SCALE
- 03 HYBRIDITY**
 - EXTREME CLIMATE
 - STRUCTURAL STABILIZATION
 - WIND SIMULATION
- 04 FUTURE ADAPTATION**

THE RESERACH METHODOLOGY

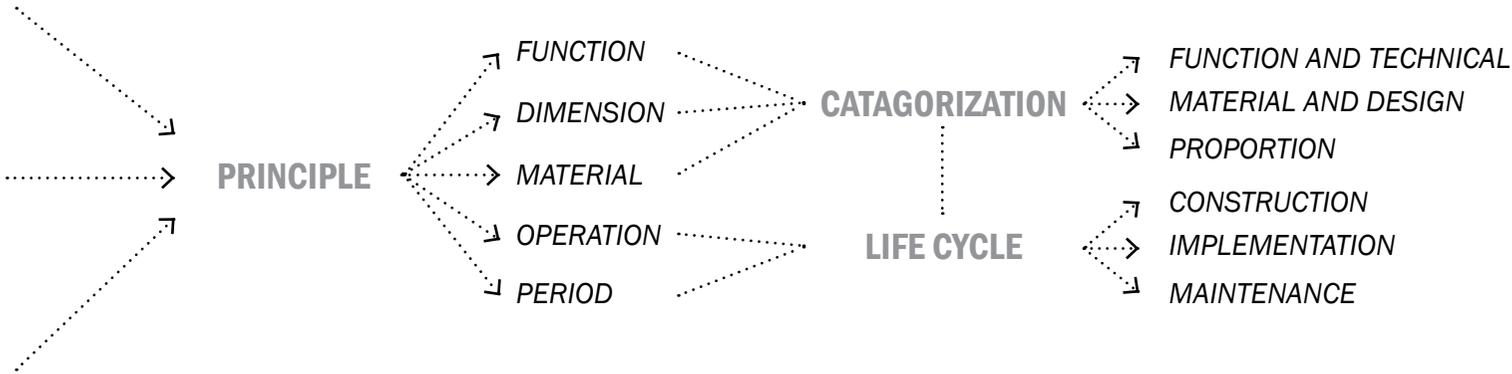
Main research questions

What flood barriers typology offers the greatest biodiversity potential for future spatial adaptation?

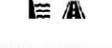
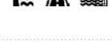


PHASE 1: THE PRINCIPLE OF THE DELTA WORKS

Literature



PRINCIPLE

	NAME	FUNCTION	SIZE/FORM	MATERIAL (APPEARANCE)	NEW MATERIAL (POSSIBILITY)	PASSAGE	NEW FUNCTION (POSSIBILITY)	LIFE CYCLE (CONSTRUCTION/IMPLEMENTATION/MAINTENANCE)	DURING MAINTENANCE
01	ALGERAKERING								1 YEAR
02	ZANDKREEKEDAM								
03	VOLKERAKWERKEN								1 YEAR
04	VEERSEGATDAM								
05	GREVELINGENDAM								1 YEAR
06	HARINGVLIETDAM								1.4 YEAR RESEARCH 1 YEAR
07	BROUWERSDAM								1 YEAR
08	OOSTERSHIELDKERING								3-6 YEAR
09	PHILIPSDAM								2 YEAR
10	OESTERDAM								1 YEAR
11	MARKIEZAATSKADE								
12	BATHSESPUISLUIS								1 YEAR
13	HARTELKERING								
14	MAESLANTKERING								

SYMBOL





FUNCTION

CONSTRUCTION MATERIAL

NEW FUNCTION (BASE ON NEW AND OLD MATERIAL)

CATAGORIZATION

FUNCTION AND TECHNICAL

BY ENGINEER

	01	02	03	04	05	06	07	08	09	10	11	12	13	14
CLOSURE DAM		ZANDKREEK DAM		VEERSEGATDAM	GREVELINGEN DAM		BROUWERSDAM			OESTERDAM		BATHSE SPUISLUIS		
LOCKS (SHIPPING)			VOLKERAK WERKEN				HARINGVLIET DAM		PHILIPSDAM		MARKIEZAATS KADE			
STORM SURGE BARRIERS	ALGERAKERING							OOSTERSCHELDE KERING				HARTELKERING	MAESLANT KERING	

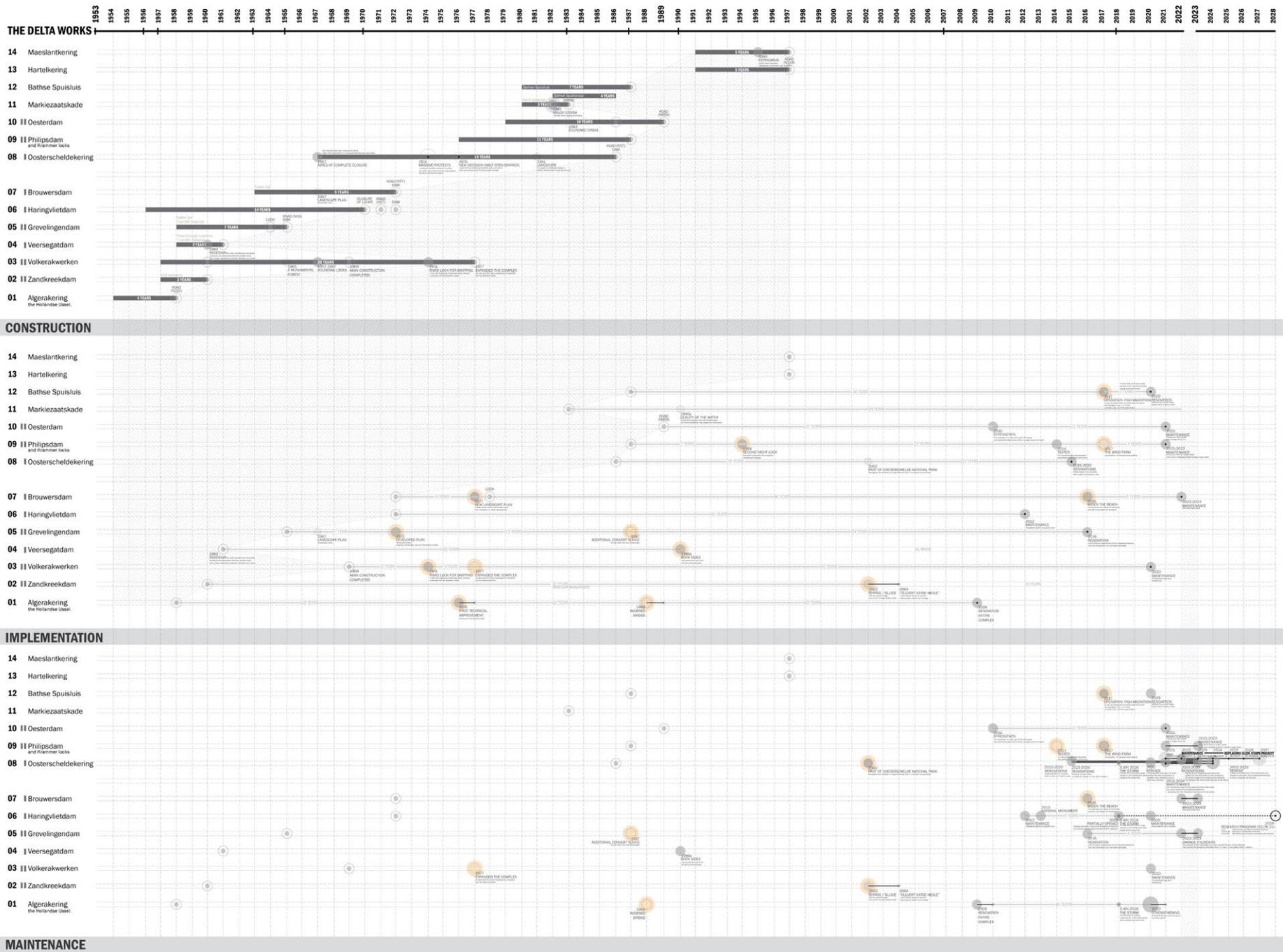
MATERIAL AND DESIGN

	01	02	03	04	05	06	07	08	09	10	11	12	13	14
LANDSCAPE LANDFILL MATERIAL SAND / PLANTS		ZANDKREEK DAM		VEERSEGATDAM	GREVELINGEN DAM		BROUWERSDAM			OESTERDAM		BATHSE SPUISLUIS		
MIXED			VOLKERAK WERKEN						PHILIPSDAM		MARKIEZAATS KADE			
MONUMENTAL CONCRETE - STEEL	ALGERAKERING						HARINGVLIET DAM	OOSTERSCHELDE KERING				HARTELKERING	MAESLANT KERING	

PROPORTION

	01	02	03	04	05	06	07	08	09	10	11	12	13	14
S FROM 200 to 830 m	ALGERAKERING	ZANDKREEK DAM											HARTELKERING	MAESLANT KERING
M FROM 2.8 to 5 km.			VOLKERAK WERKEN	VEERSEGATDAM			HARINGVLIET DAM				MARKIEZAATS KADE			
L FROM 6 to 10.5 km.					GREVELINGEN DAM		BROUWERSDAM	OOSTERSCHELDE KERING	PHILIPSDAM	OESTERDAM		BATHSE SPUISLUIS		

LIFE CYCLE



CONCLUSION OF PHASE 1

MAINTENANCE
 APPROXIMATELY **42.5 YEARS** THAT
 THE FLOOD BARRIERS REQUIRED
 A CONSIDERABLE MAINTENANCE.



OOSTERSCHELDEKERING

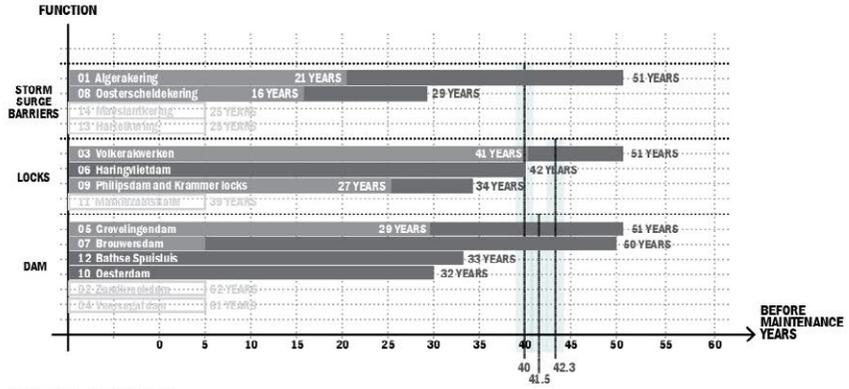
NEED MAJOR MAINTENANCE
 every 29 years



SITE SELECTION

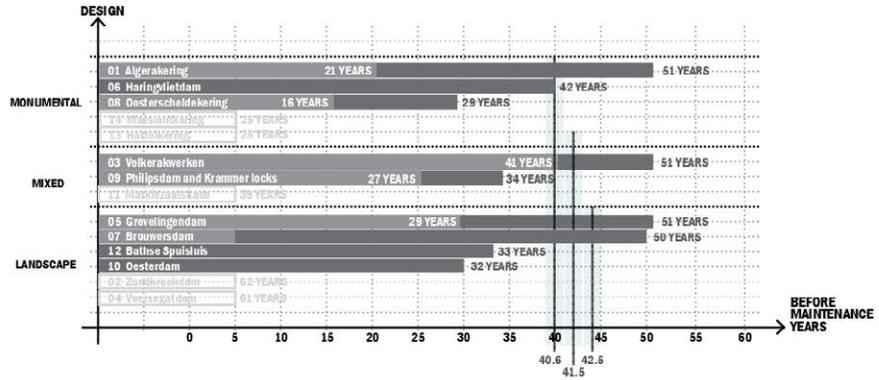
FUNCTION AND TECHNICAL

THE GRAPH INDICATED THE PERIOD OF TIME THAT THE BARRIERS REQUIRED A MAJOR MAINTENANCE AFTER THE COMPLETION.
 ALL CATEGORIES ILLUSTRATED SIMILAR AVERAGE OF THE TIME: **AROUND 40, 41.5, AND 42.30**



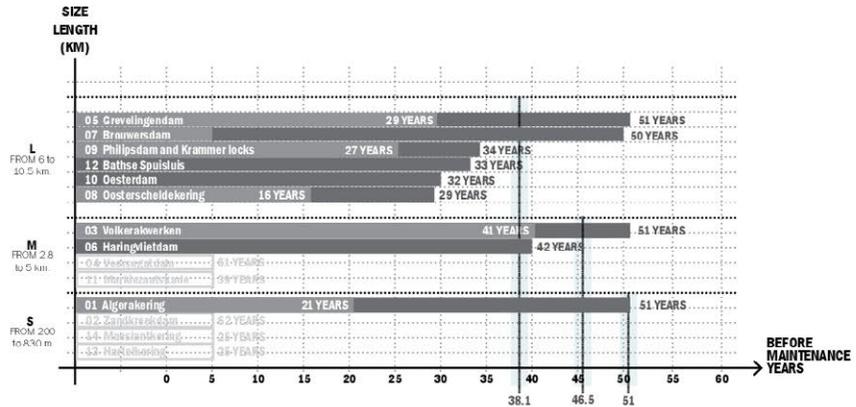
MATERIAL AND DESIGN

THE GRAPH INDICATED THE PERIOD OF TIME THAT THE BARRIERS REQUIRED A MAJOR MAINTENANCE AFTER THE COMPLETION.
 ALL CATEGORIES ILLUSTRATED SIMILAR AVERAGE OF THE TIME: **AROUND 40.6, 40.6, AND 42.5**



PROPORTION

THE GRAPH INDICATED THE PERIOD OF TIME THAT THE BARRIERS REQUIRED A MAJOR MAINTENANCE AFTER THE COMPLETION.
 THE LEAST AMOUNT OF TIME: **L SCALE** (APPROXIMATELY 38.1 YEARS)
 THE MOST AMOUNT OF TIME: **S SCALE** (APPROXIMATELY 51 YEARS)



PHASE 2: THE ALTERATION OF BIODIVERSITY

Historical Mapping



archieven.nl



Zeeuws Archief



vaarweginformatie.nl

**Before
(1910-1923)**



**After
(2022)**



CONTEXT

LAND

*Geographical (land)
Transportation
Cities*

WATER

*Water transition
Maritime route
Fish migration
Vegetations*

THE DISAPPEARANCE OF...

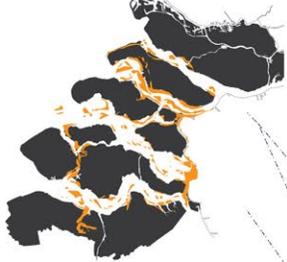
1

THE BOUNDARY OF THE LAND



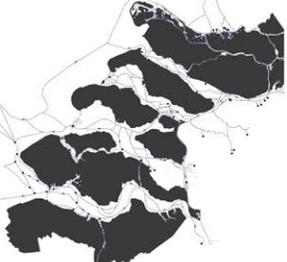
2

LOSS OF NATURAL HABITATION
LESS SEDIMENT



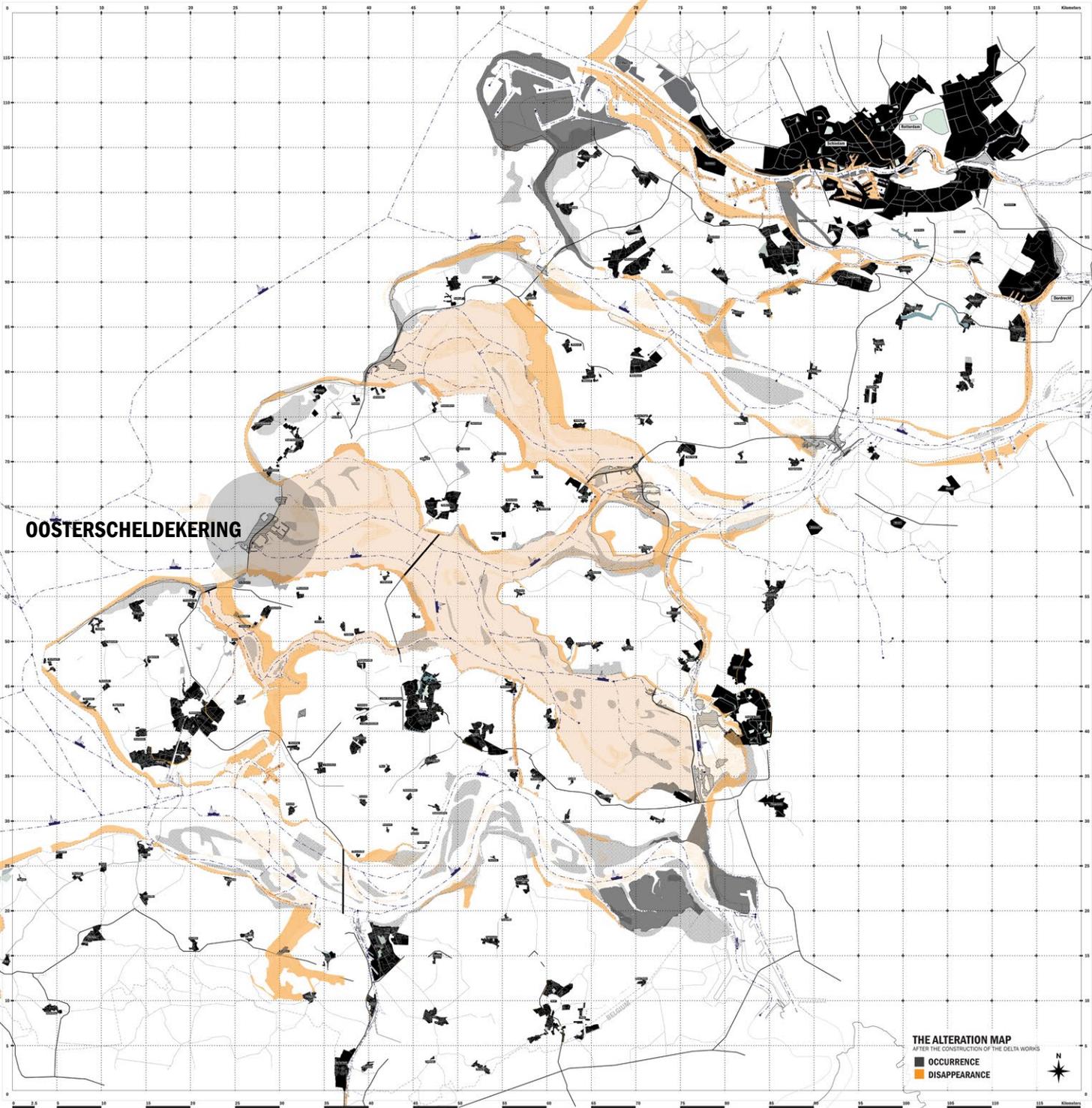
3

THE LIMITATION OF MARITIME ROUTE
TURNING POINT OF THE DOMESTIC ECONOMY
AND THE OCCURRENCE OF MONO-FUNCTION (TOURISM)



4

PERMANENTLY CLOSE THE ESTUARY AREA
LOSS OF WATER TRANSITION AREA
AND SEAGRASS MEADOW
(NURSERY HABITATS FOR ECOSYSTEM)



OOSTERSCHELDEKERING

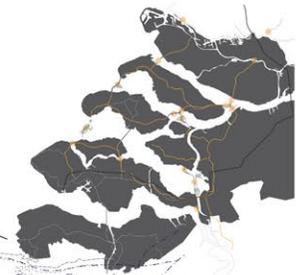
THE ALTERATION MAP
AFTER THE CONSTRUCTION OF THE DELTA WORKS
■ OCCURRENCE
■ DISAPPEARANCE



THE OCCURRENCE OF...

1

THE NEW NETWORK AND LAND ACCESSIBILITY
THE CONSTRUCTION OF DELTA WORKS



2

THE NEW ROAD BASED ON AGRICULTURE GRID SYSTEM



3

THE NEW NATURAL HABITATION



4

THE CITIES EXPANSION
THE GROWTH MAINLY OCCURRED IN THE AREA THAT
DIRECTLY CONNECT TO THE MAINLAND



RESULTS

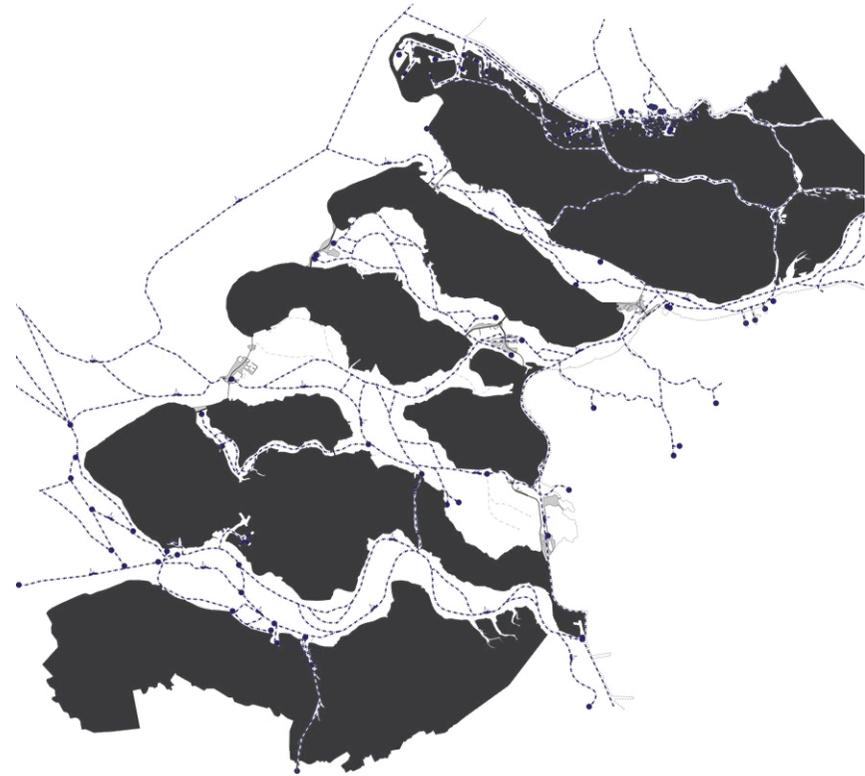
THE OCCURANCE OF...

- 2** **MORE THAN DAM**
THE NEW NETWORK AND LAND ACCESSIBILITY
The multi-function of the flood-barriers



THE DISAPPEARANCE OF...

- 3** **THE LIMITATION OF MARITIME ROUTE**
*TURNING POINT OF THE DOMESTIC
ECONOMY AND THE OCCURANCE OF
MONO-FUNCTION (TOURISM)*



Accessibility alteration

“DAM NEVER ONLY JUST A DAM ”

It always combined with other function such as infrastructure.



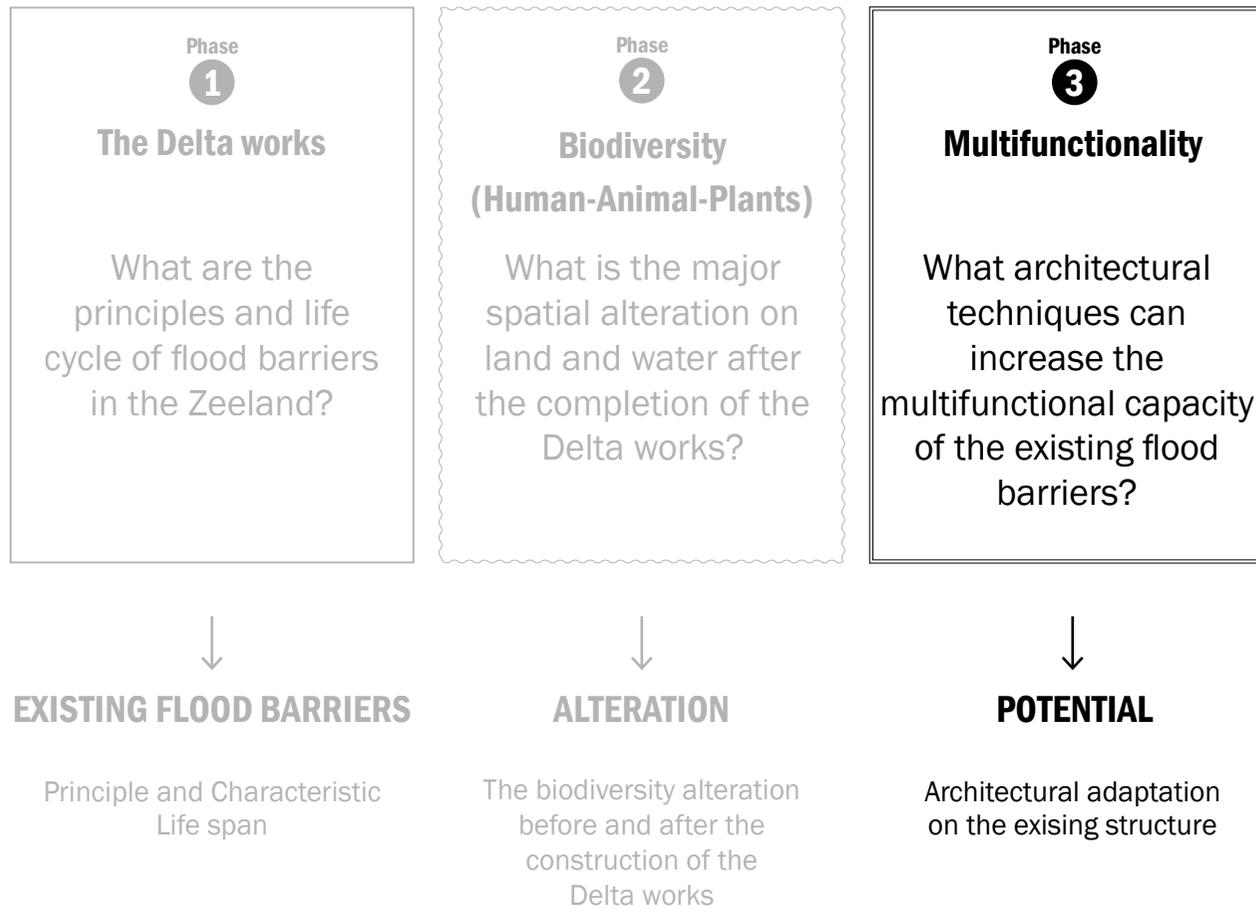
Multifunctionality



**“How to maximize the potential of multifunctionality of
the existing flood barriers on every scale?”**

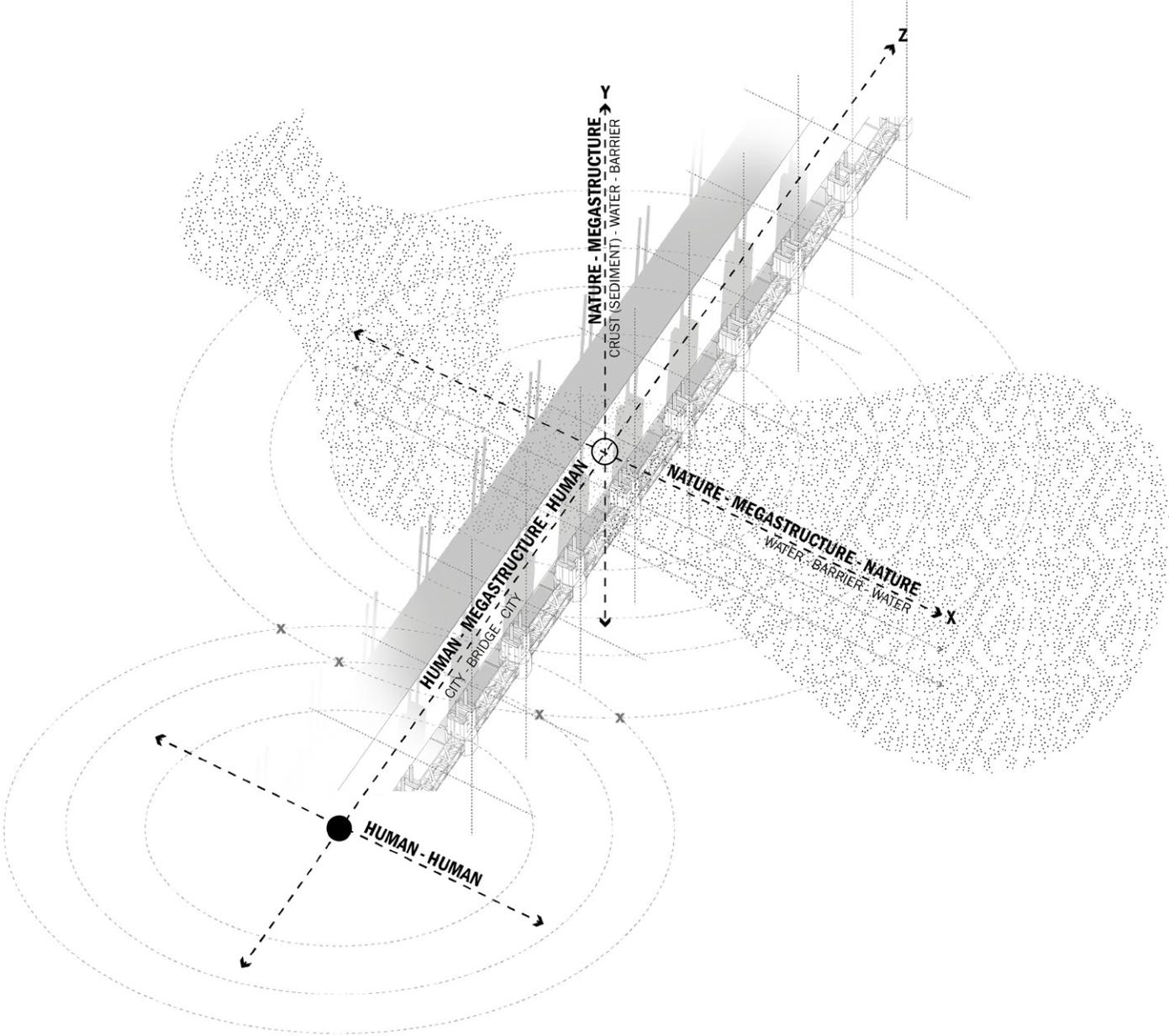
*In order to explore how this potential can help with the future adaptation, Sea level rise
and at the same time support the local economy and ecology of Zeeland.*

THE METHODOLOGY



MULTIFUNCTIONALITY

ON EVERY SCALE FROM URBAN, ARCHITECTURE AND DETAIL SCALE



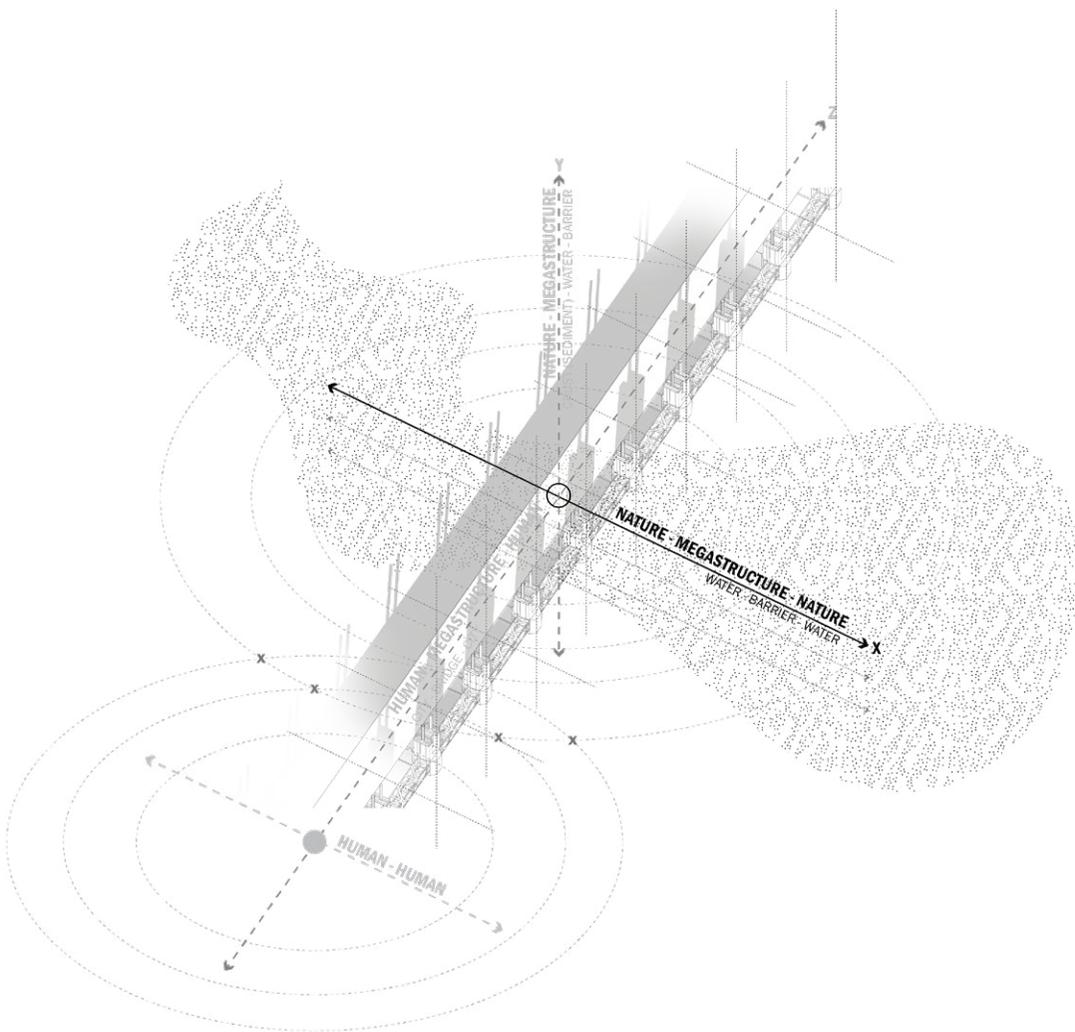
X AXIS
Water Passage

Z AXIS
Land connectivity and surrounding

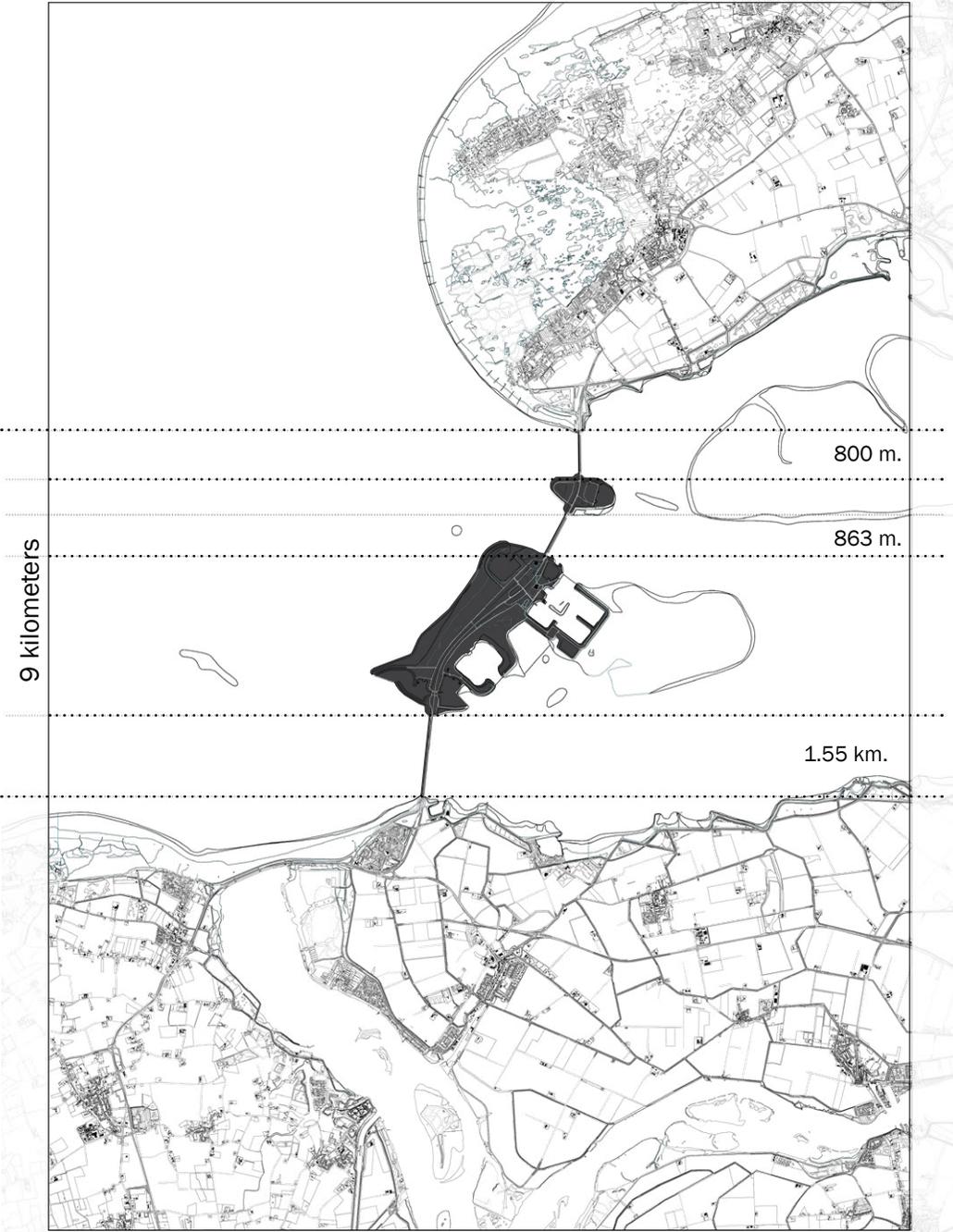
Y AXIS
Experimental ground of the existing structure and new architecture

URBAN SCALE

X AXIS - WATER PASSAGE



OOSTERSCHELDEKERING

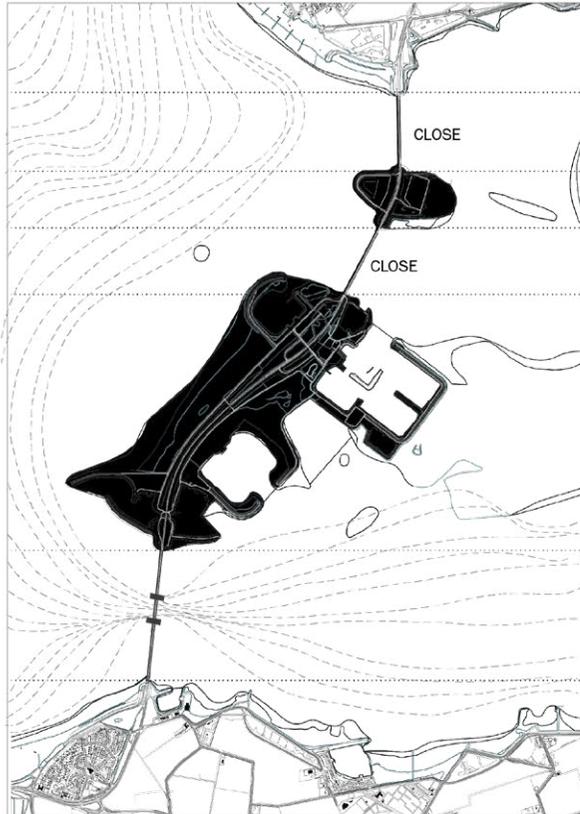


- 1 HAMMEN** 16 Pillars
15 Gates Operating every 5 gates Gates
- A ISLAND 01**
- 2 SCHAAR** 17 Pillars
16 Gates Operating every 4 gates Gates
- B ISLAND 02**
- 3 ROOMPOT** 33 Pillars
32 Gates Operating every 3-4 gates Gates

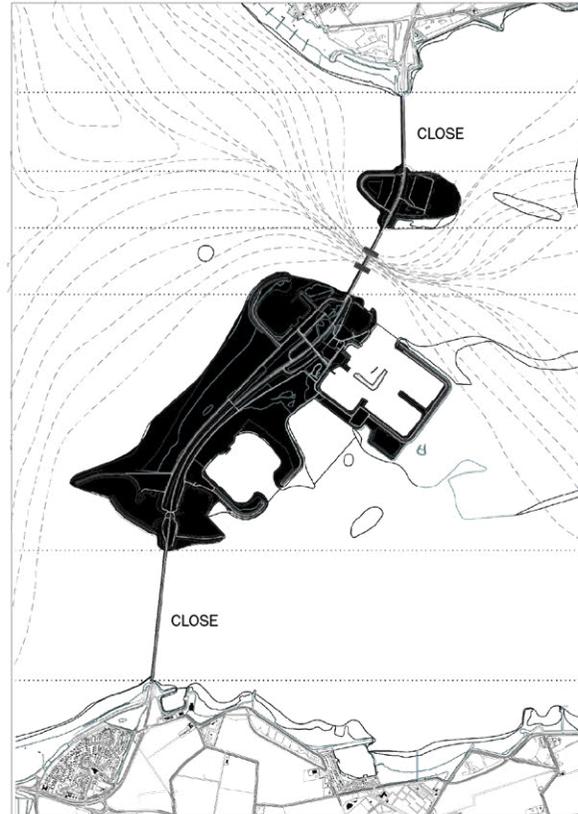
OPEN GATE FOR FISH MIGRATION

X AXIS - WATER PASSAGE

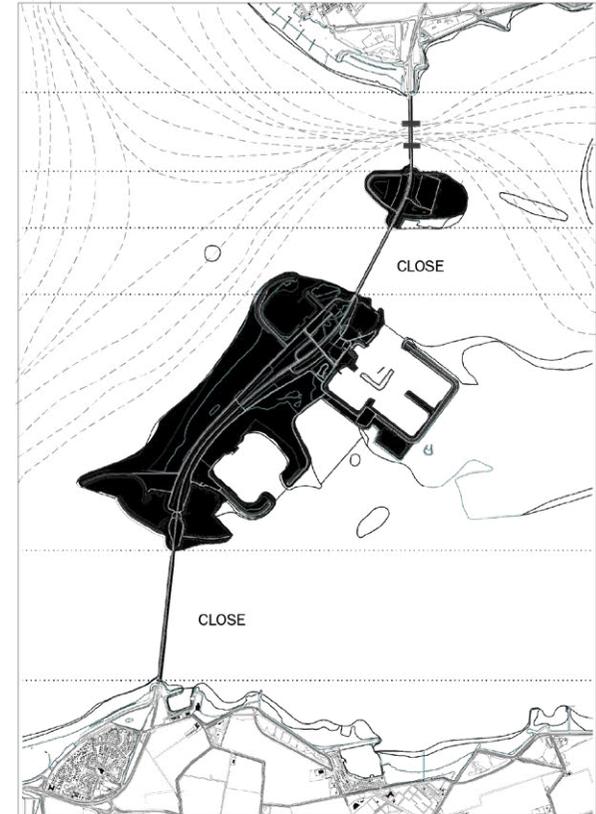
FUTURE POSSIBILITY OF OOSTERSCHLDEKERING ROLE CHANGING DUE TO RISING SEA LEVEL FROM MOVABLE GATE TO PERMANENT DAM IN ORDER TO MAINTAIN ECOLOGICAL, ECONOMICAL AND SEA LEVEL RISE FACTOR, AT LEAST ONE PART OF THE FLOOD BARRIER REQUIRED OPEN GATE.



HAMMEN

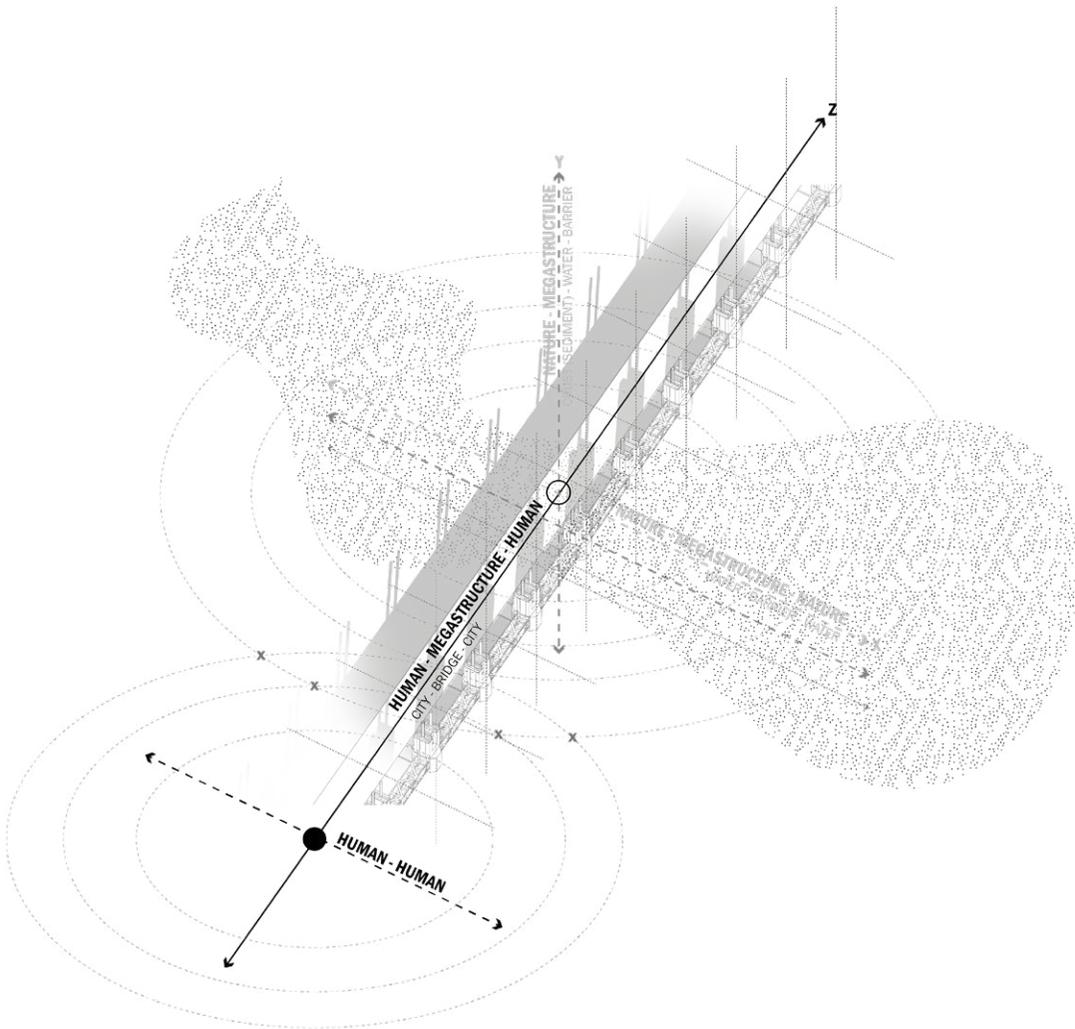


SCHAAR



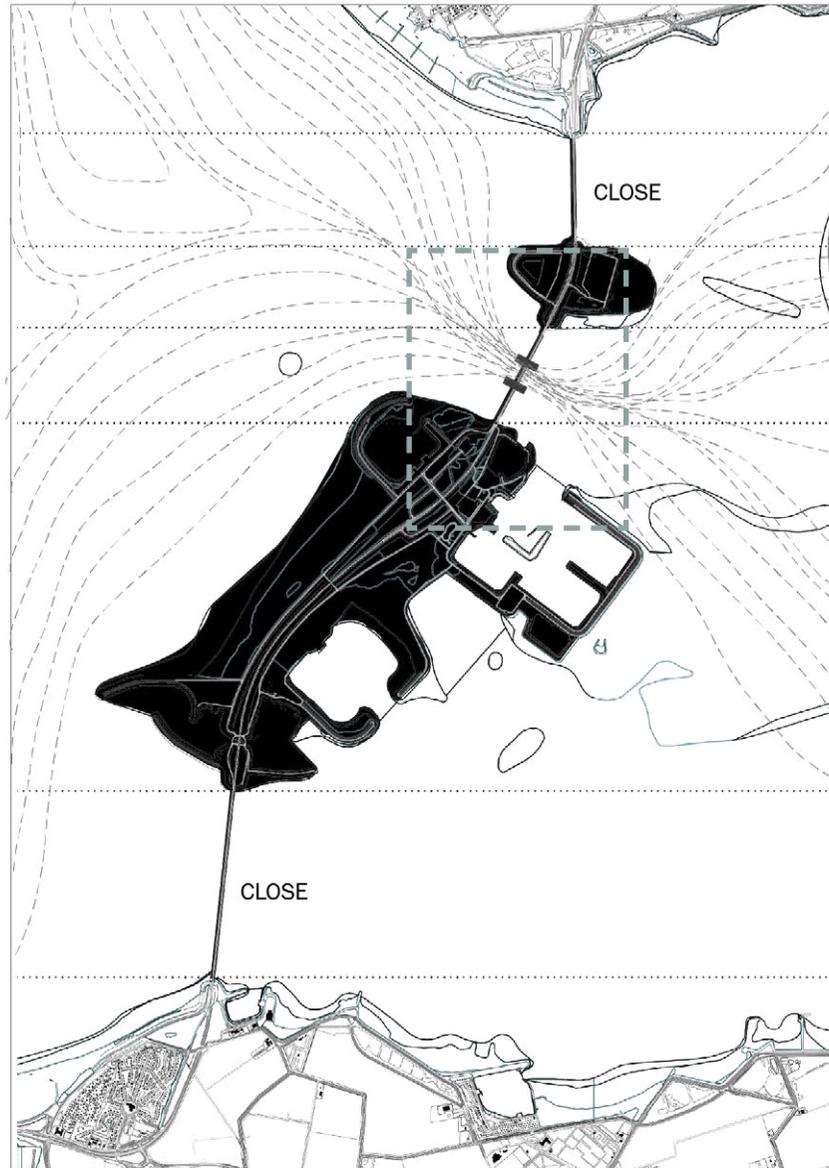
ROOMPOT

URBAN SCALE
Z AXIS - LAND CONNECTIVITIES



URBAN SCALE

Z AXIS - LAND CONNECTIVITIES



URBAN SCALE

Z AXIS - LAND CONNECTIVITIES

SITE

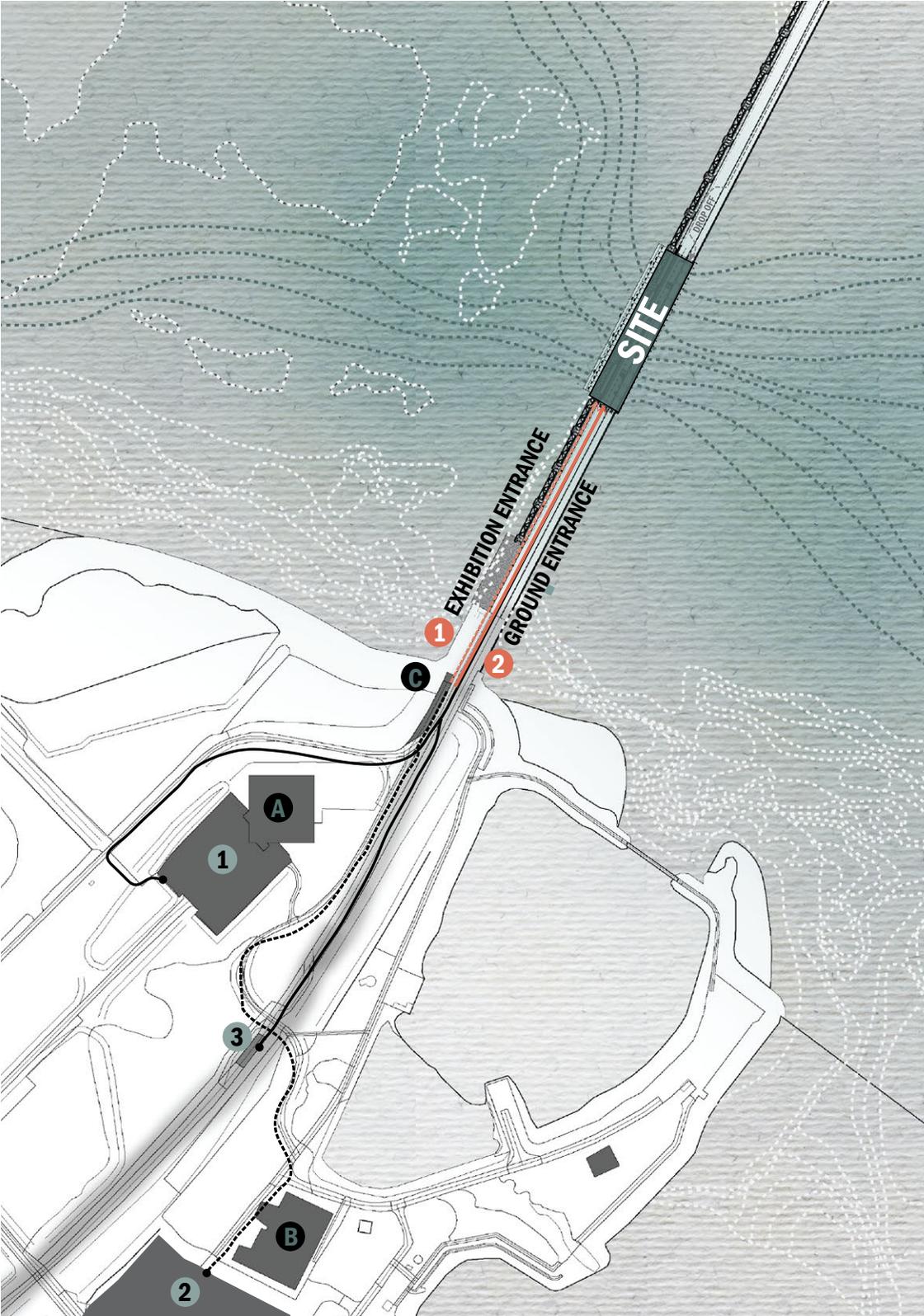
OOSTERSCHELDEKERING MUSEUM

TOPSHUIS
PARKING LOTS 01

BUS STOP

DELTAPARK NEELTJE JANS
(AMUSEMENT PARK)
PARKING LOTS 02





ACCESSIBILITY

Z AXIS - LAND CONNECTIVITY

EXHIBITION ROUTE

- A** TOPSHUIS'S PERMANENT EXHIBITION
- B** DELTAPARK NEELTJE JANS GUIDED TOUR OF EASTERN SCHELDT STORM SURGE BARRIER
- C** OOSTERSCHELDEKERING MUSEUM

ACCESSIBILITY ALTERNATIVE ROUTE

- 1** TOPSHUIS'S PARKING LOTS
- 2** NEELTJE JANS'S PARKING LOTS
- 3** BUS STOP

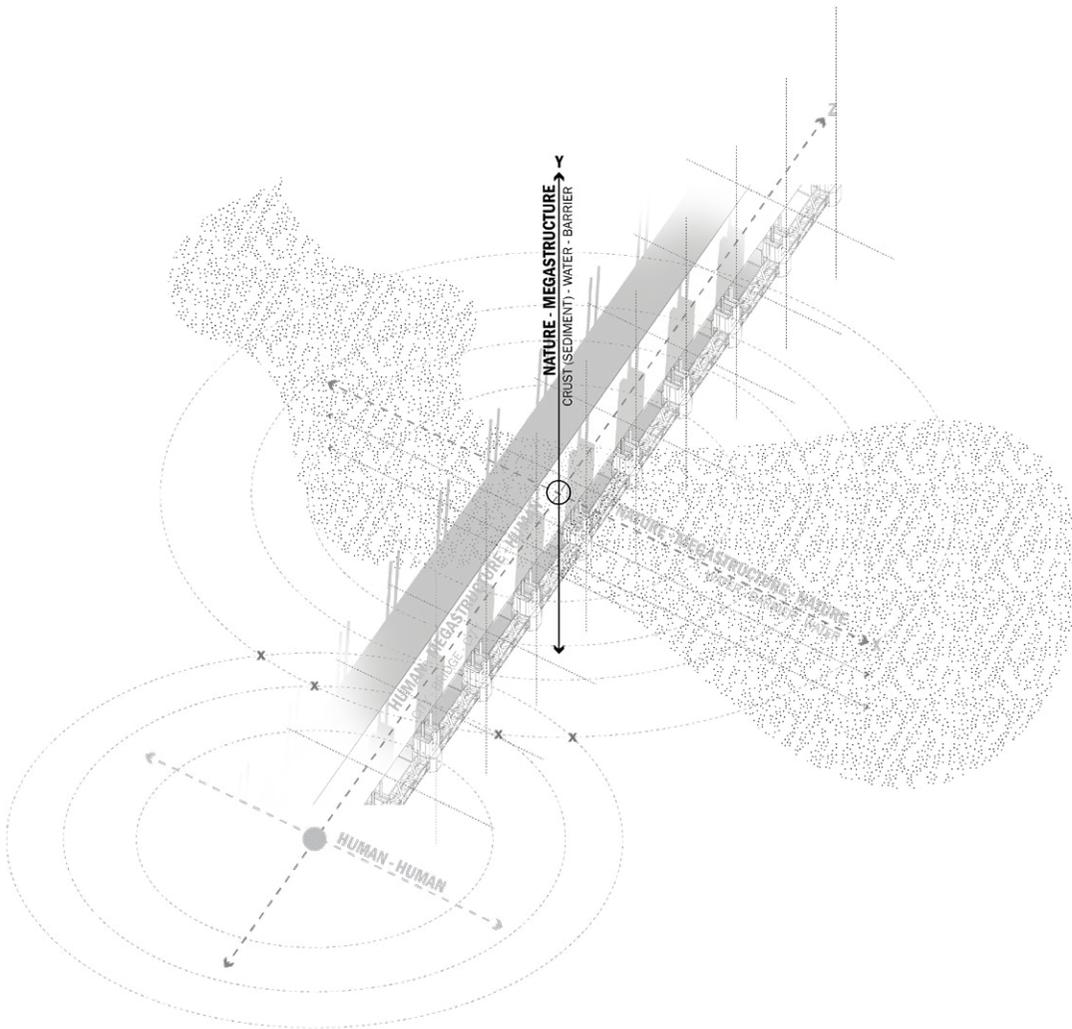


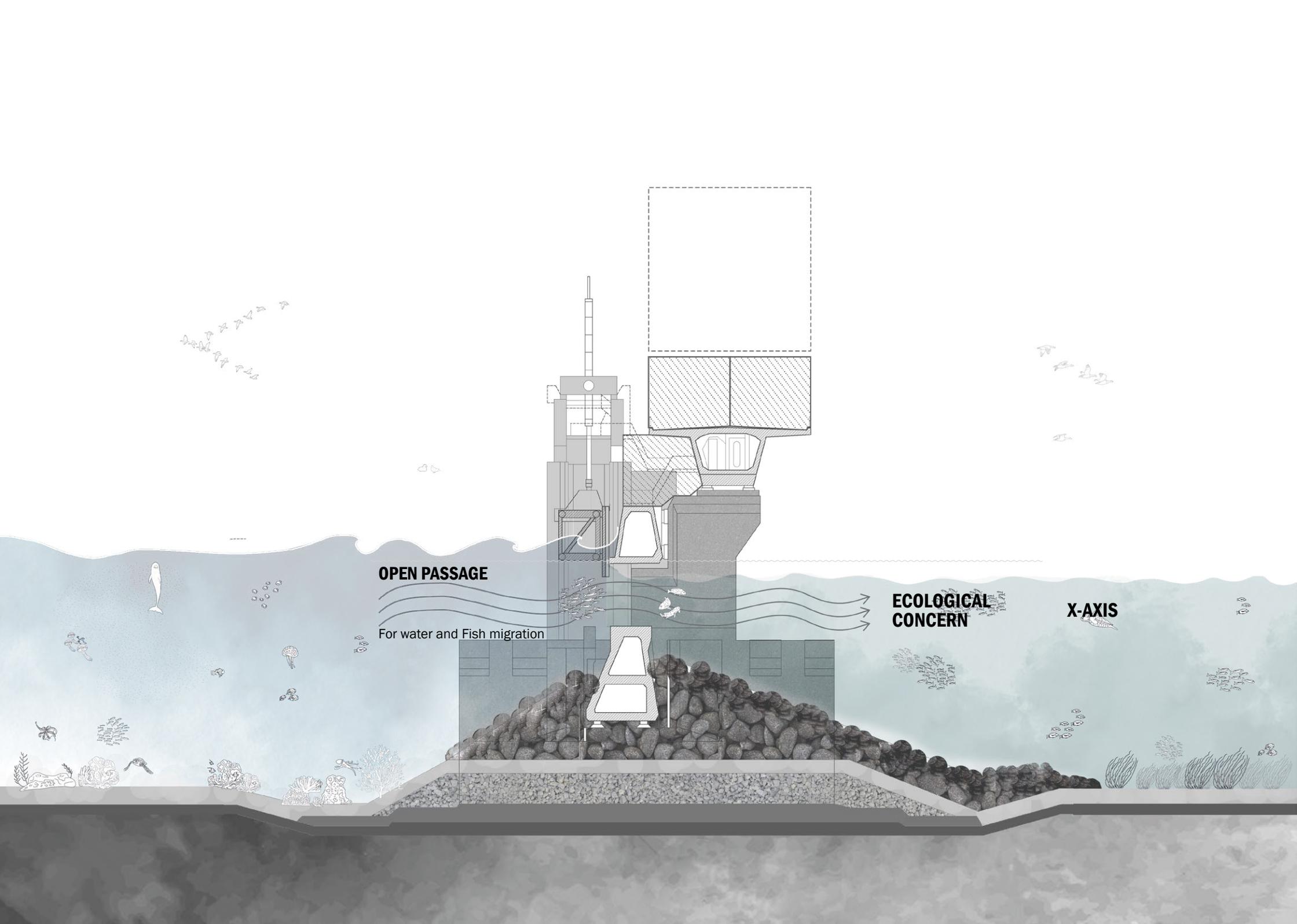
2 LEVEL OF THE ENTRANCE

- 1** GROUND FLOOR
- 2** UNDER HIGHWAY LEVEL

ARCHITECTURE SCALE

Y AXIS - EXISTING STRUCTURE AS A FOUNDATION



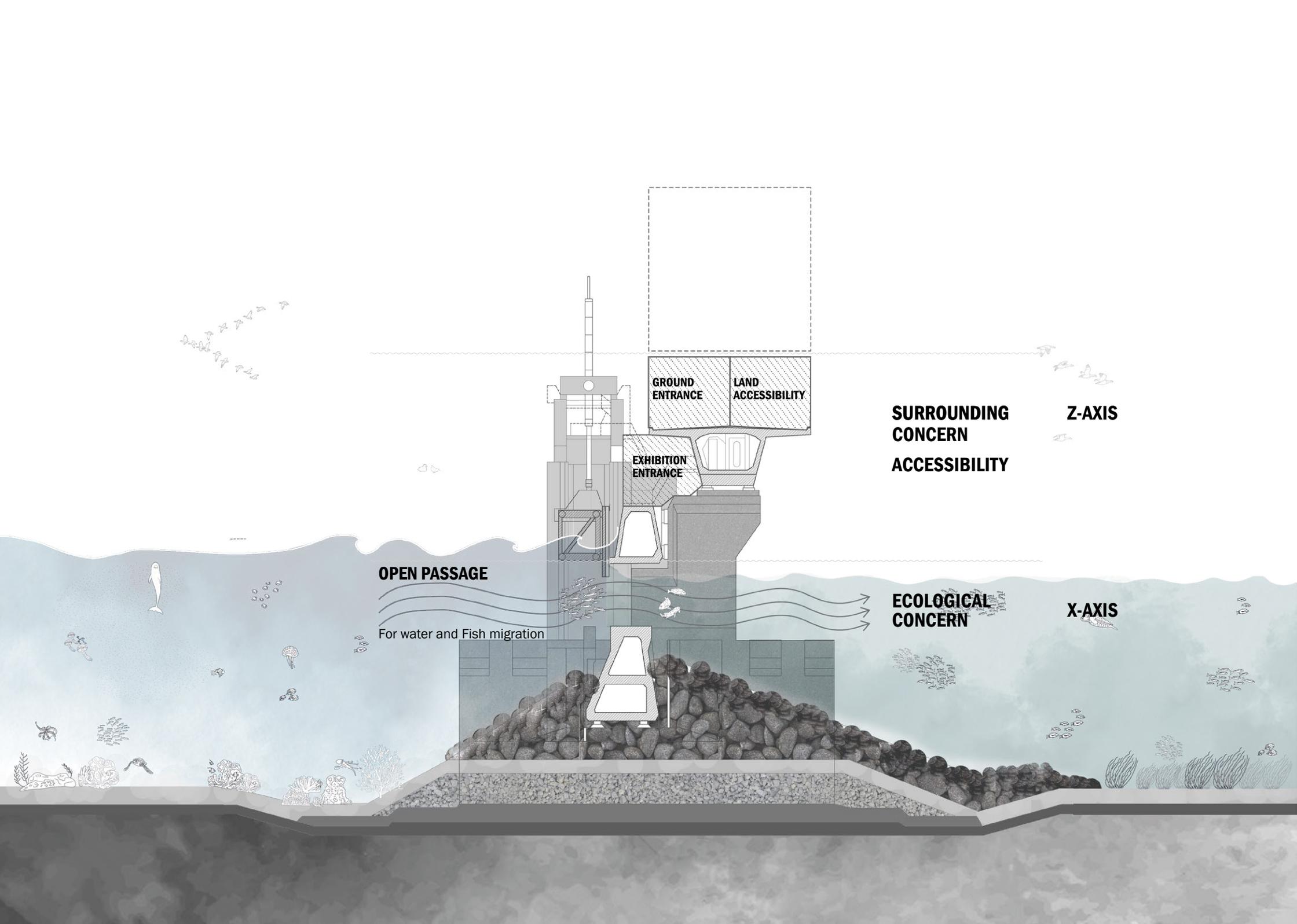


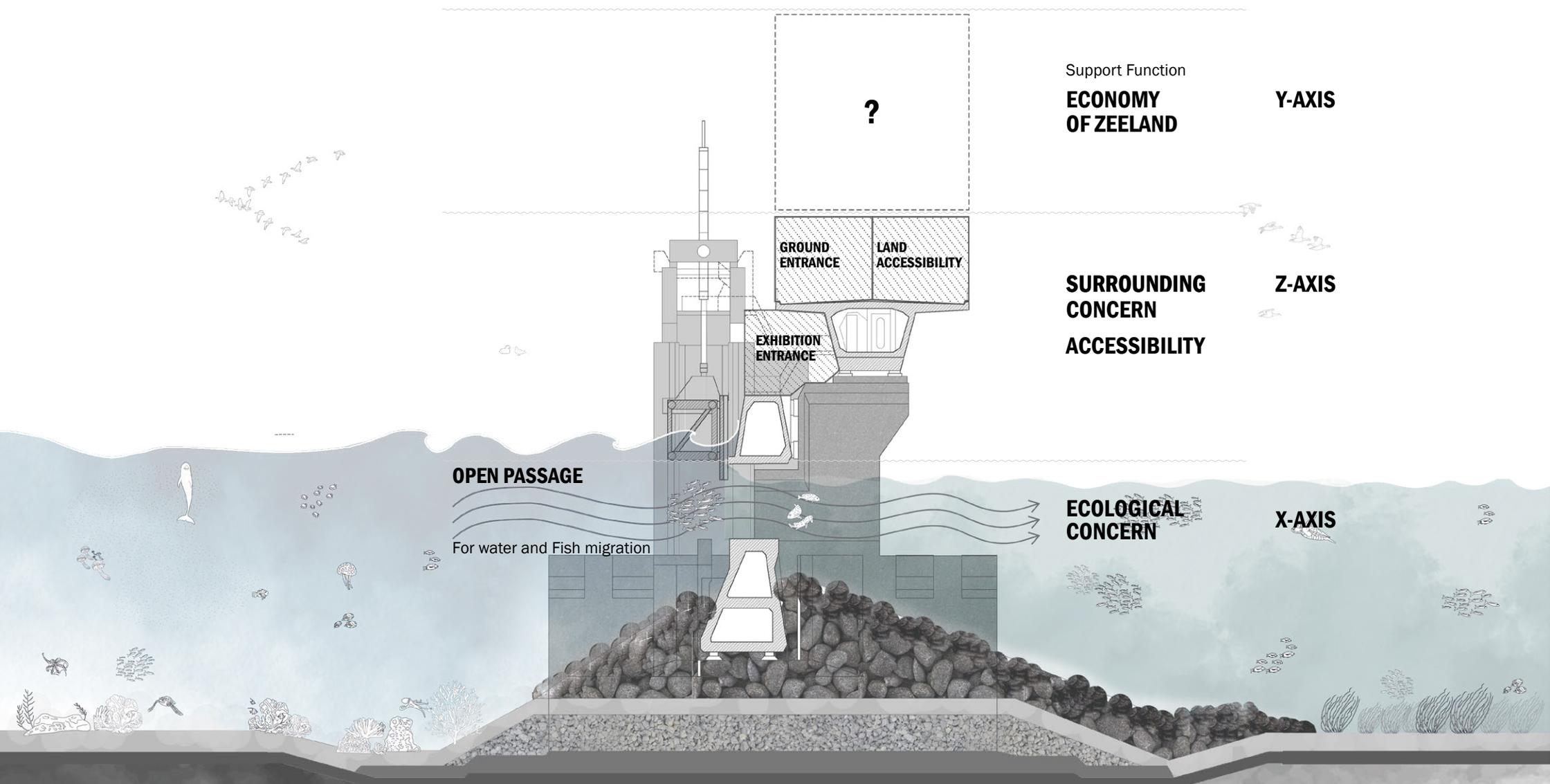
OPEN PASSAGE

For water and Fish migration

ECOLOGICAL CONCERN

X-AXIS





?

Support Function
**ECONOMY
OF ZEELAND**

Y-AXIS

**GROUND
ENTRANCE**

**LAND
ACCESSIBILITY**

**SURROUNDING
CONCERN
ACCESSIBILITY**

Z-AXIS

**EXHIBITION
ENTRANCE**

OPEN PASSAGE

For water and Fish migration

**ECOLOGICAL
CONCERN**

X-AXIS

FUNCTION

ZEELAND ECONOMICAL DEVELOPMENT DOMESTIC ECONOMY



THE INTERGRATION OF ZEELAND IDENTITY THROUGH TIME



- BEFORE THE DELTA WORKS**> **FISHERIES / AQUACULTURE**
COASTAL IDENTITY
- AFTER THE DELTA WORKS**> **RECREATIONAL ACTIVITIES**
- PRESENT TIME**> **HOLIDAY HOUSE**



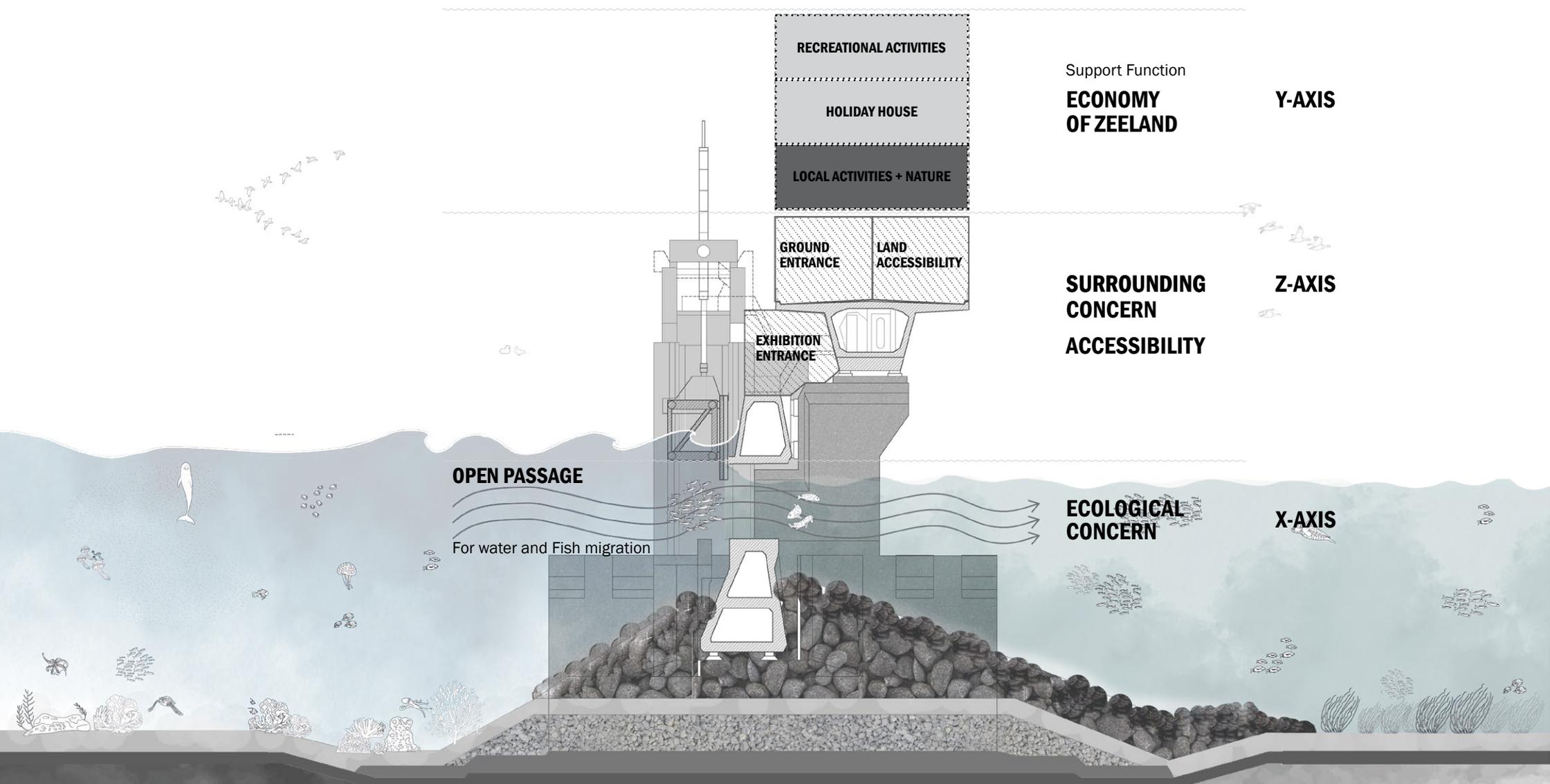
Harbor in Bruinisse, Zeeland



Kayaking



Holiday house in Zeeland



RECREATIONAL ACTIVITIES

HOLIDAY HOUSE

LOCAL ACTIVITIES + NATURE

GROUND
ENTRANCE

LAND
ACCESSIBILITY

EXHIBITION
ENTRANCE

OPEN PASSAGE

For water and Fish migration

Support Function

**ECONOMY
OF ZEELAND**

Y-AXIS

**SURROUNDING
CONCERN
ACCESSIBILITY**

Z-AXIS

**ECOLOGICAL
CONCERN**

X-AXIS

FUNCTION

BEFORE THE DELTA WORKS> **FISHERIES / AQUACULTURE**
COASTAL IDENTITY



NEW INTERPRETATION



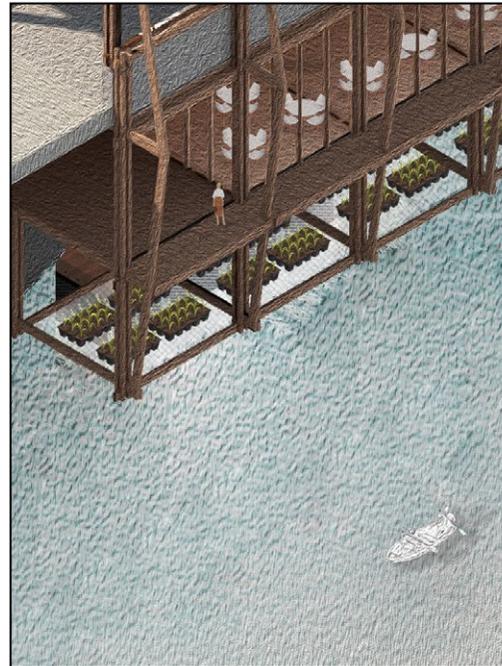
Exhibition

Exhibition of Zeeland economical and ecological development



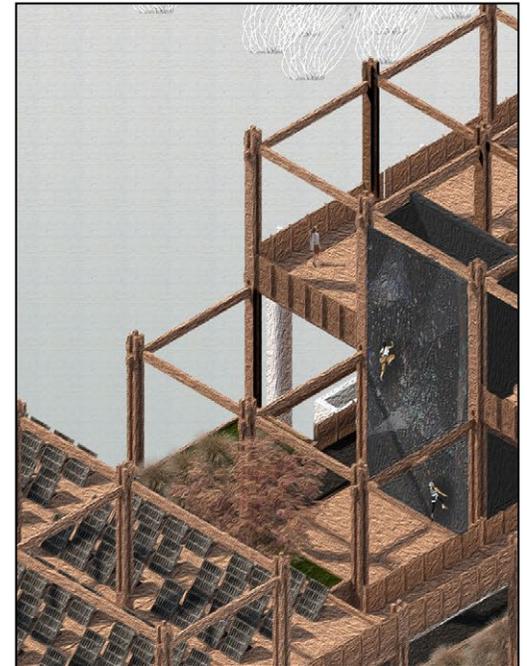
Architecture as an Exhibition

User experience Oosterdscheldekering in person from above and below



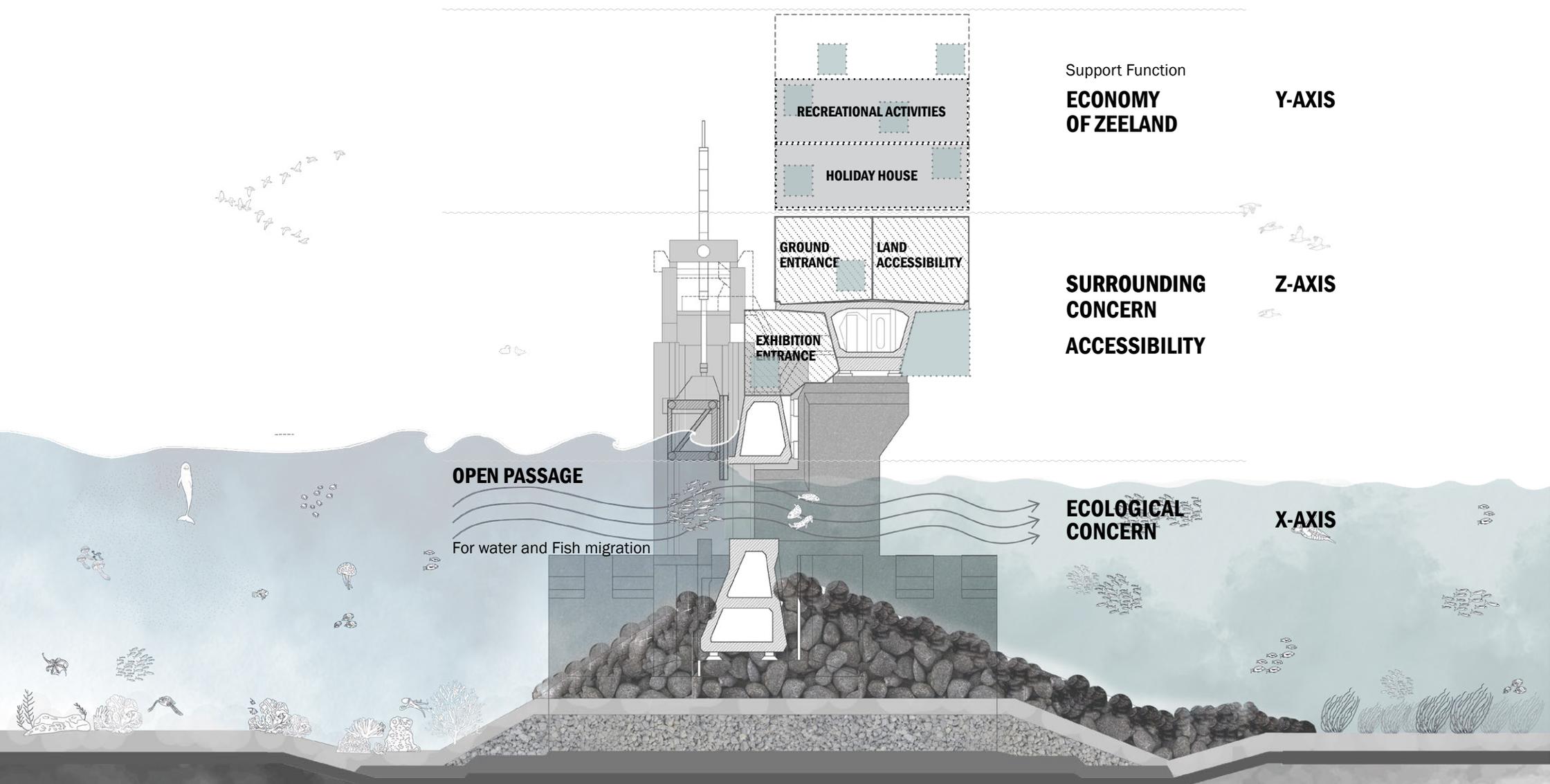
Recreational activities

Fishing
Collecting Mussel / Oyster
Diving - Replanted Seagrass
Experimental ground of new agriculture on Seawater



Recreational activities

Running
Climbing
Cycling



Support Function
**ECONOMY
OF ZEELAND**

Y-AXIS

RECREATIONAL ACTIVITIES
HOLIDAY HOUSE

**GROUND
ENTRANCE** **LAND
ACCESSIBILITY**

**SURROUNDING
CONCERN**
ACCESSIBILITY

Z-AXIS

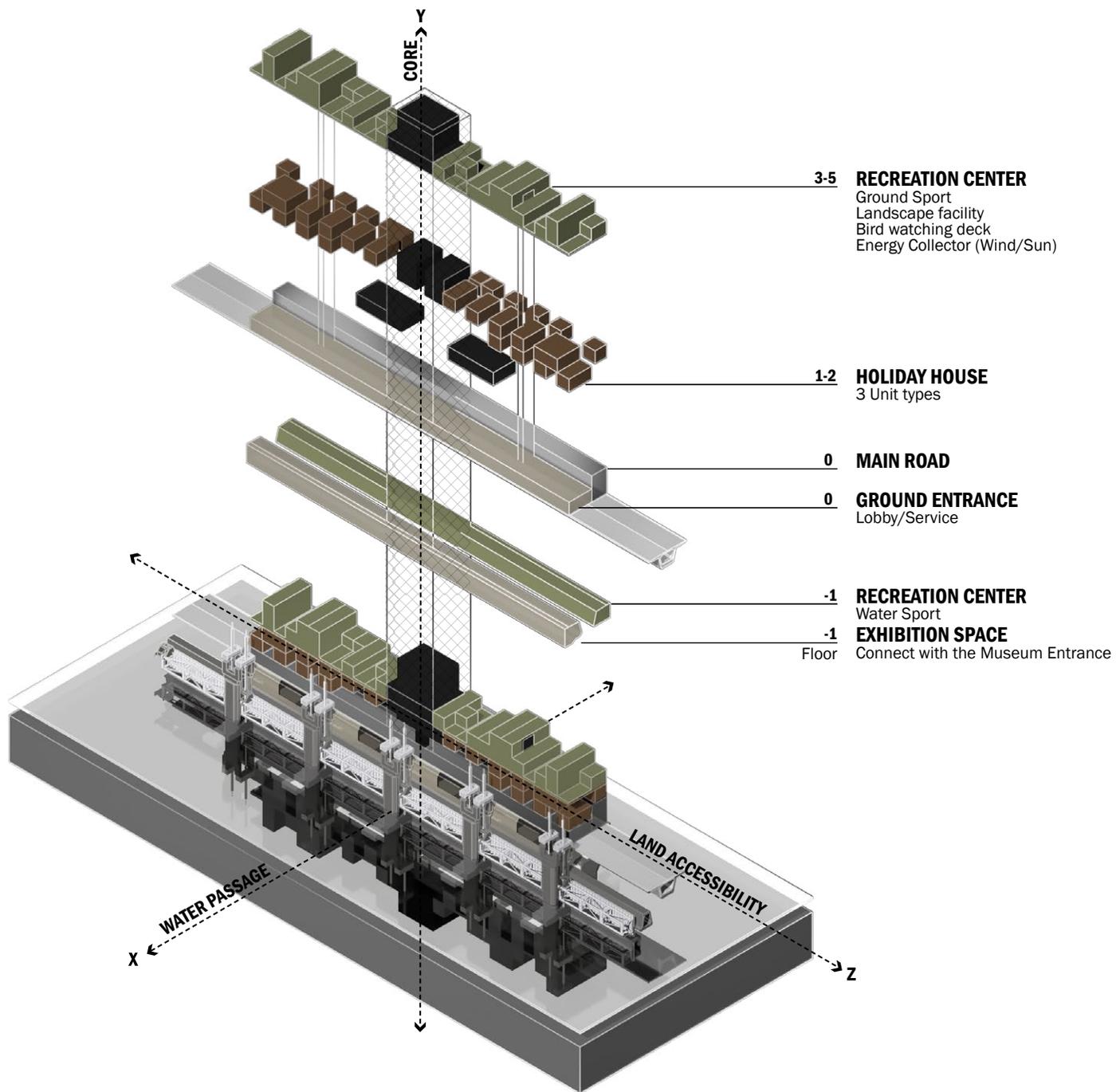
**EXHIBITION
ENTRANCE**

OPEN PASSAGE
For water and Fish migration

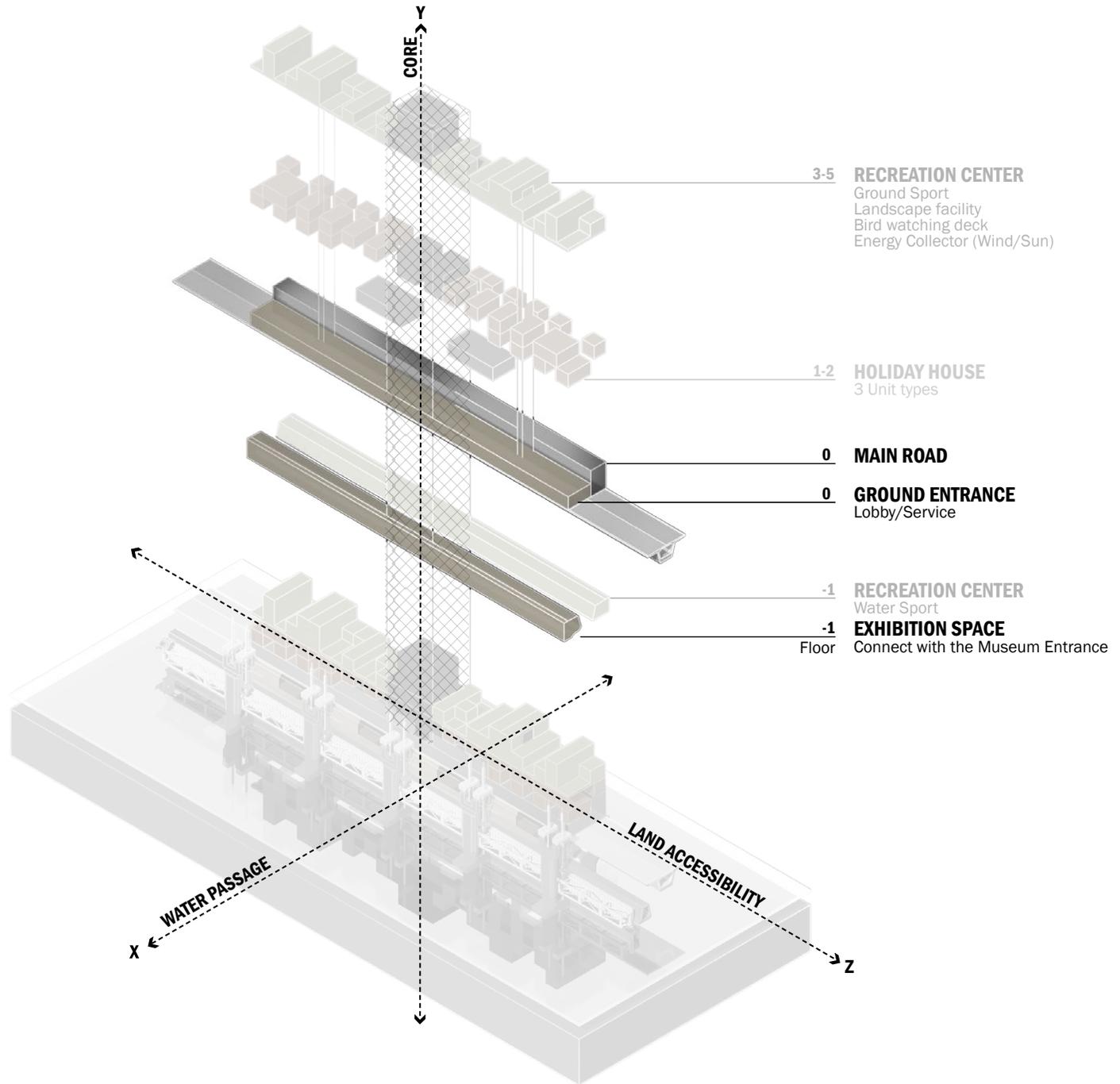
**ECOLOGICAL
CONCERN**

X-AXIS

ZONING

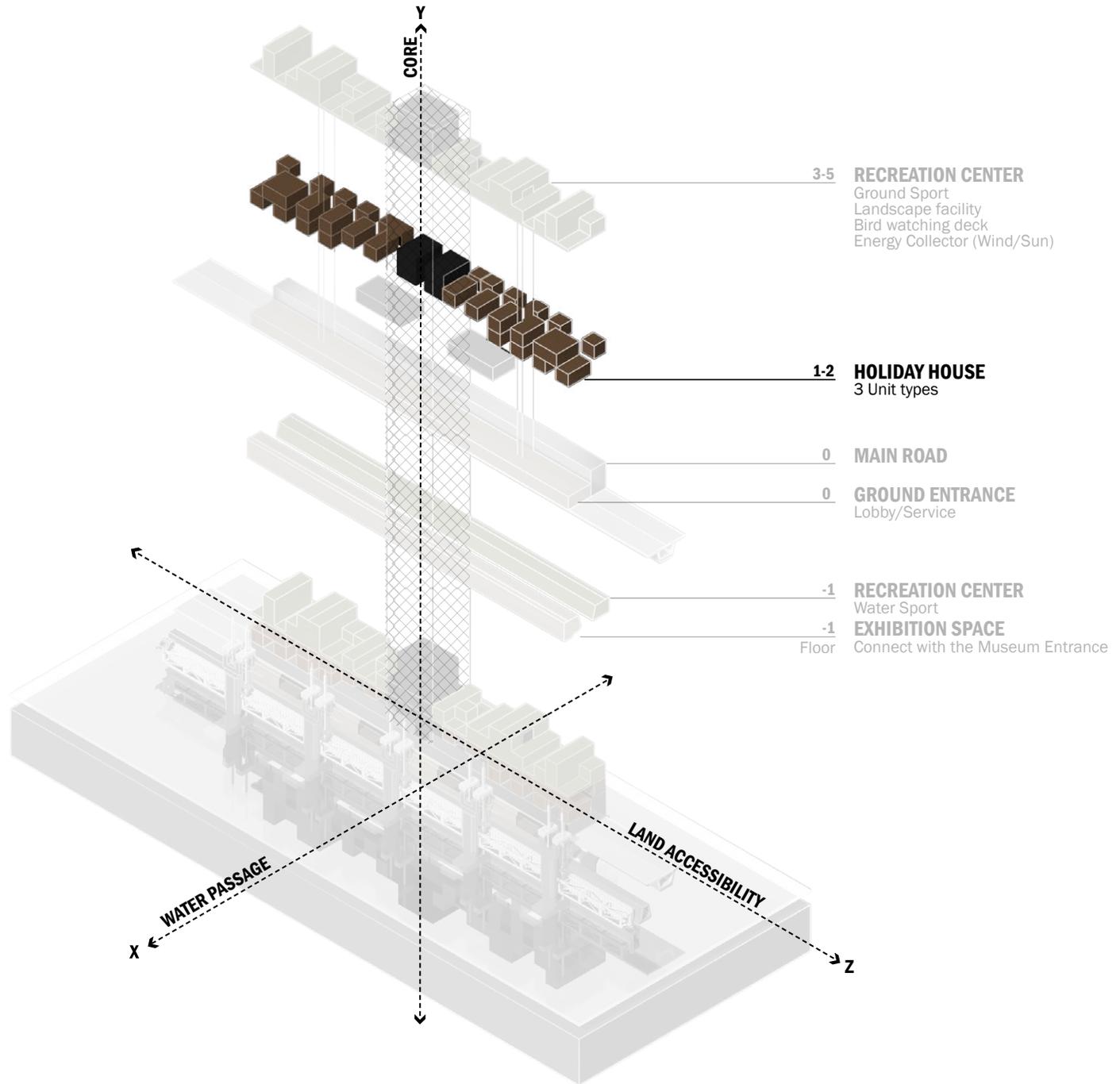


ZONING



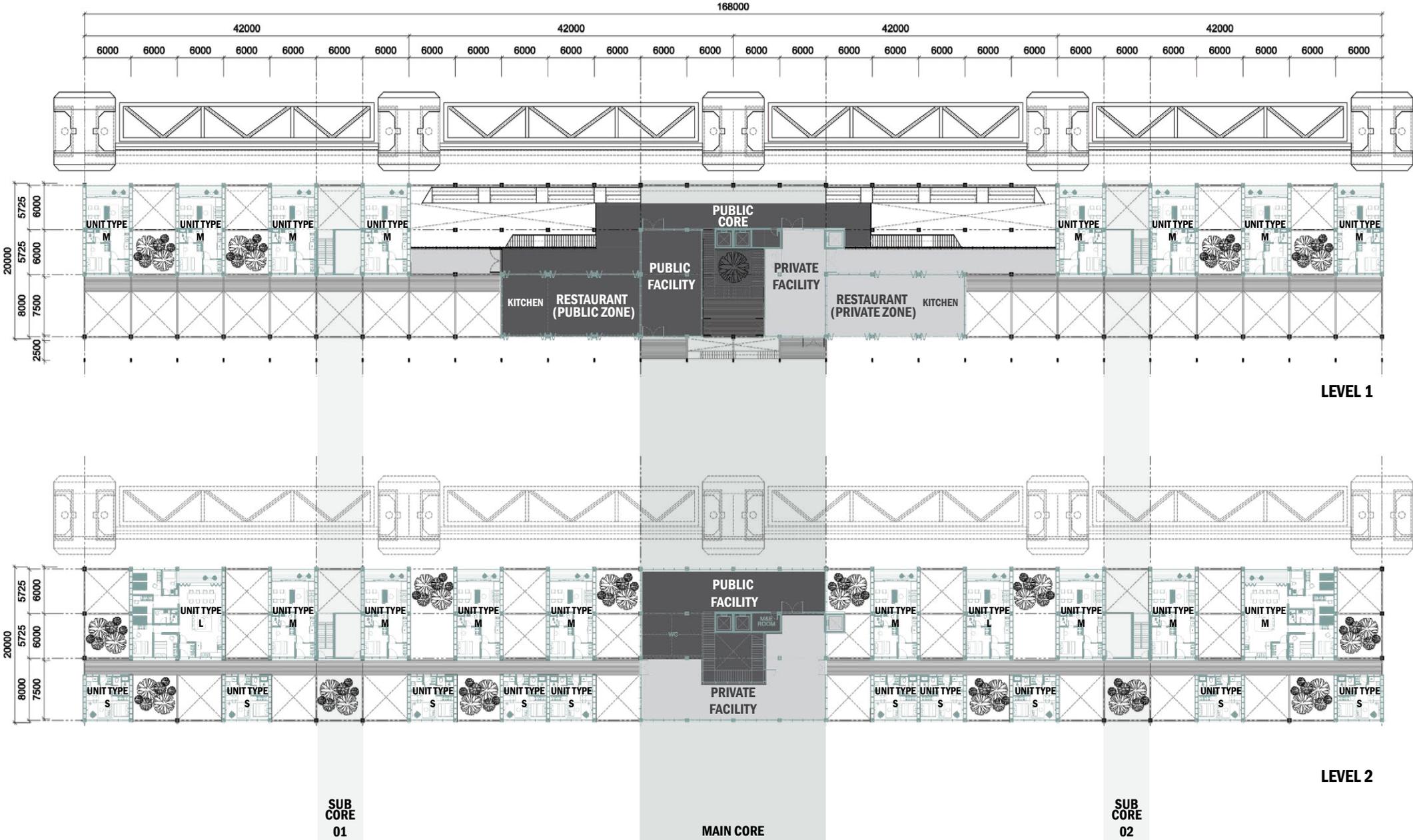


ZONING

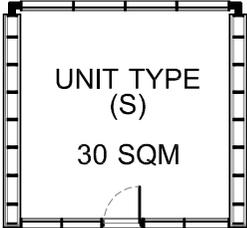


MAIN PLAN

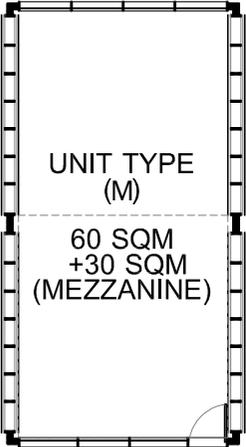
HOLIDAY HOUSE



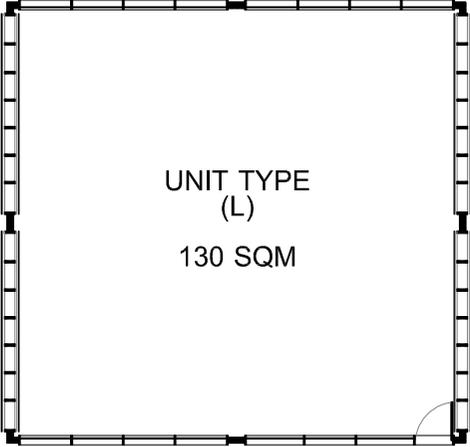
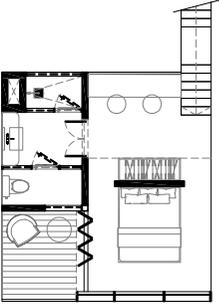
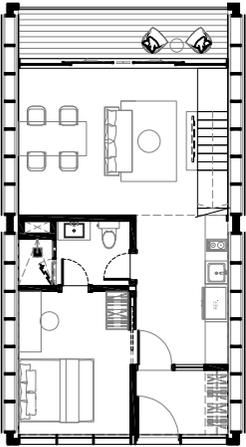
HOLIDAY HOUSE



1 BEDROOM
1 BATHROOM
FOR 1-2 People



2 BEDROOMS
2 BATHROOMS
FOR 3-4 People

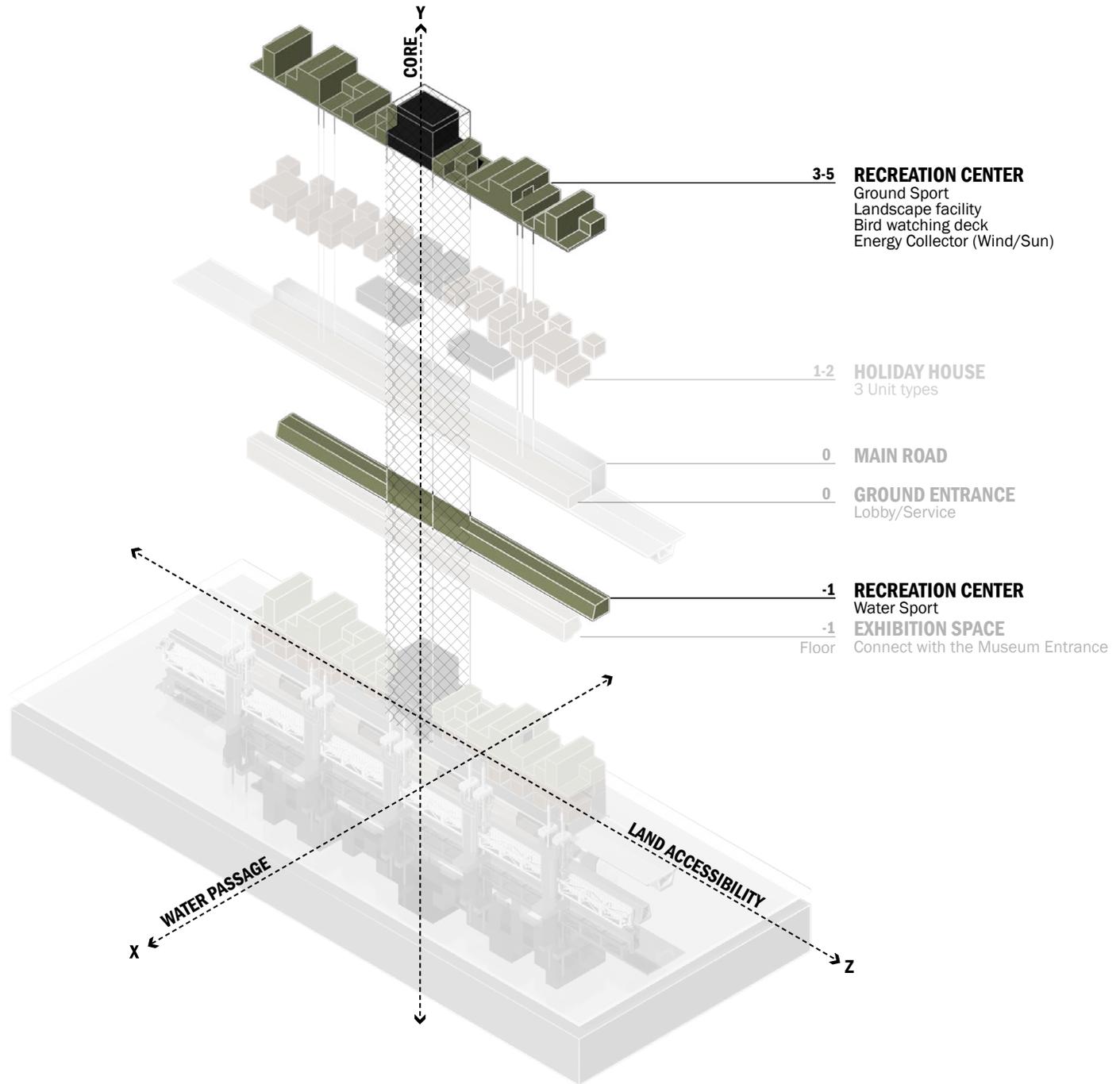


4 BEDROOMS
2 BATHROOMS
FOR 6-8 People



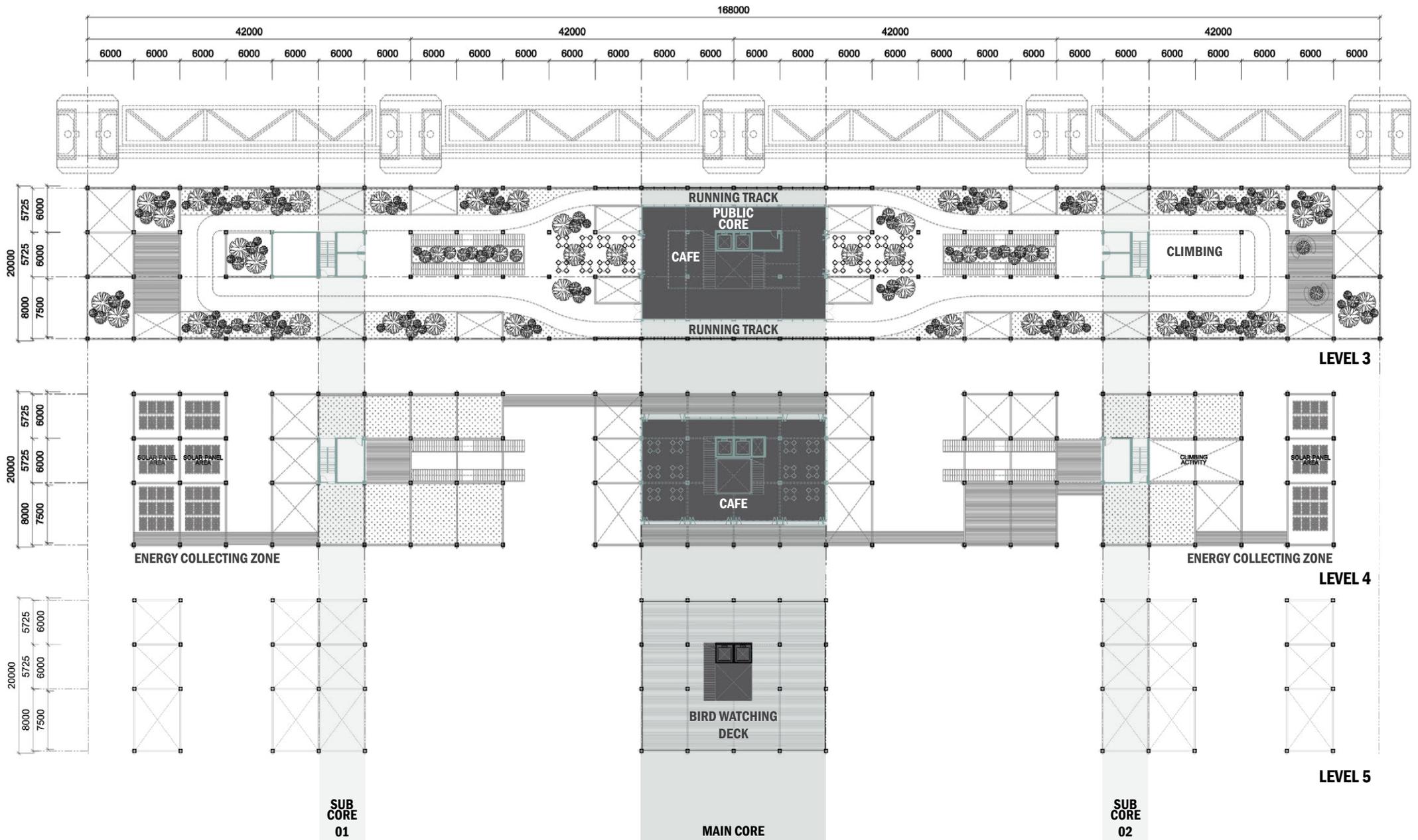


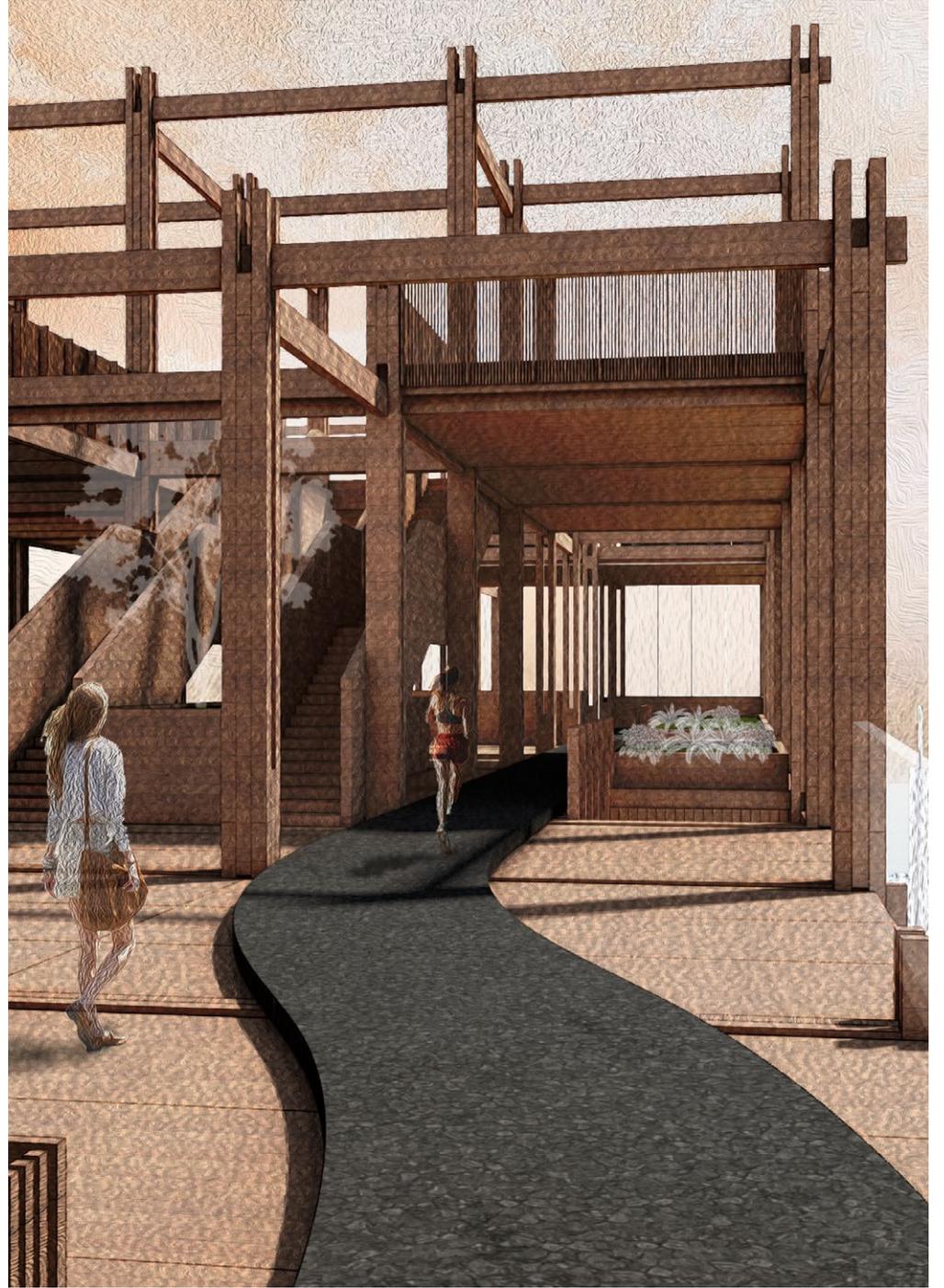
ZONING

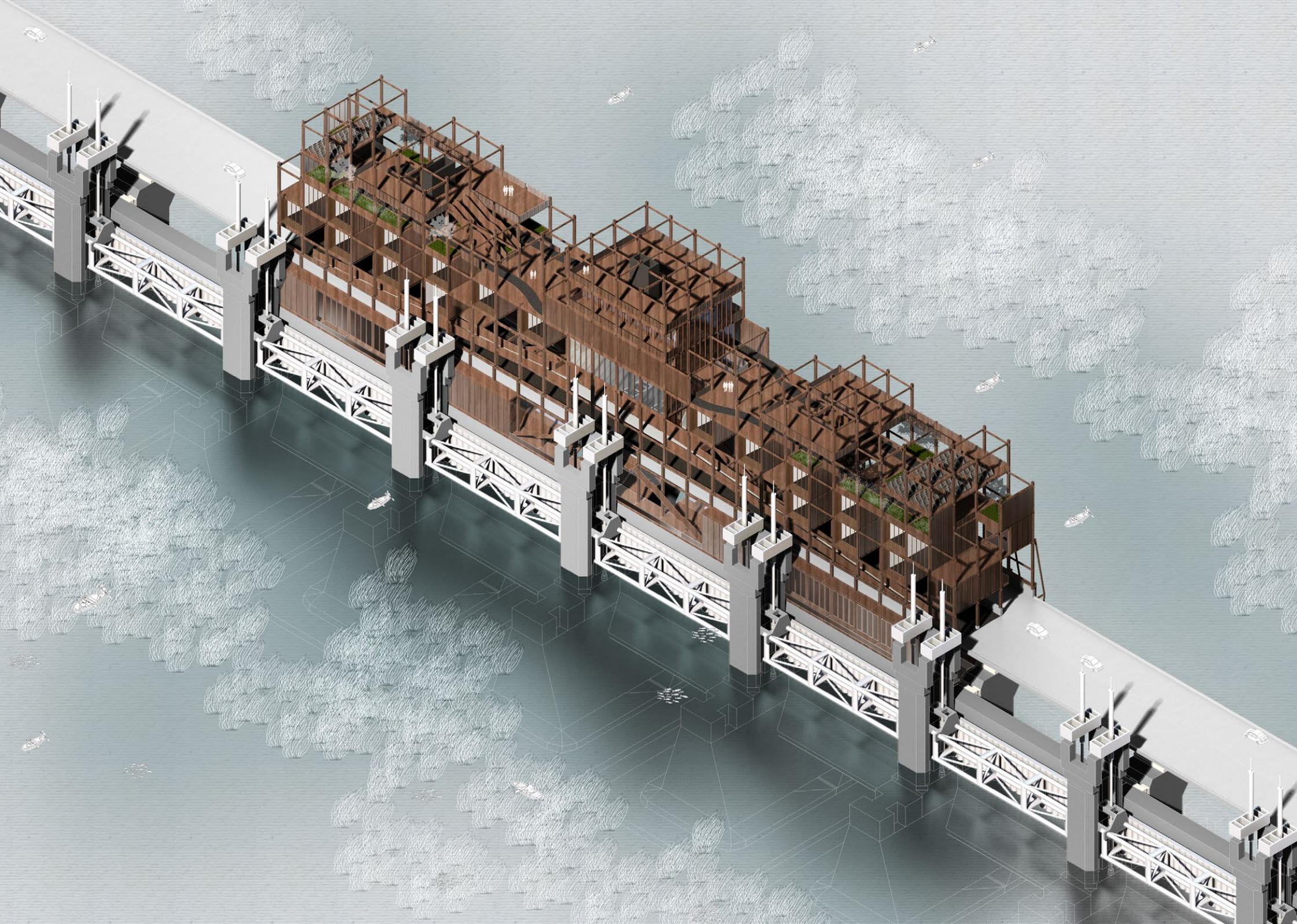


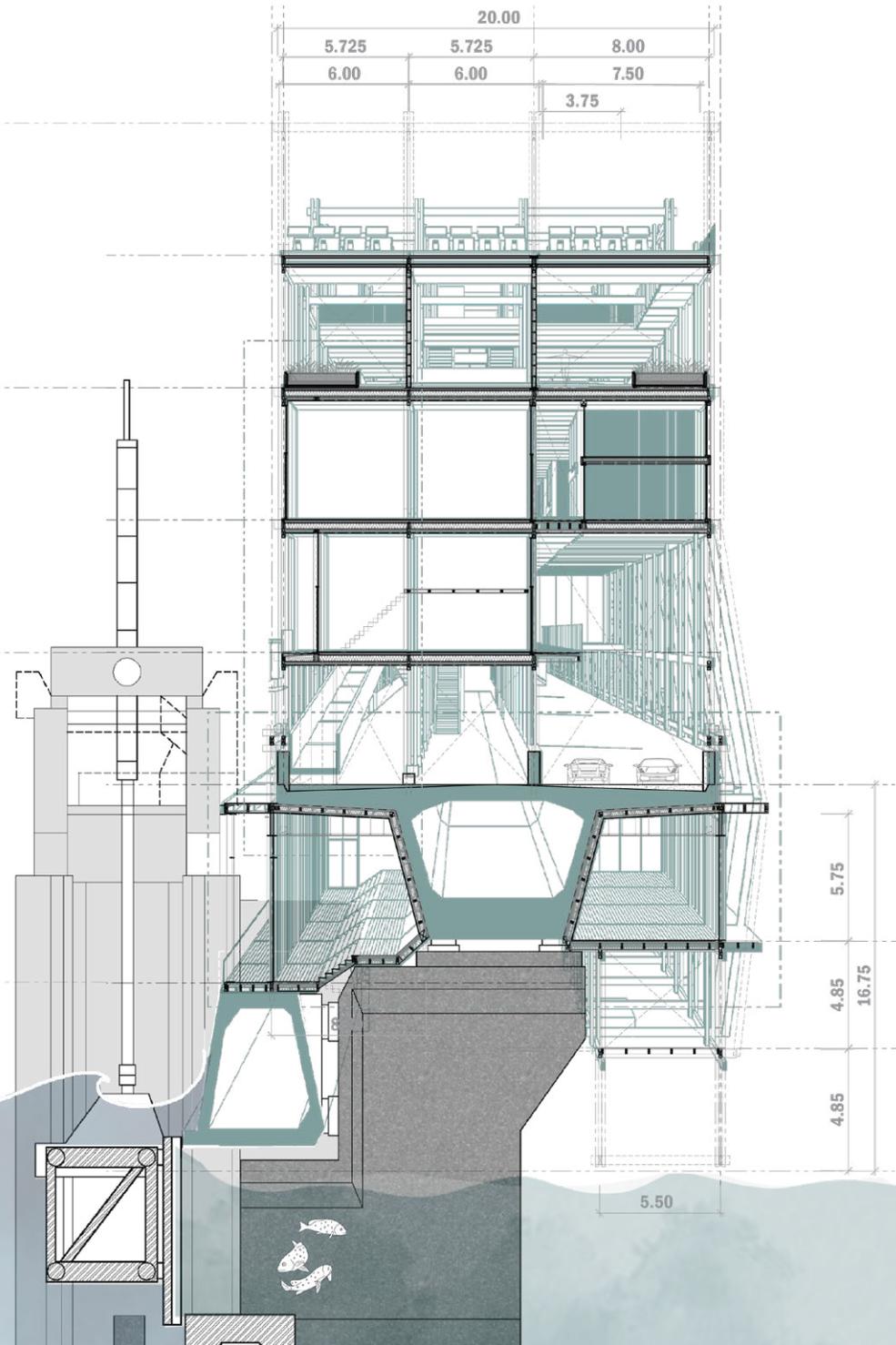
MAIN PLAN

RECREATIONAL CENTER









CONTENT

01 THE METHODOLOGY

RESERACH CONCLUSION
FROM RESEARCH TO DESIGN

02 MULTIFUNCTIONALITY

URBAN SCALE
ARCHITECTURE SCALE

03 HYBRIDITY

EXTREME CLIMATE
STRUCTURAL STABILIZATION
WIND SIMULATION

04 FUTURE ADAPTATION

EXTREME CLIMATE

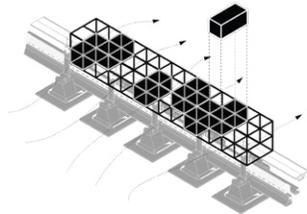
EXTREME CLIMATE

Eastern Scheldt Storm Surge Barrier

STRONG WIND AND STORM

Influence
↓

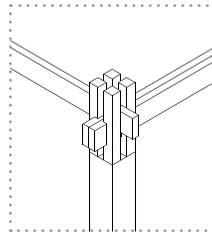
ARCHITECTURAL FORM



**HIGH SALINITY
HIGH HUMIDITY**

Influence
↓

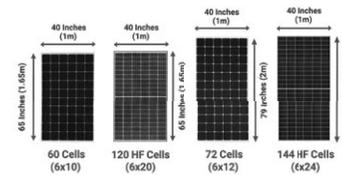
MATERIALS AND PLANTS



LONGER PERIOD OF SUN LIGHT

Influence
↓

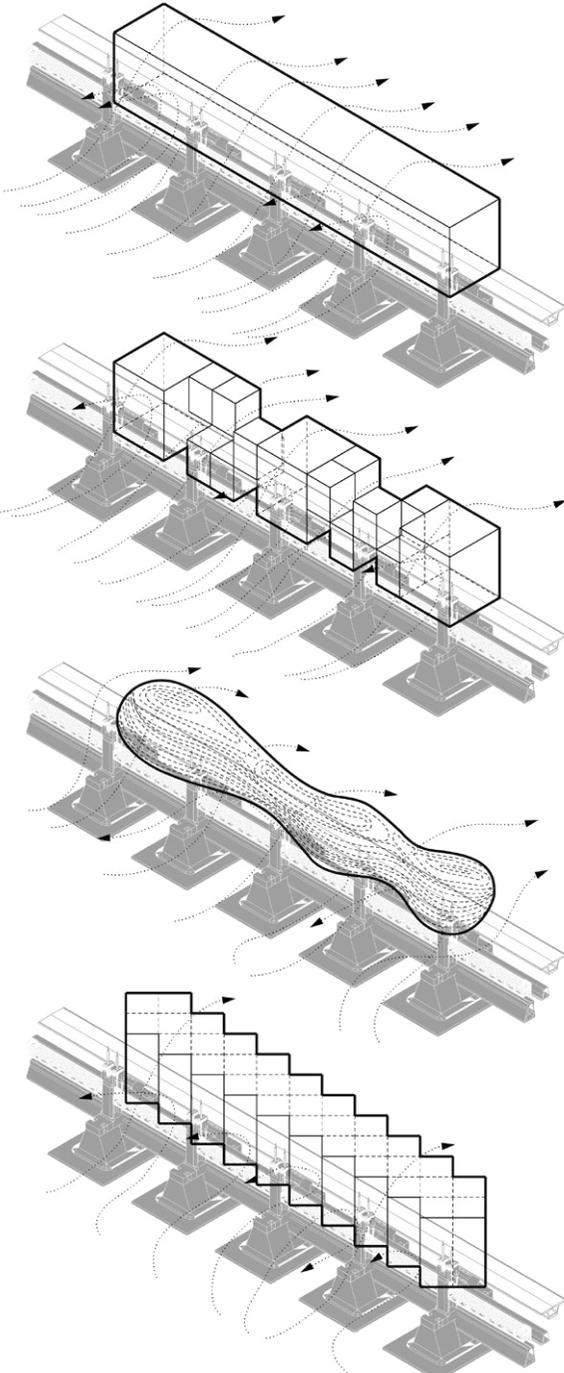
ENERGY COLLECTOR



EXTREME CLIMATE

STRONG WIND AND STORM

ARCHITECTURAL FORM



WIND BEHAVIOR

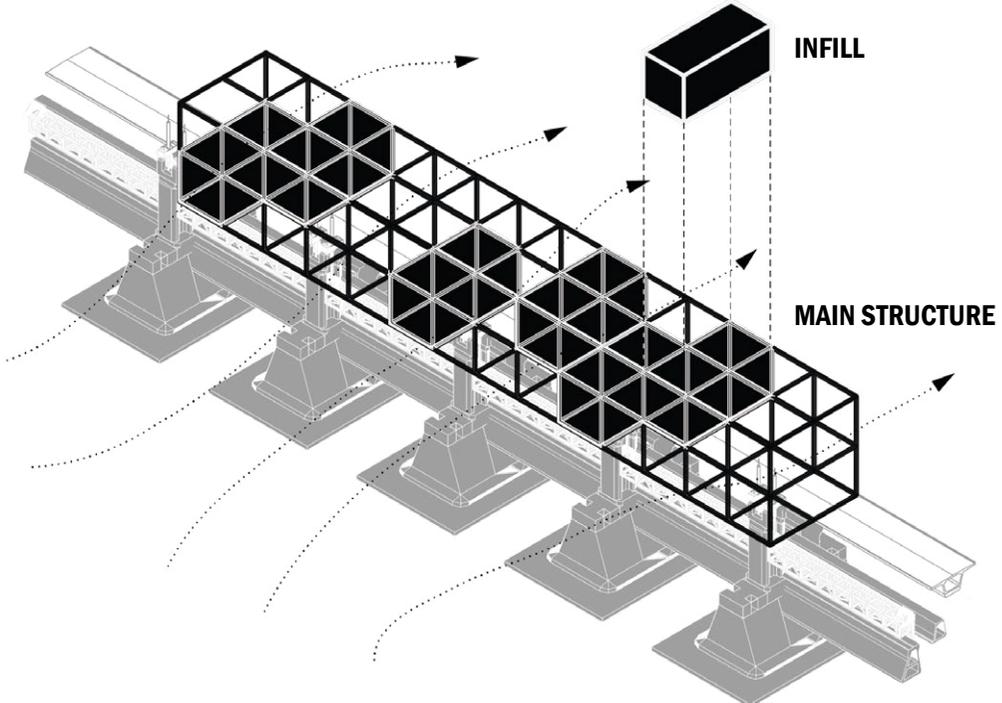
AERODYNAMIC

 1.05
Cube
Build against the wind

 1.15
Short Cylinder
Reduce the volumn of the building

 0.04
Streamlined Body
Low Aerodynamic tension

 0.50
Cone
Breaking the wind force



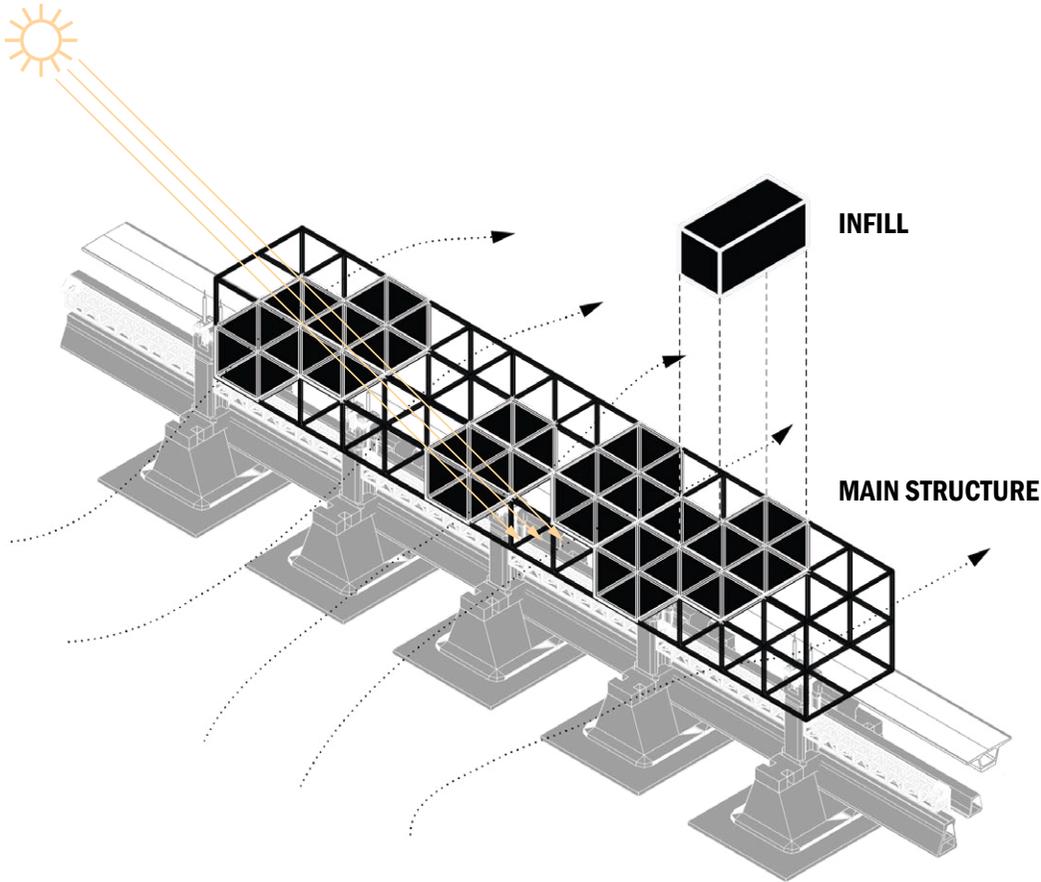
Instead of build against the wind, allowing the wind to passthrough the building
Balance between indoor and outdoor (Room for wind) by using grid system

EXTREME CLIMATE

Wind and Longer period of sunlight



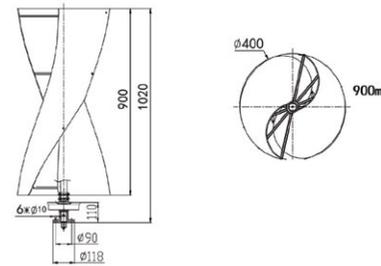
ENERGY COLLECTOR



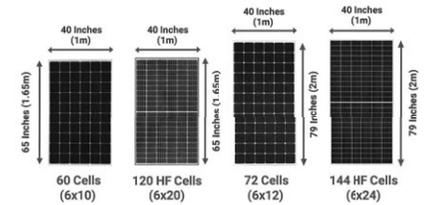
WIND ENERGY

Residential vertical axis wind turbine

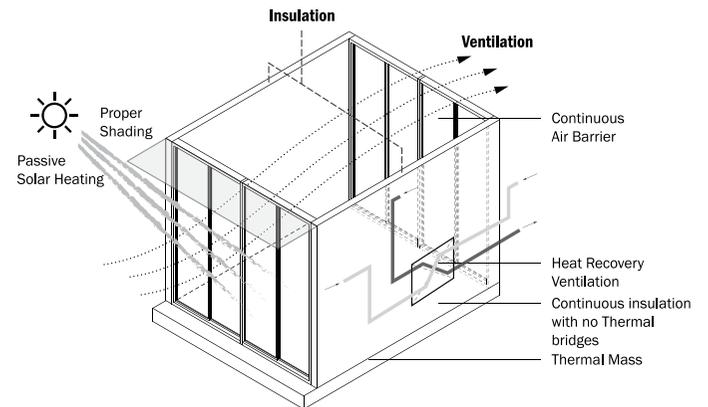
WIND SPEED STANDARD 3 - 25 m / sec
WIND SPEED ON SITE 8 - 11 m / sec
Approximately 8.95 m/sec



SOLAR ENERGY



PASSIVE HOUSE PRINCIPLE



EXTREME CLIMATE

Salty air and High Humidity



MATERIAL

Light weight material

TIMBER

Azobé Iron wood

Meerpaal Second hand



Sustainability - Low carbon footprint

No Corrosion

Wind Resistant (Flexibility)

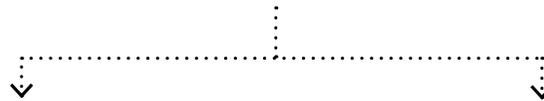
Longevity (Same as Steel)

Aesthetic qualities

Resistant rot and worm

Recyclable

Main Structure



Black Walnut

Naturally durable wood for Coastal area



Infill

Spruce Lumber



Interior

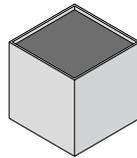
EXTREME CLIMATE

Salty air and High Humidity



LOCAL PLANTS

Wind-resistant
Drought-tolerant
Insensitive to salt



W : 2000 MM
L : 2000 MM
H : 2000 MM

TREE



W : 1000-1500 MM
L : 1000-1500 MM
H : 1000-1500 MM

TREE



Shrub

W : 600 MM
L : 600 MM
H : 600 MM

Shrub

Tree



Hippophae

0.5 - 6 meters



Elaeagnus

2.5 - 3 meters



Ornamental grasses

40 - 50 cm



Pinus sylvestris
(The Scots pine)

Pinus parviflora
'Glauca'.

10 - 30 meters



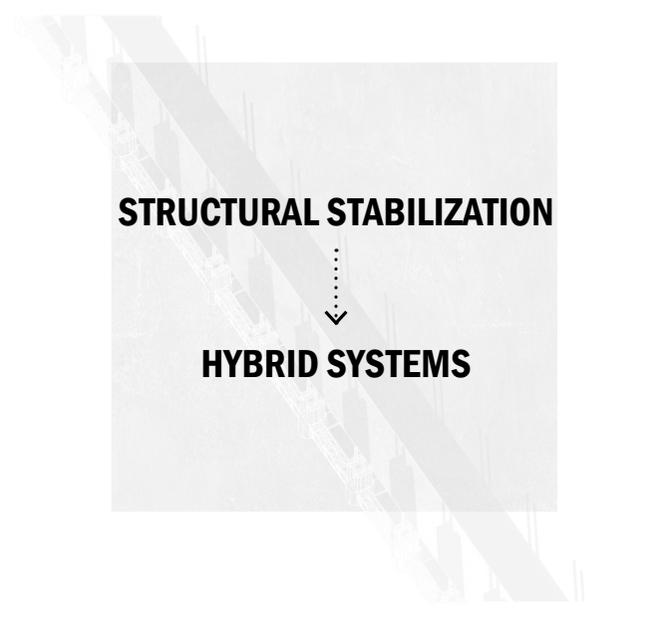
Tilia tomentosa
'Doornik'

25 meters



Ulmus laevis

30 meters



STRUCTURAL STABILIZATION

↓

HYBRID SYSTEMS

OVERALL GRID SYSTEMS

MAIN STRUCTURE

INFILL

MAIN STRUCTURE

UPPER STRUCTURE

UNDERNEATH STRUCTURE

CONSTRUCTION TYPES ORDER ASSEMBLY

CUSTOMIZED

MODULAR SYSTEMS

JOINERY

WOOD CONNECTION

STEEL CONNECTION

FLOOR SYSTEMS

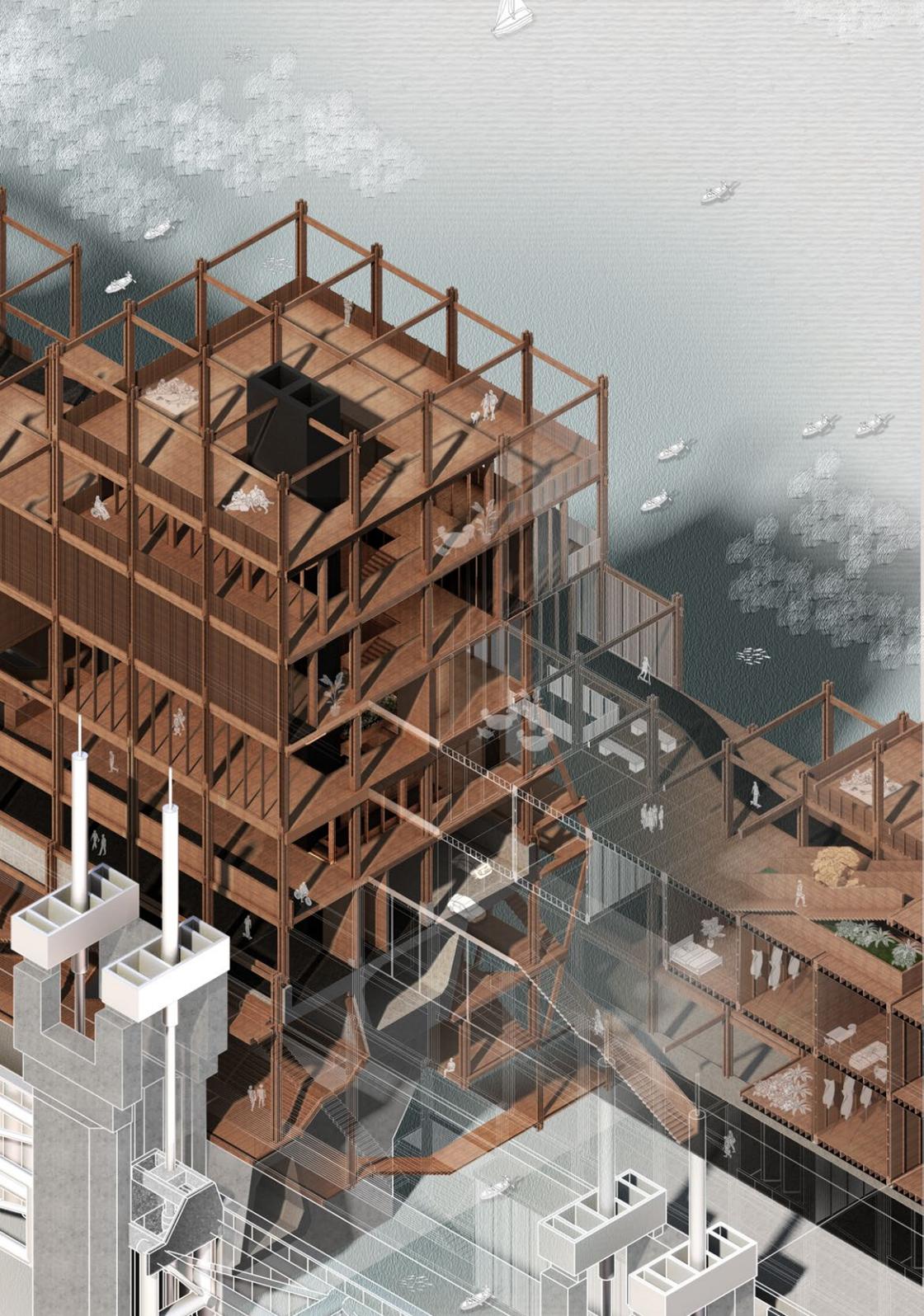
KERTO-RIPA

CLT

THREE CORE LOCATION BRACING

MAIN CORE

2 SUPPORT CORE



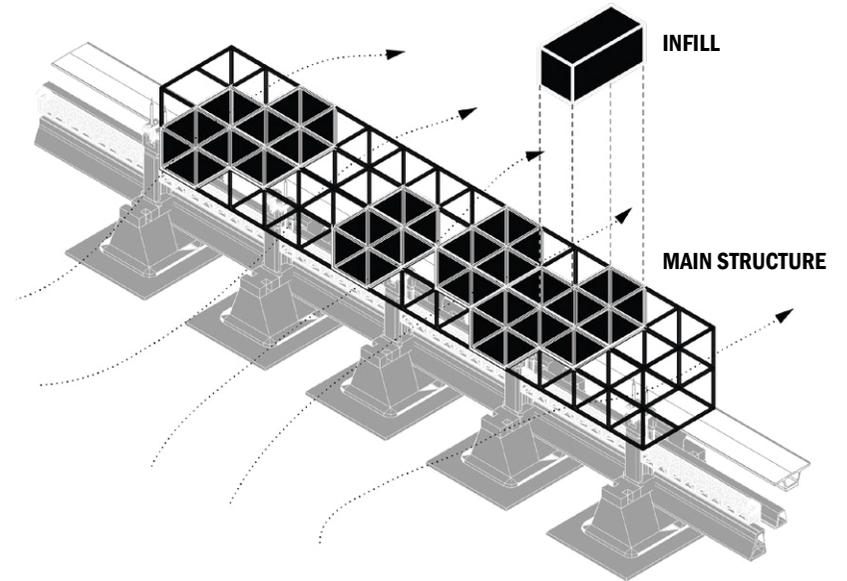
HYBRIDITY

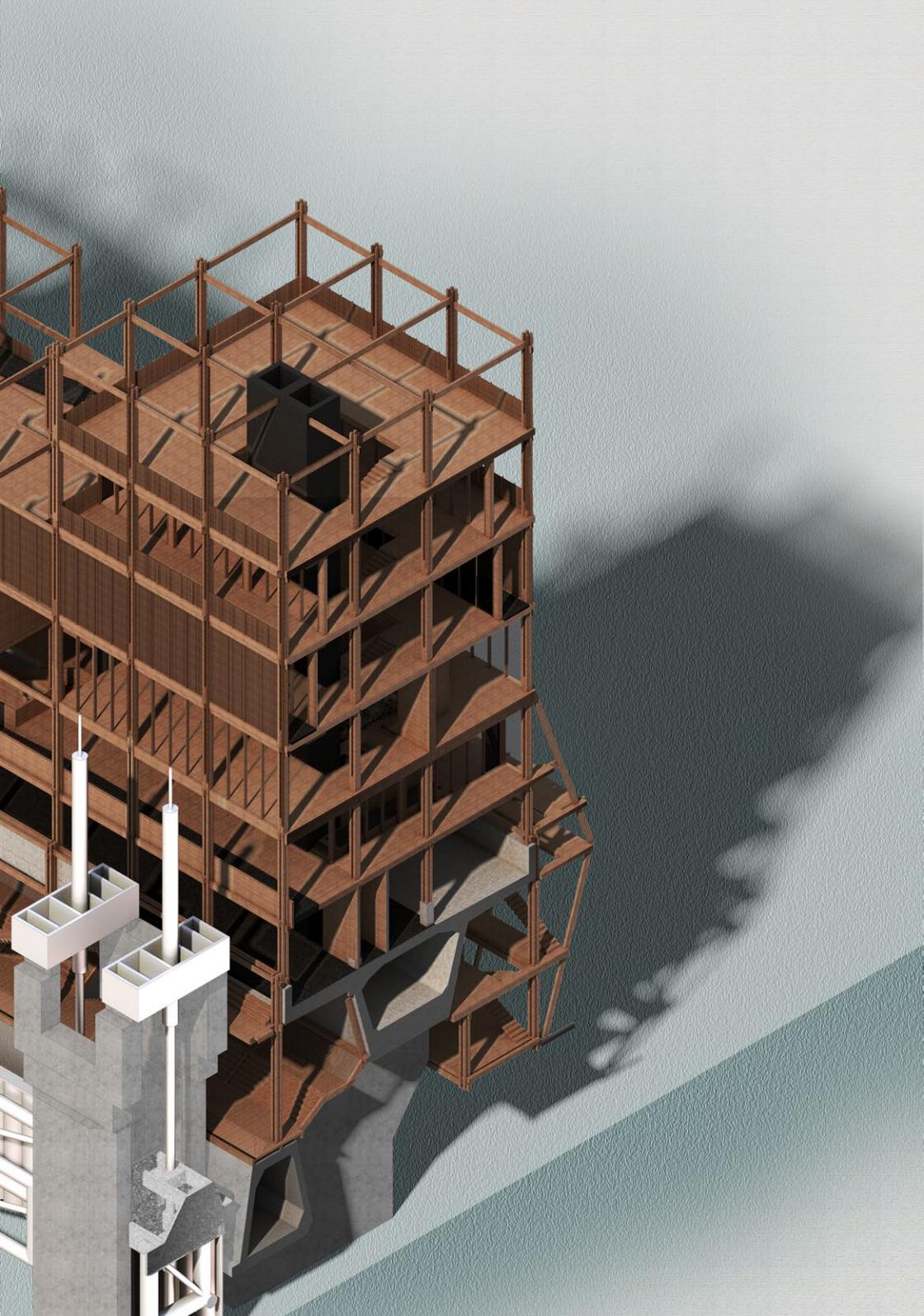
STRUCTURAL STABILIZATION

OVERALL GRID SYSTEMS

MAIN STRUCTURE

INFILL

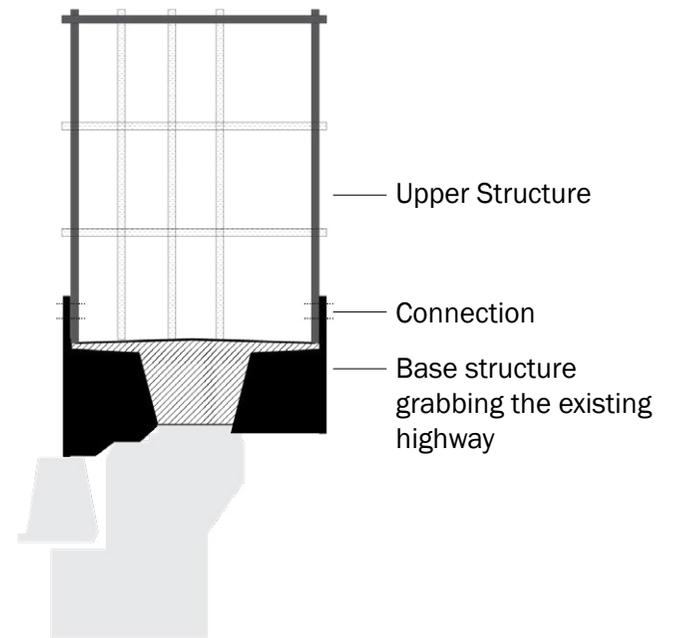


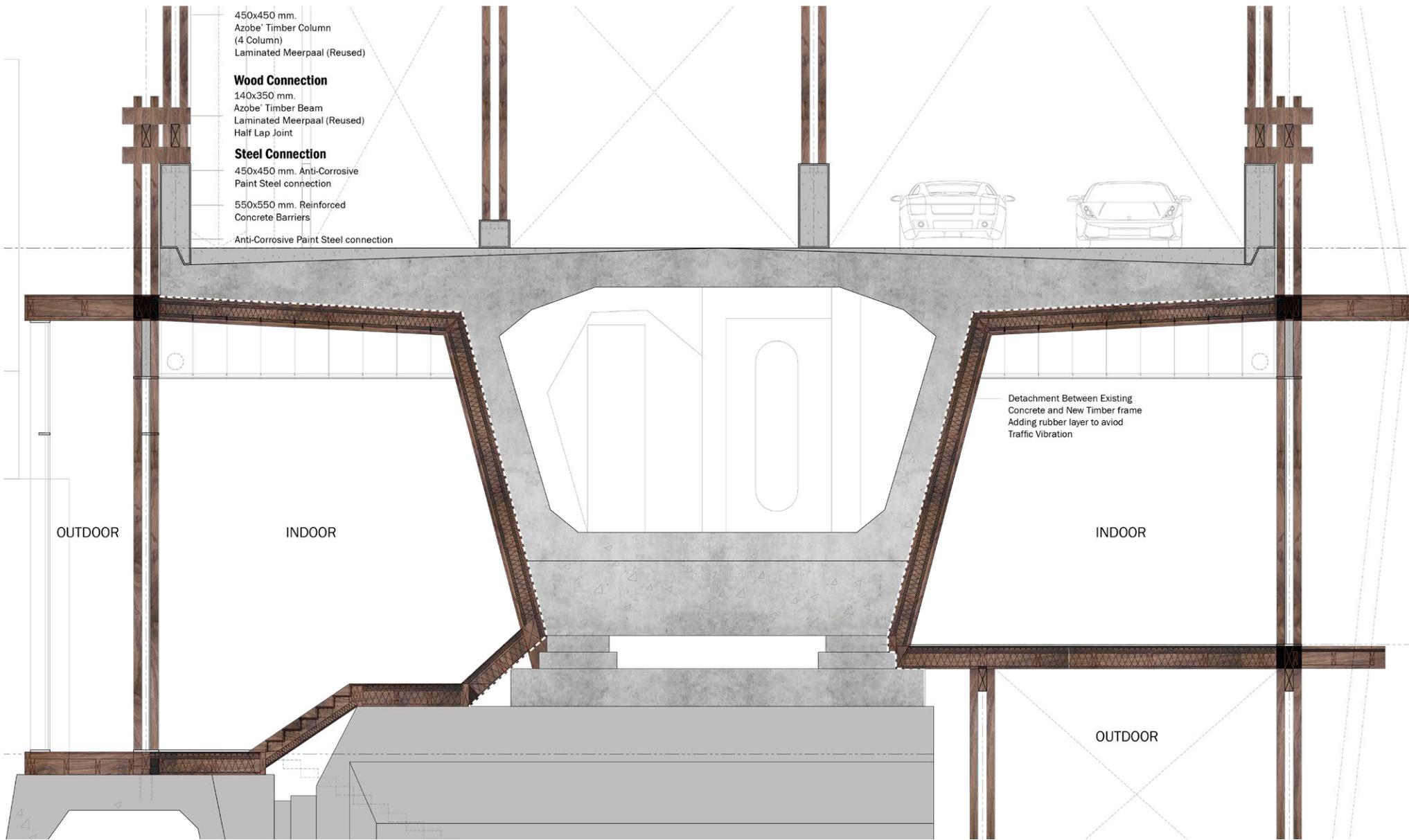


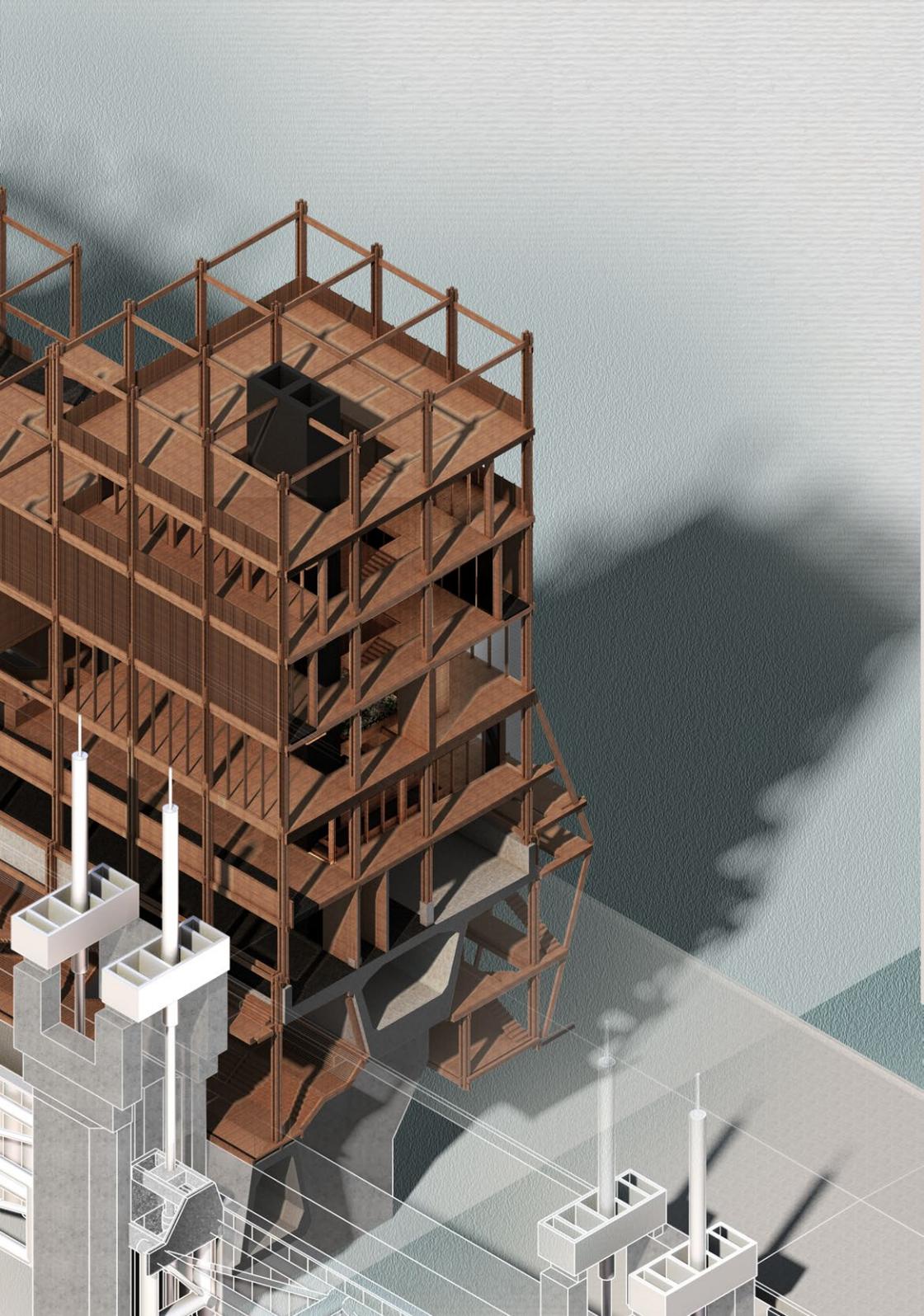
HYBRIDITY

STRUCTURAL STABILIZATION

MAIN STRUCTURE | UPPER STRUCTURE | UNDERNEATH STRUCTURE







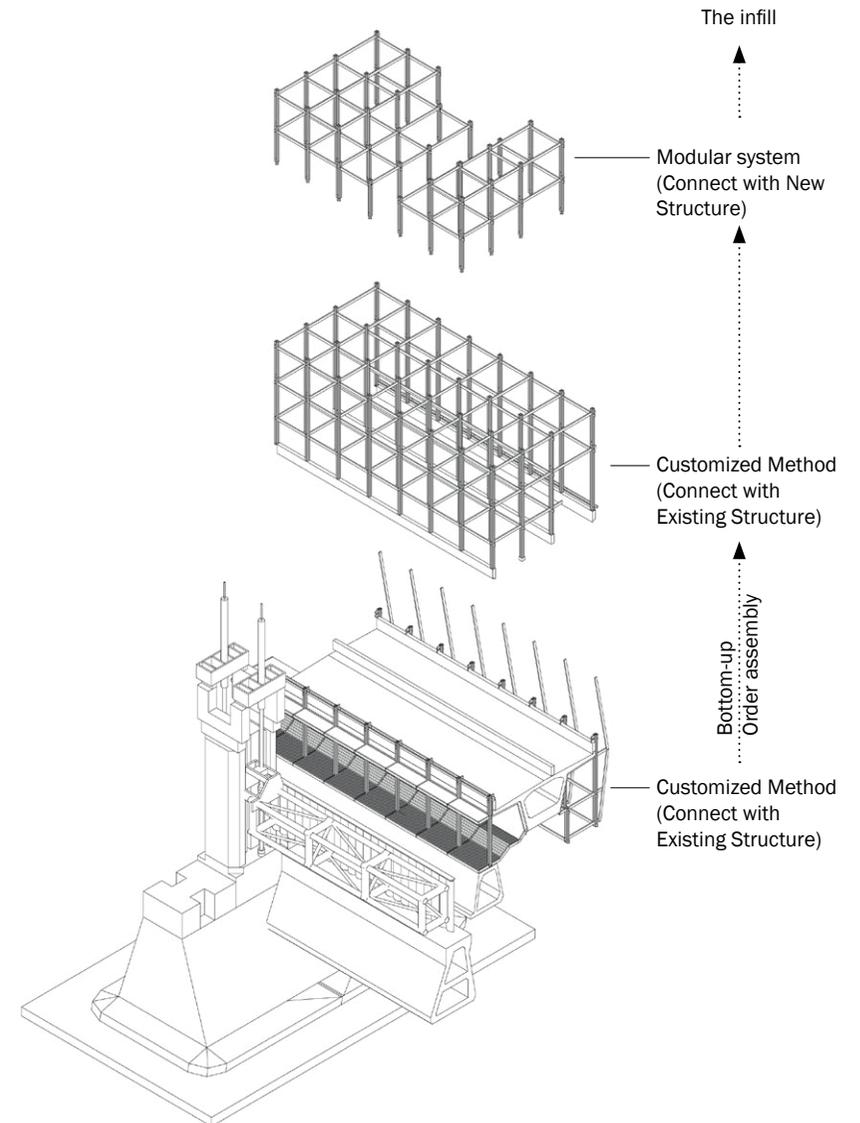
HYBRIDITY

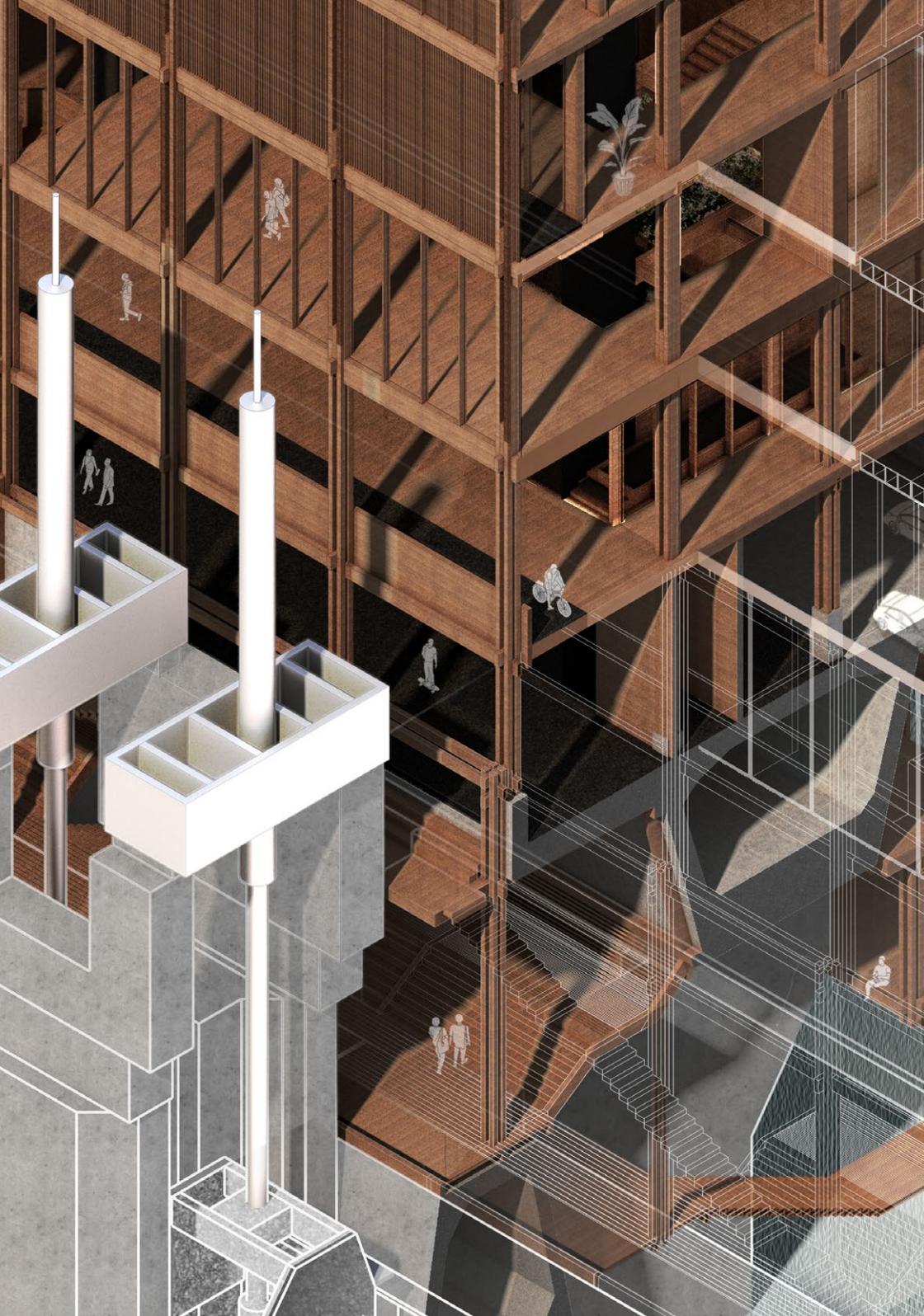
STRUCTURAL STABILIZATION

CONSTRUCTION TYPES

CUSTOMIZED

MODULAR SYSTEMS





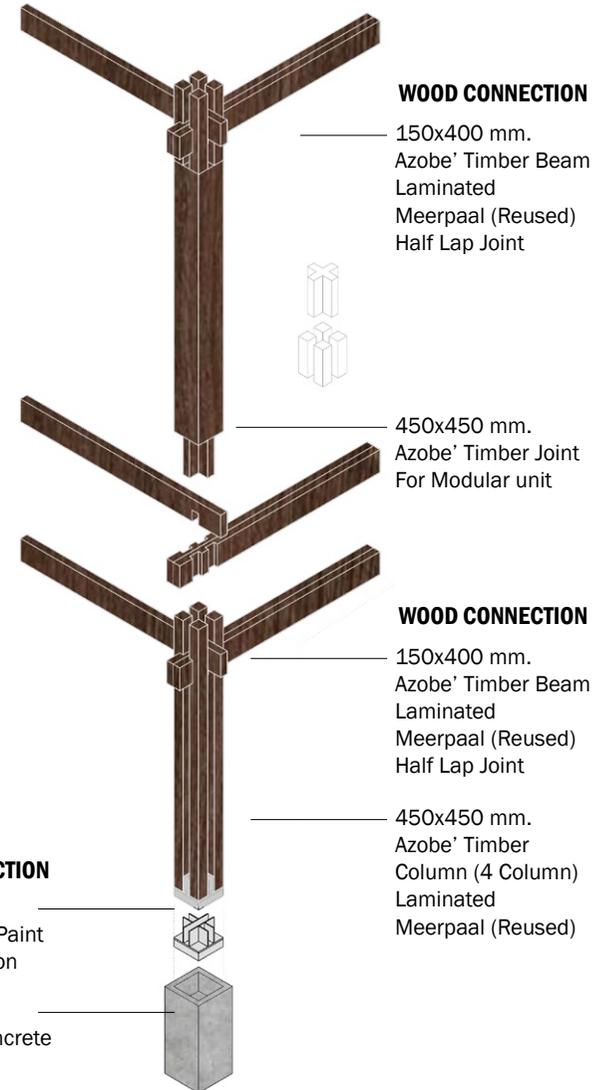
HYBRIDITY

STRUCTURAL STABILIZATION

JOINERY

WOOD CONNECTION

STEEL CONNECTION

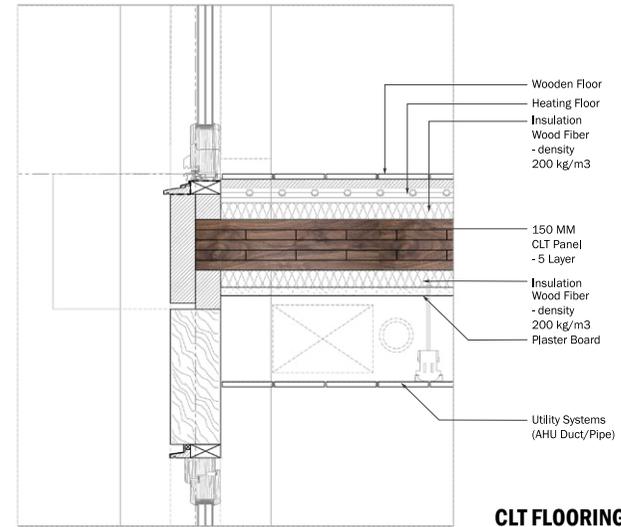




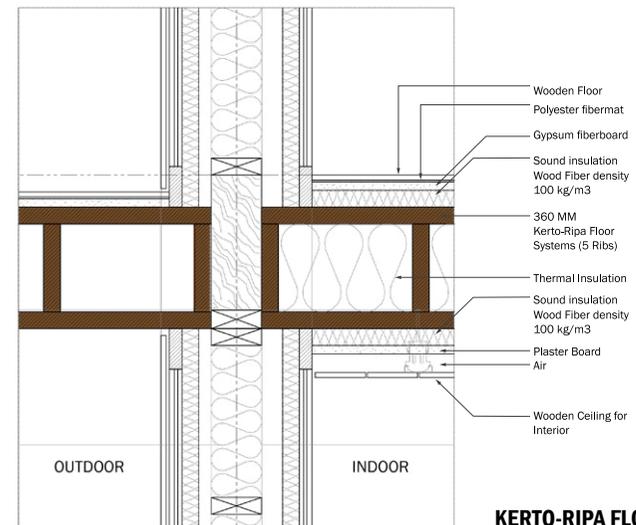
HYBRIDITY

STRUCTURAL STABILIZATION

FLOOR SYSTEMS KERTO-RIPA | CLT



CLT FLOORING SYSTEM

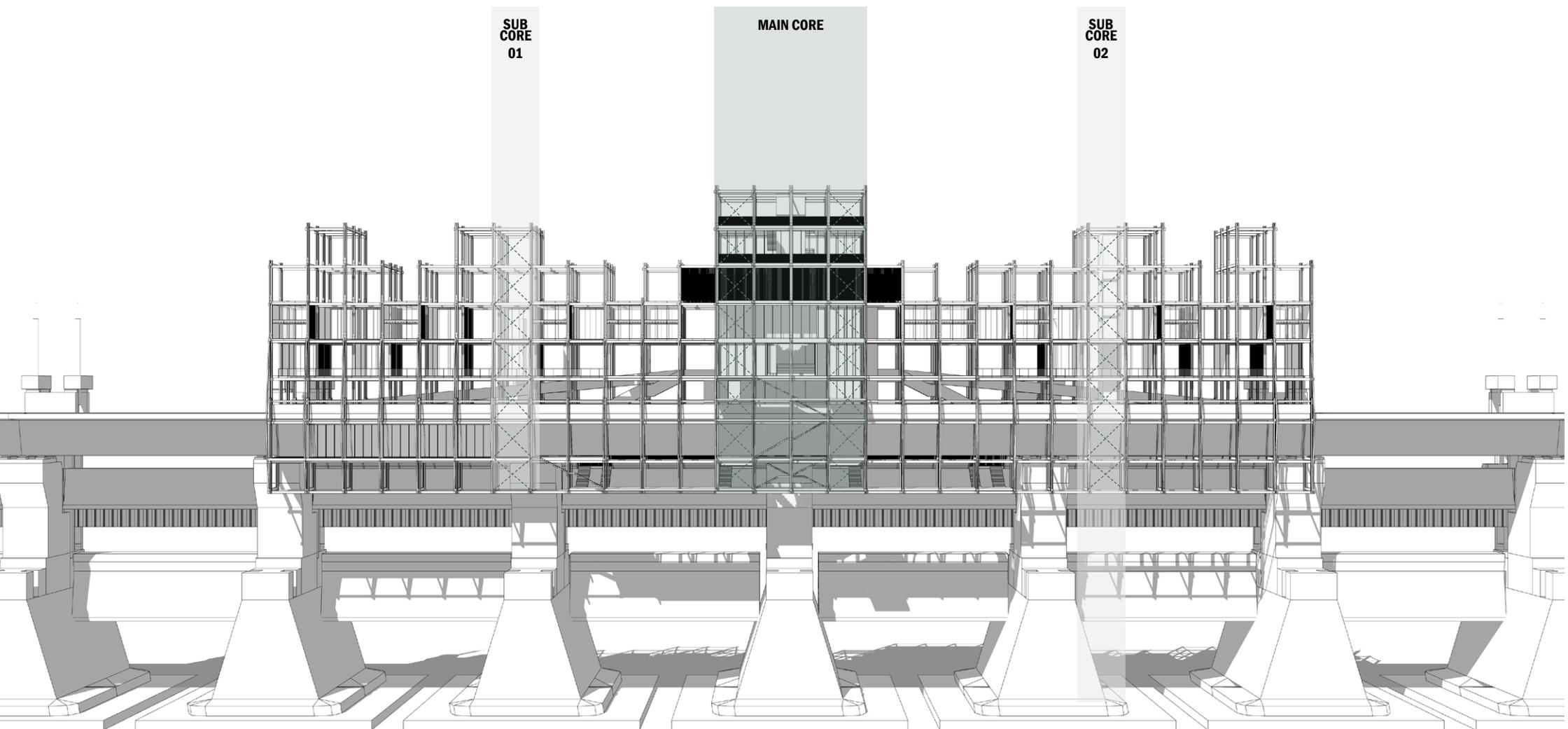


KERTO-RIPA FLOORING SYSTEM

STRUCTURAL STABILIZATION

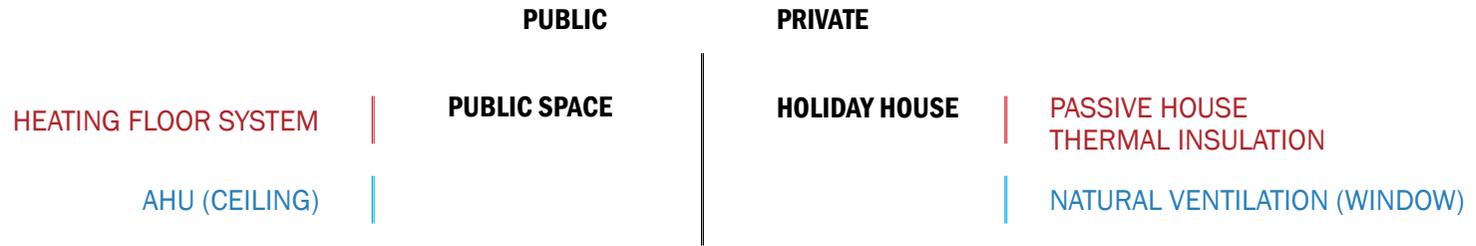
THREE CORE LOCATION BRACING

MAIN CORE | 2 SUPPORT CORE

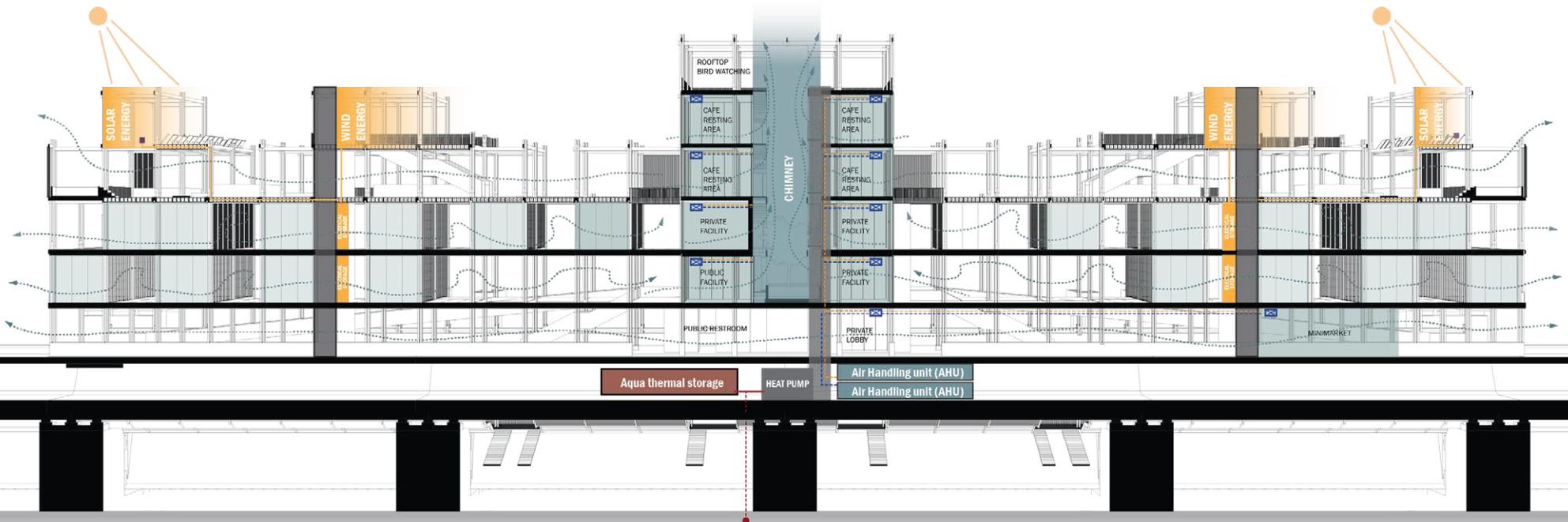


CLIMATE DESIGN

INDOOR CLIMATE



SUMMER

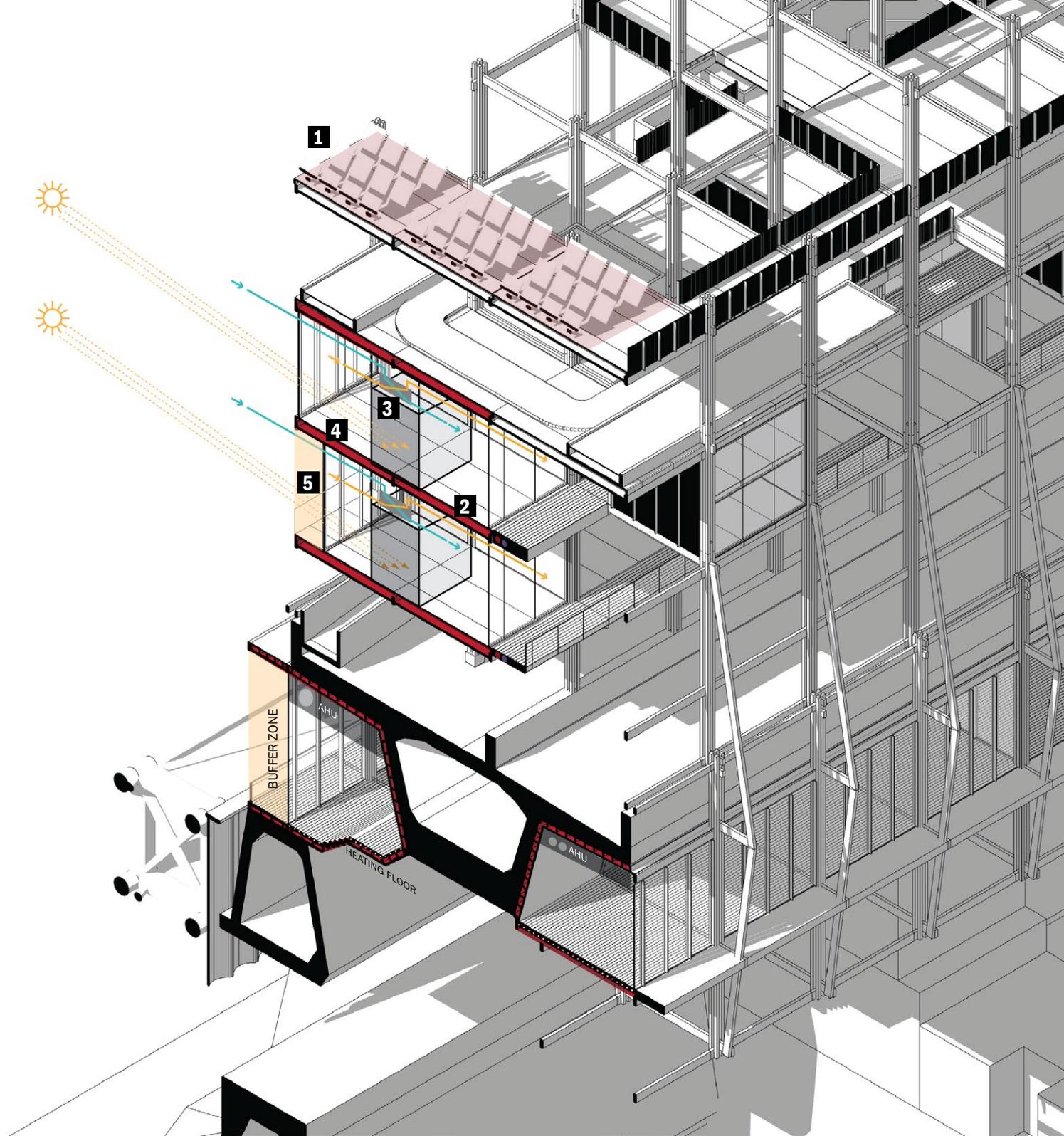


WINTER

HOLIDAY HOUSE

PASSIVE HOUSE PRINCIPLE

- 1** ACTIVE SOLAR SYSTEMS
- 2** CONTINUOUS INSULATION WITH NO THERMAL BRIDGES
- 3** HEAT RECOVERY VENTILATION
- 4** PASSIVE SOLAR HEATING
- 5** PROPER SHADING BALCONY / SCREEN

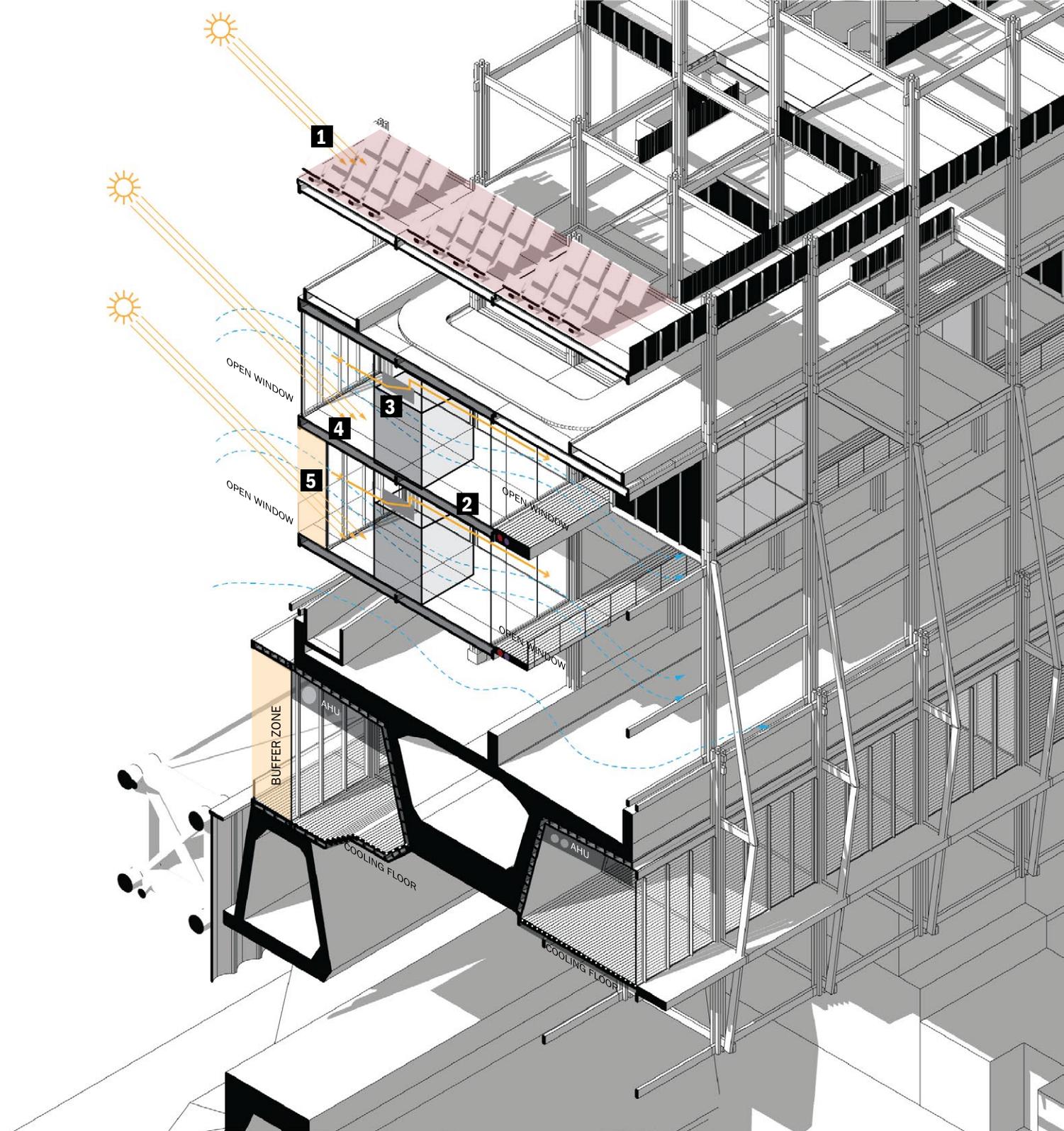


SUMMER

HOLIDAY HOUSE

PASSIVE HOUSE PRINCIPLE

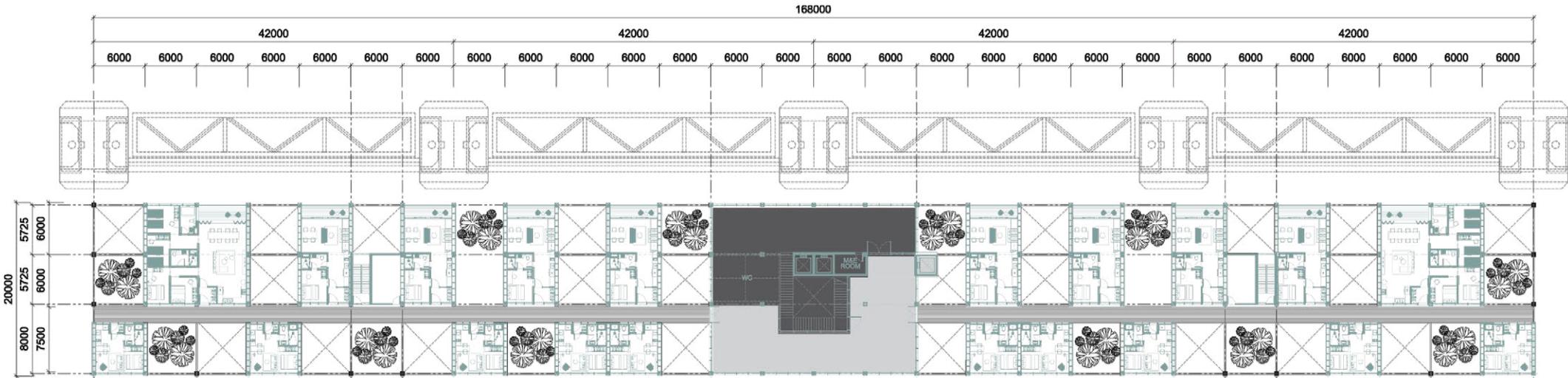
- 1** ACTIVE SOLAR SYSTEMS
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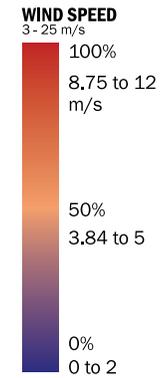
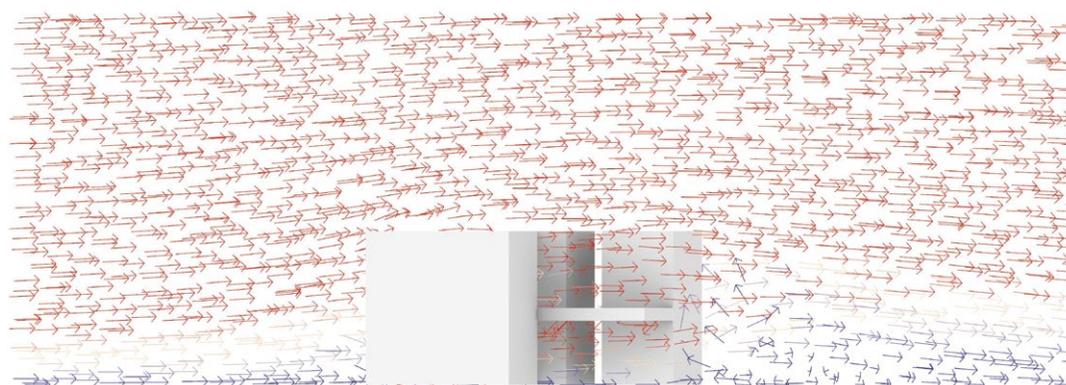
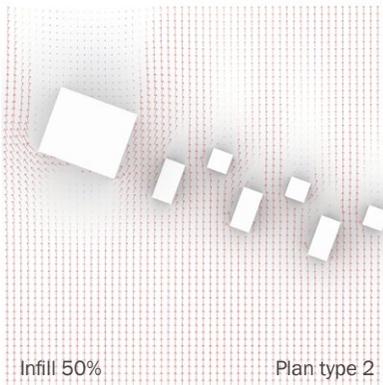
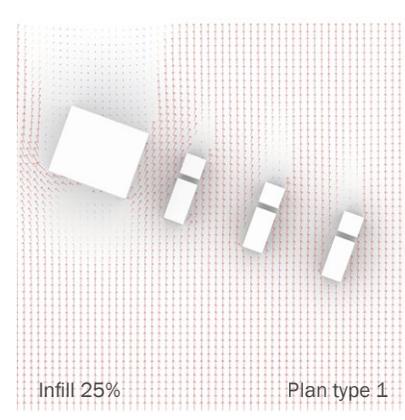
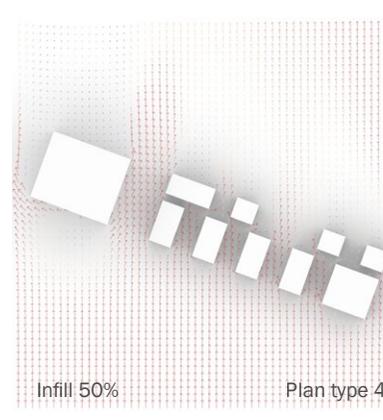
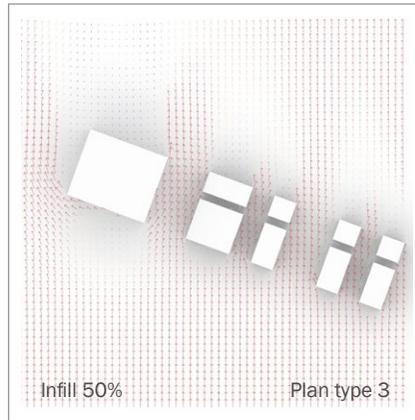
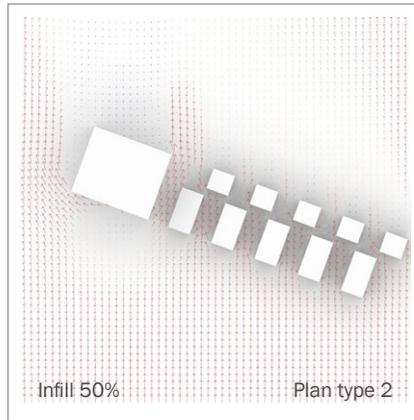
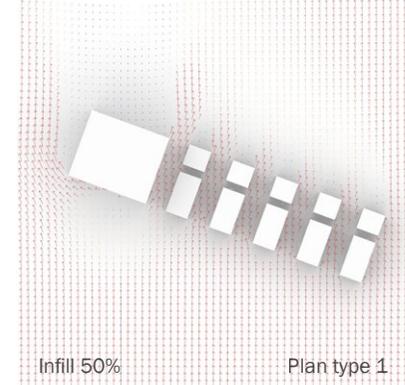
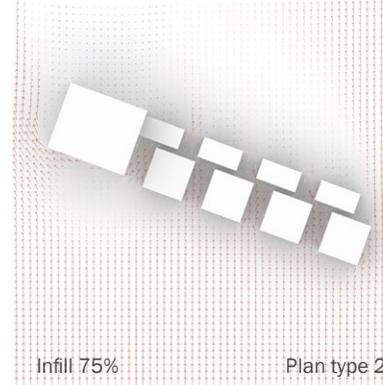
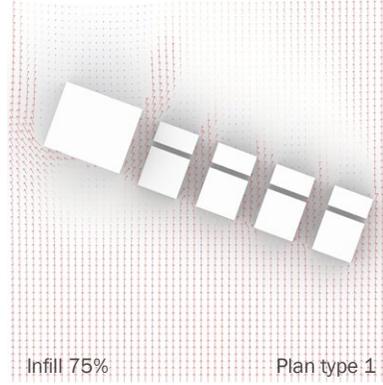
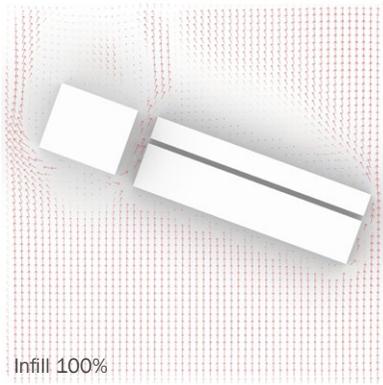
WIND SIMULATION

with final design

Room for wind



SPACE CONFIGURATION



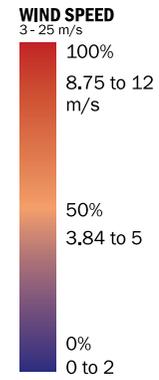
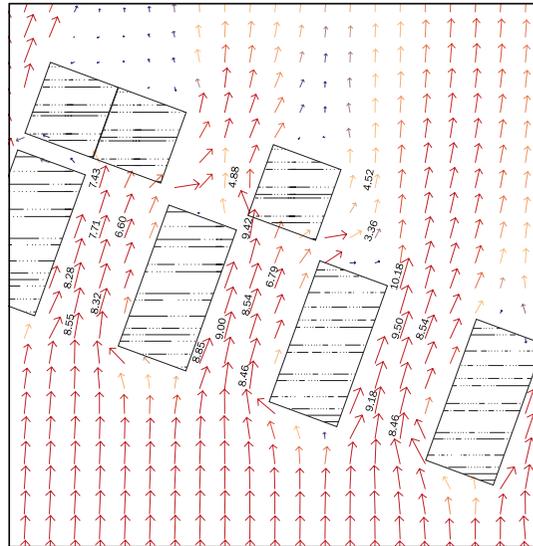
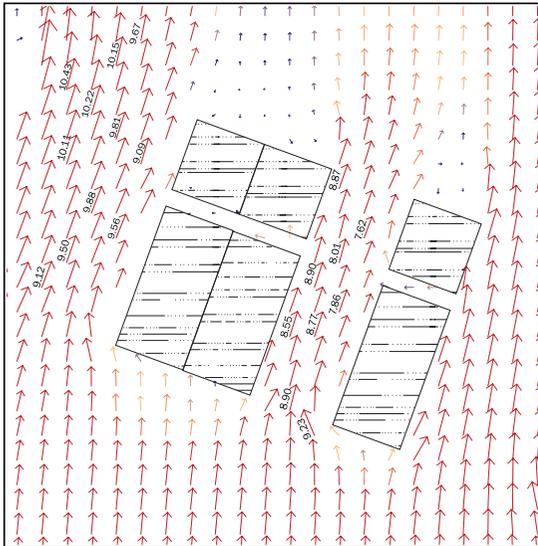
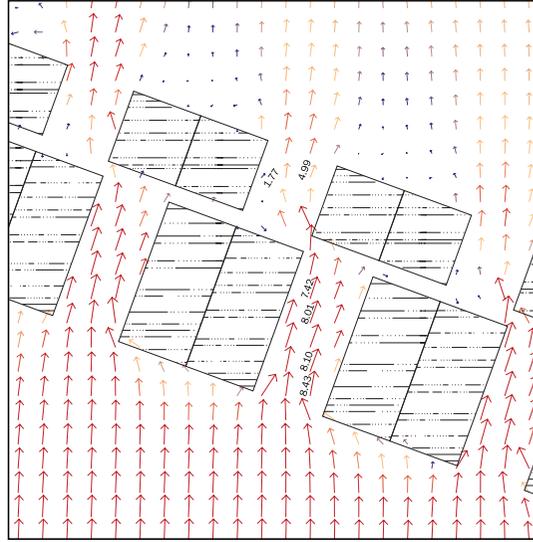
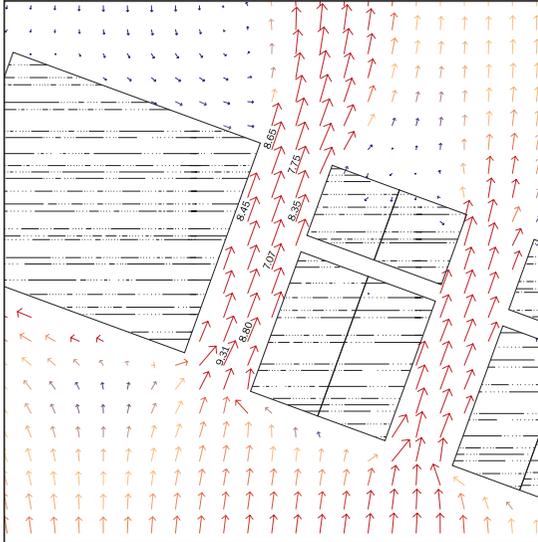
WIND SIMULATION

WIND SPEED STANDARD 3 - 25 m / sec

WIND SPEED ON SITE 8 - 11 m / sec

APPROXIMATE YEARLY 8.95 m / sec

HUMAN COMFORT 1 - 5 m / sec

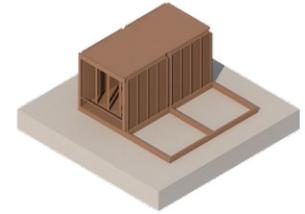




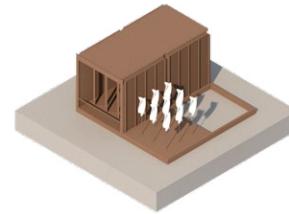
ROOMS FOR WIND



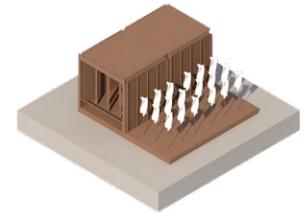
01 WIND ROOM = UNIT



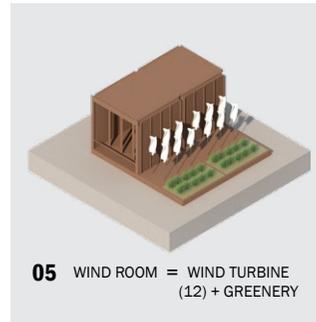
02 WIND ROOM = VOID



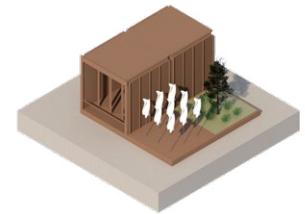
03 WIND ROOM = WIND TURBINE
(9) + VOID



04 WIND ROOM = WIND TURBINE
(18)



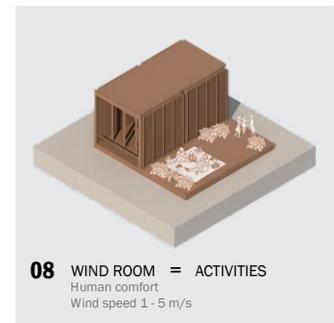
05 WIND ROOM = WIND TURBINE
(12) + GREENERY



06 WIND ROOM = WIND TURBINE
(9) + GREENERY



07 WIND ROOM = GREENERY



08 WIND ROOM = ACTIVITIES
Human comfort
Wind speed 1 - 5 m/s

ENERGY CONSUMPTION

PASSIVE HOUSE

No more than 120 kWh/m² per year
(Heating/Cooling/Electricity/etc.)



UNIT S
30 Sqm.



UNIT M
55 Sqm.



UNIT L
130 Sqm.

			WIND TURBINE	WIND ROOM (6 Turbinne)	SOLAR PANEL	WIND TURBINE + SOLAR PANEL (70/30)
25% Infill	20 Units	136,800 kWh/Year	20	3	375	14+113
50% Infill	38 Units	247,200 kWh/Year	36	6	677	25+203
75% Infill	56 Units	409,200 kWh/Year	60	10	1,120	42+336
100% Infill	88 Units	576,000 kWh/Year	84	14	1,578	59+474

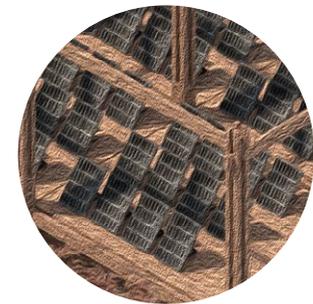
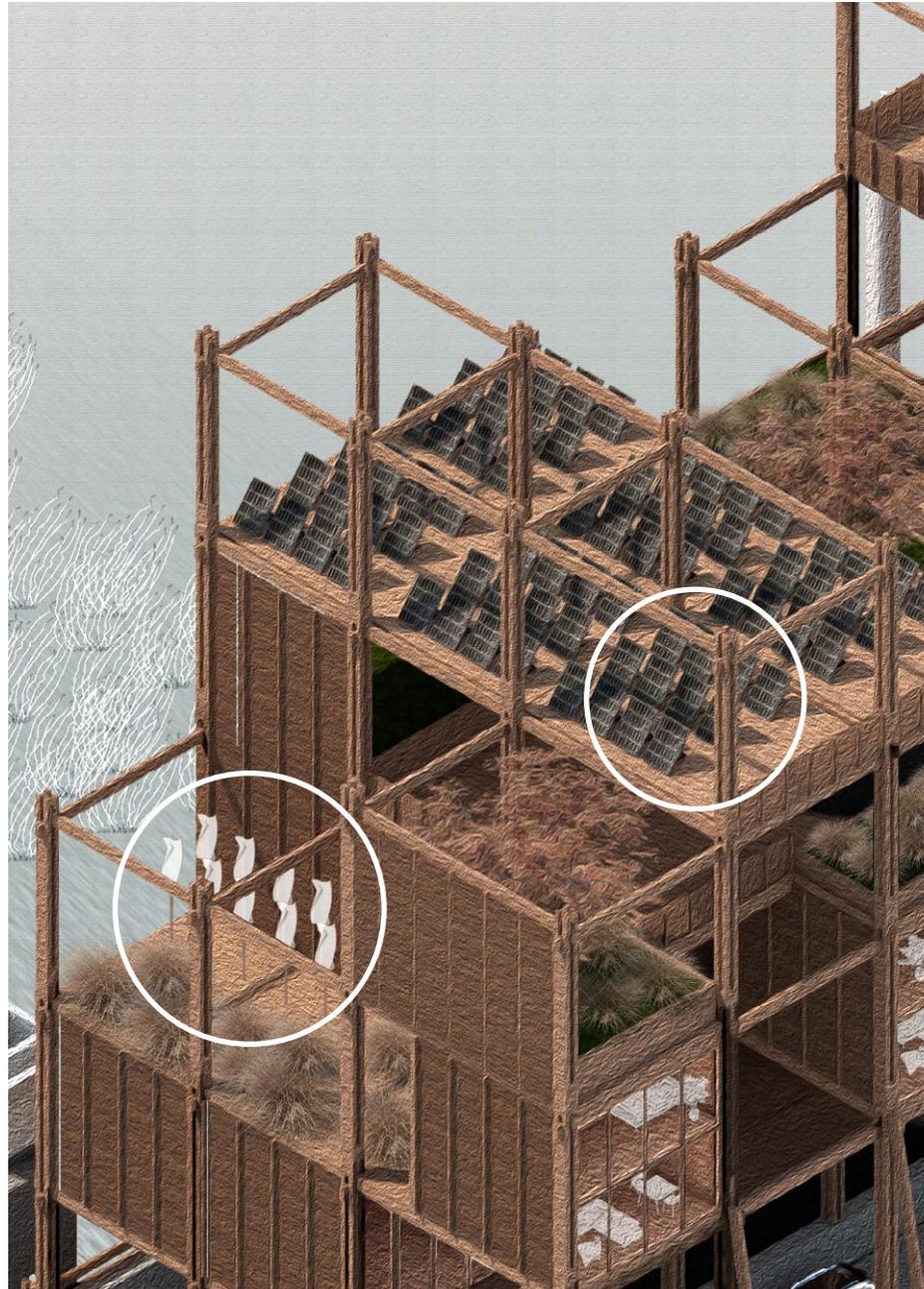
ENERGY CONSUMPTION



RESIDENTIAL WIND TURBINE

Produce the energy ranging 200 W
to 2000 W per wind turbine

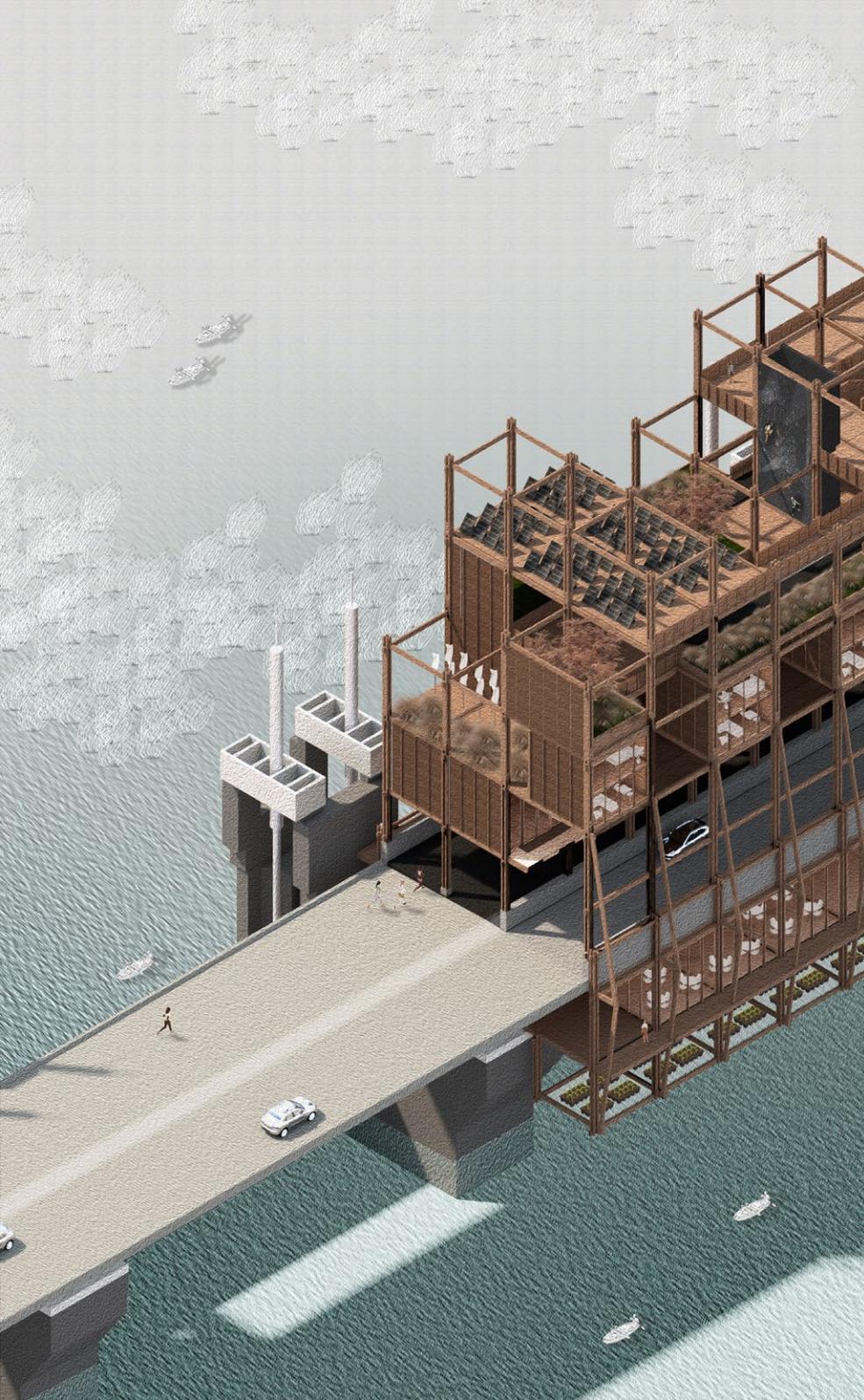
6,832.8 kWh/Wind turbine/year



SOLAR PANEL

Single panel typically produces
2 kWh / day

365 kWh/Panel/year



CONTENT

01 THE METHODOLOGY

RESERACH CONCLUSION
FROM RESEARCH TO DESIGN

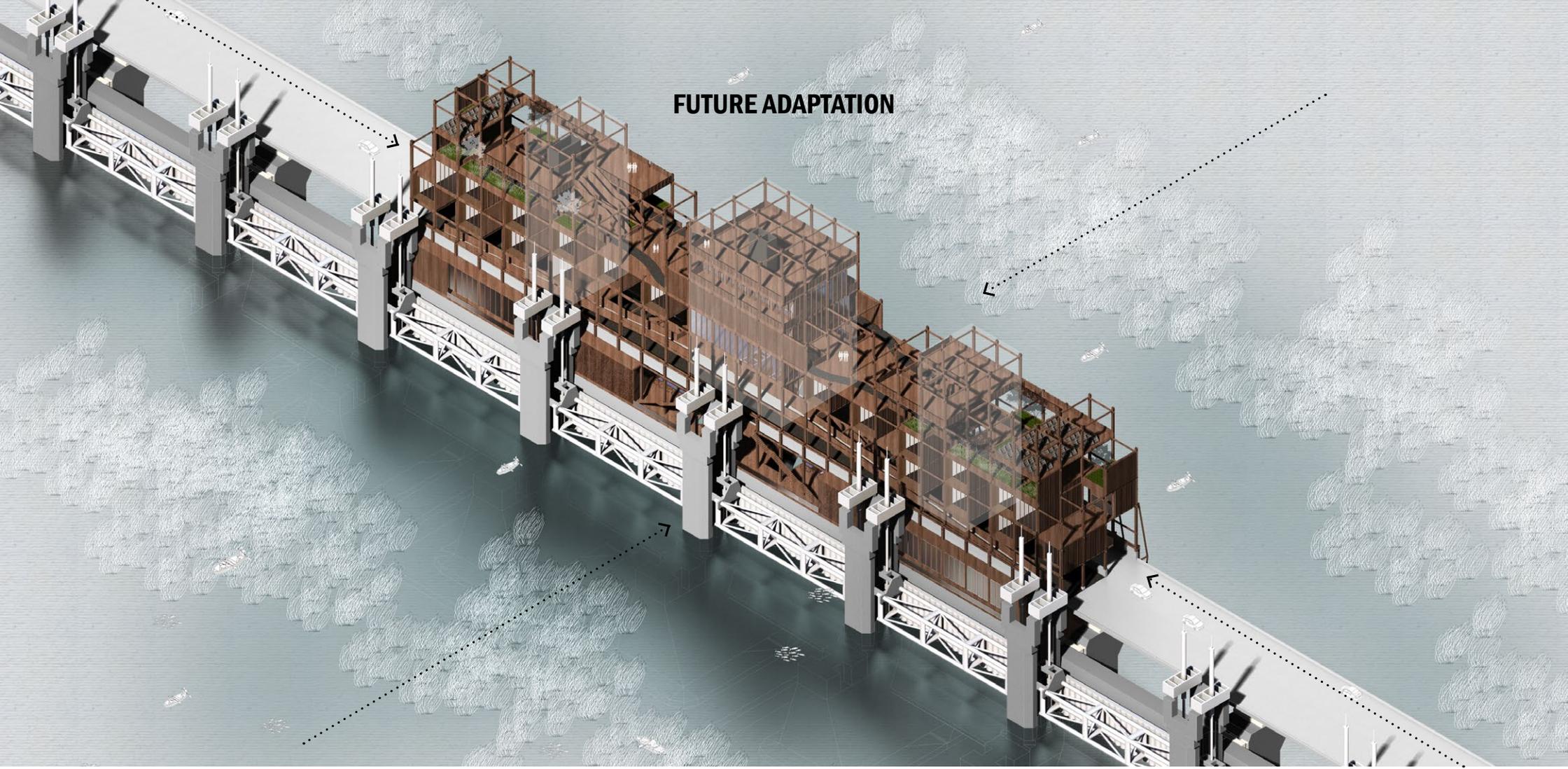
02 MULTIFUNCTIONALITY

URBAN SCALE
ARCHITECTURE SCALE

03 HYBRIDITY

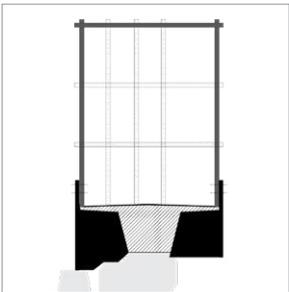
EXTREME CLIMATE
STRUCTURAL STABILIZATION
WIND SIMULATION

04 FUTURE ADAPTATION

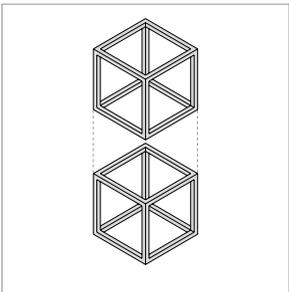


FUTURE ADAPTATION

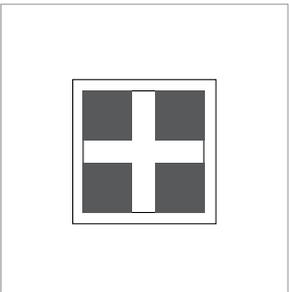
“FLOATING COMMUNITY HUB”



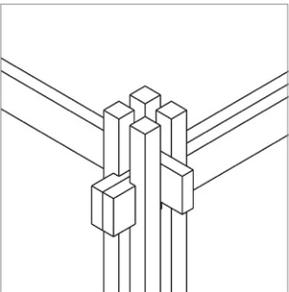
Structural Prototyping



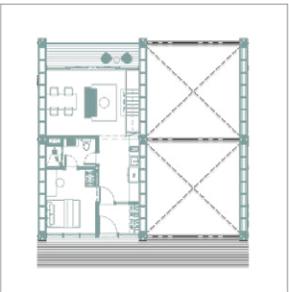
Modular Systems



4 Division Column

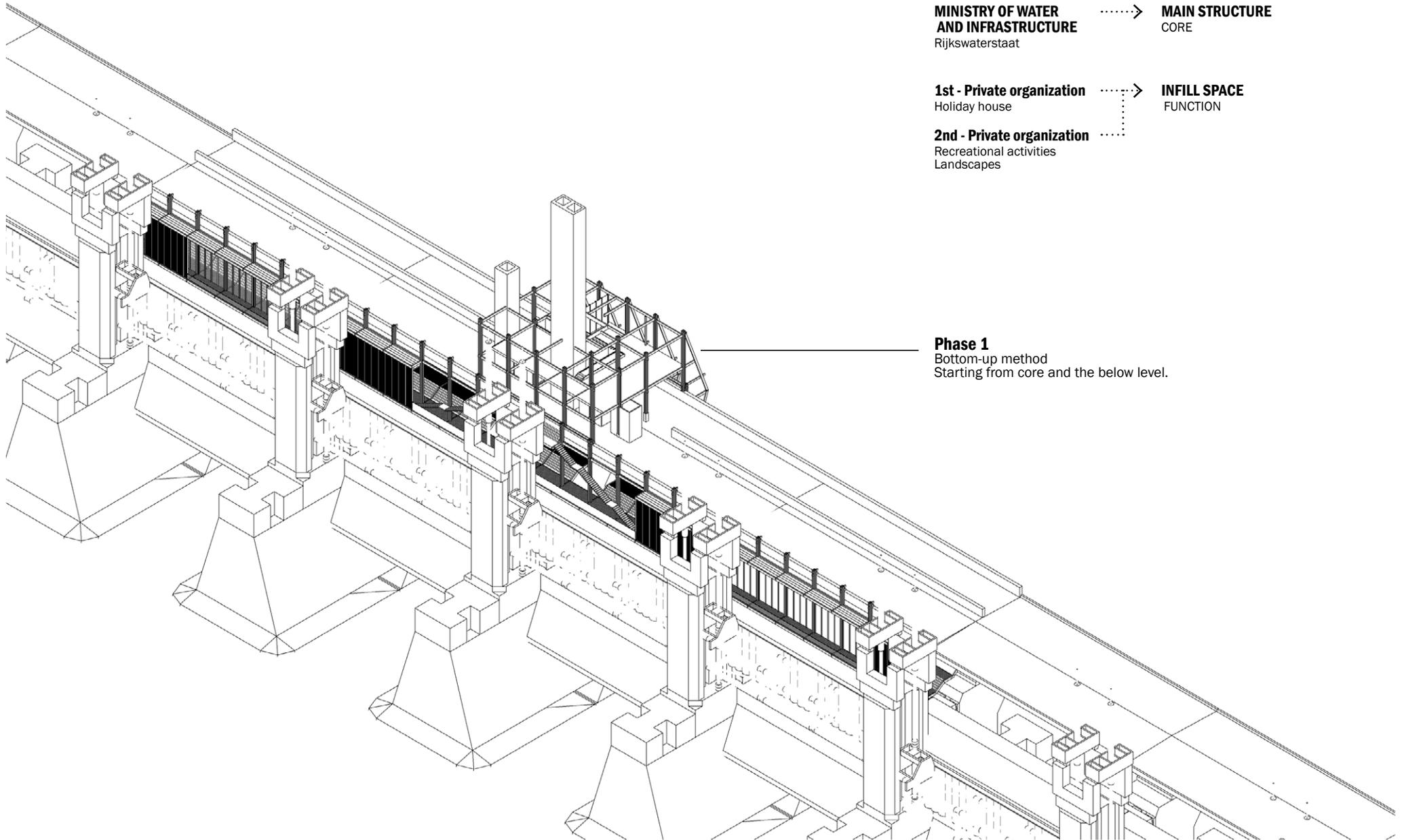


Wooden joinery



Room for Wind

CONSTRUCTION PHASING



**MINISTRY OF WATER
AND INFRASTRUCTURE**
Rijkswaterstaat



**MAIN STRUCTURE
CORE**

1st - Private organization
Holiday house

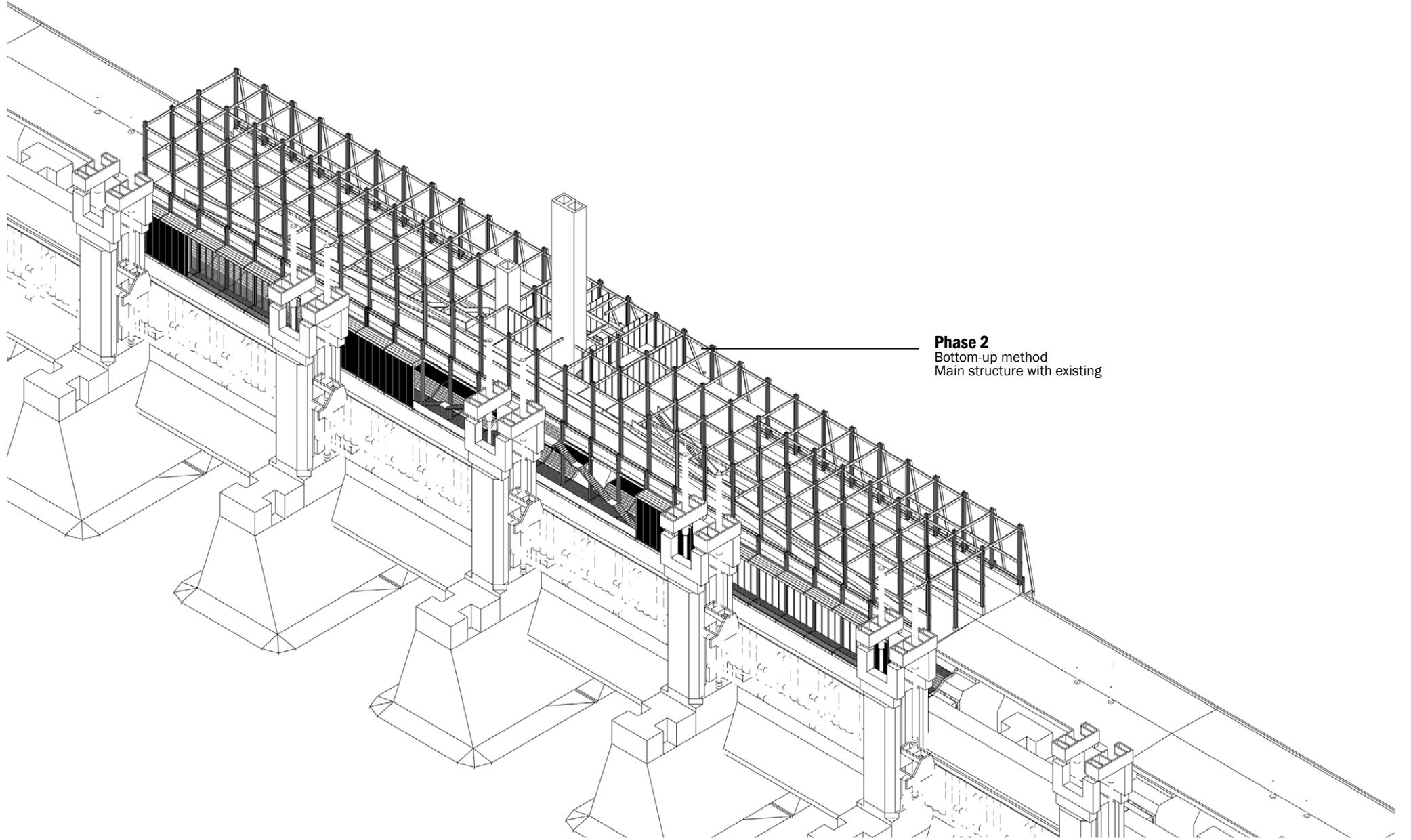


**INFILL SPACE
FUNCTION**

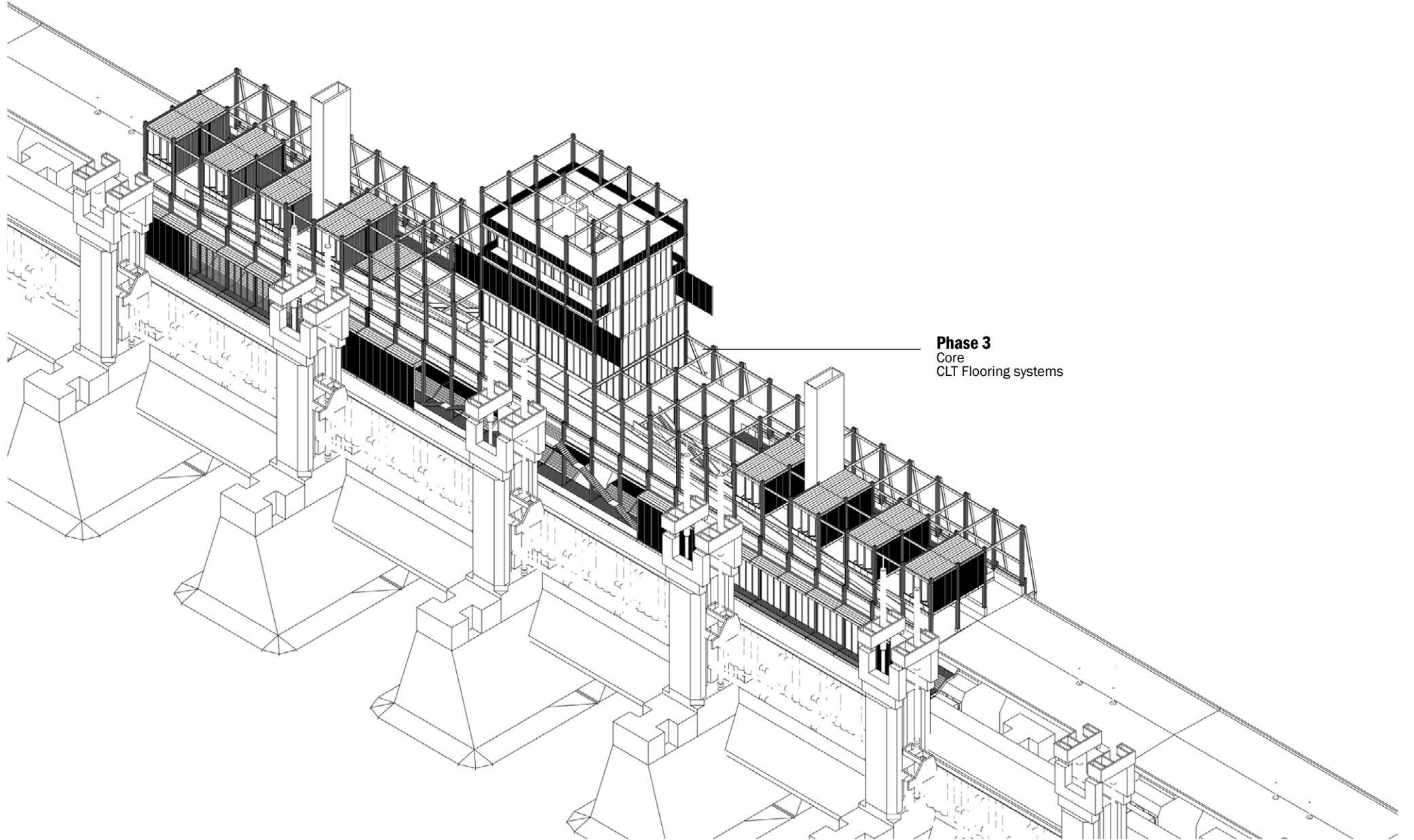
2nd - Private organization
Recreational activities
Landscapes



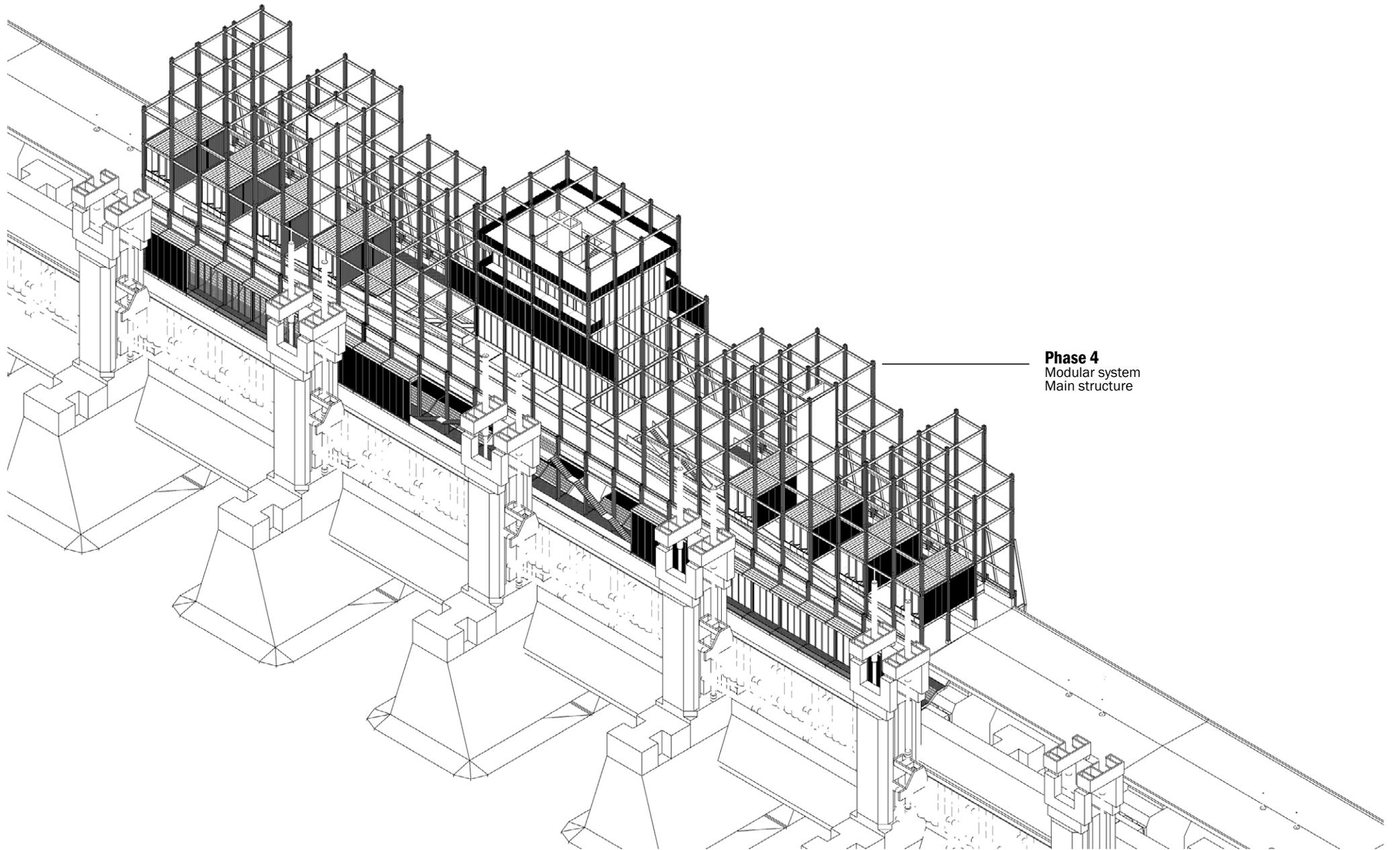
Phase 1
Bottom-up method
Starting from core and the below level.



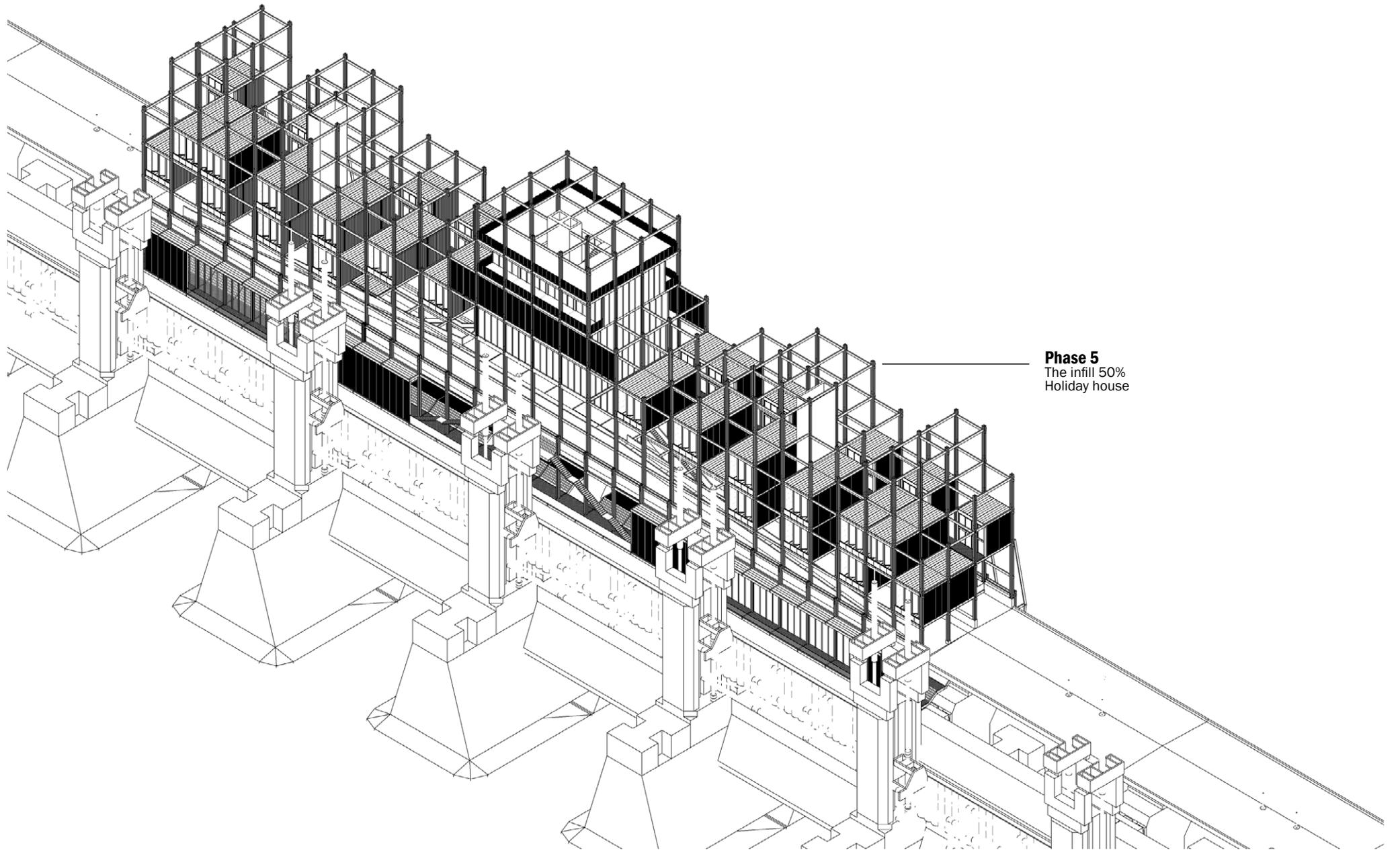
Phase 2
Bottom-up method
Main structure with existing



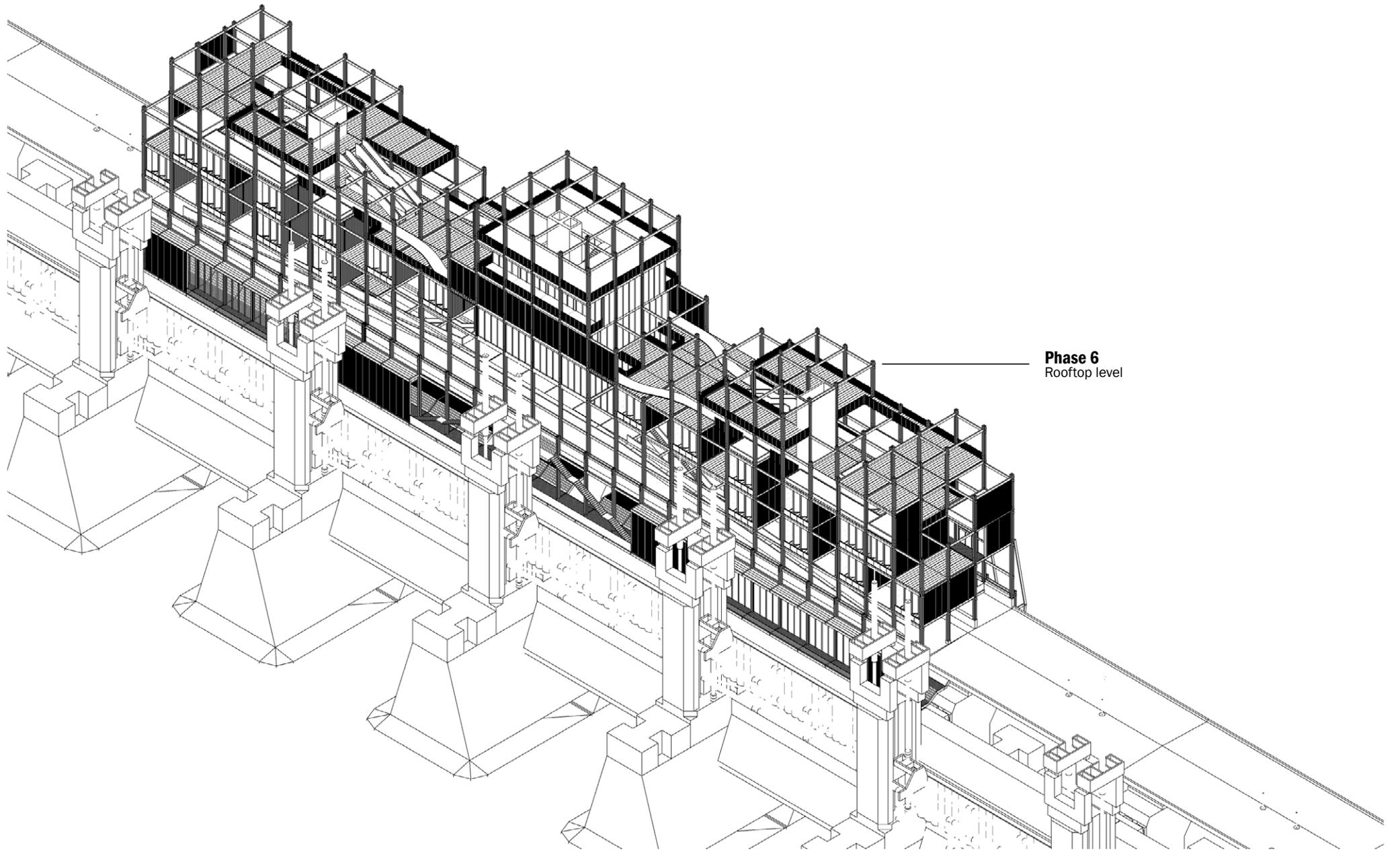
Phase 3
Core
CLT Flooring systems



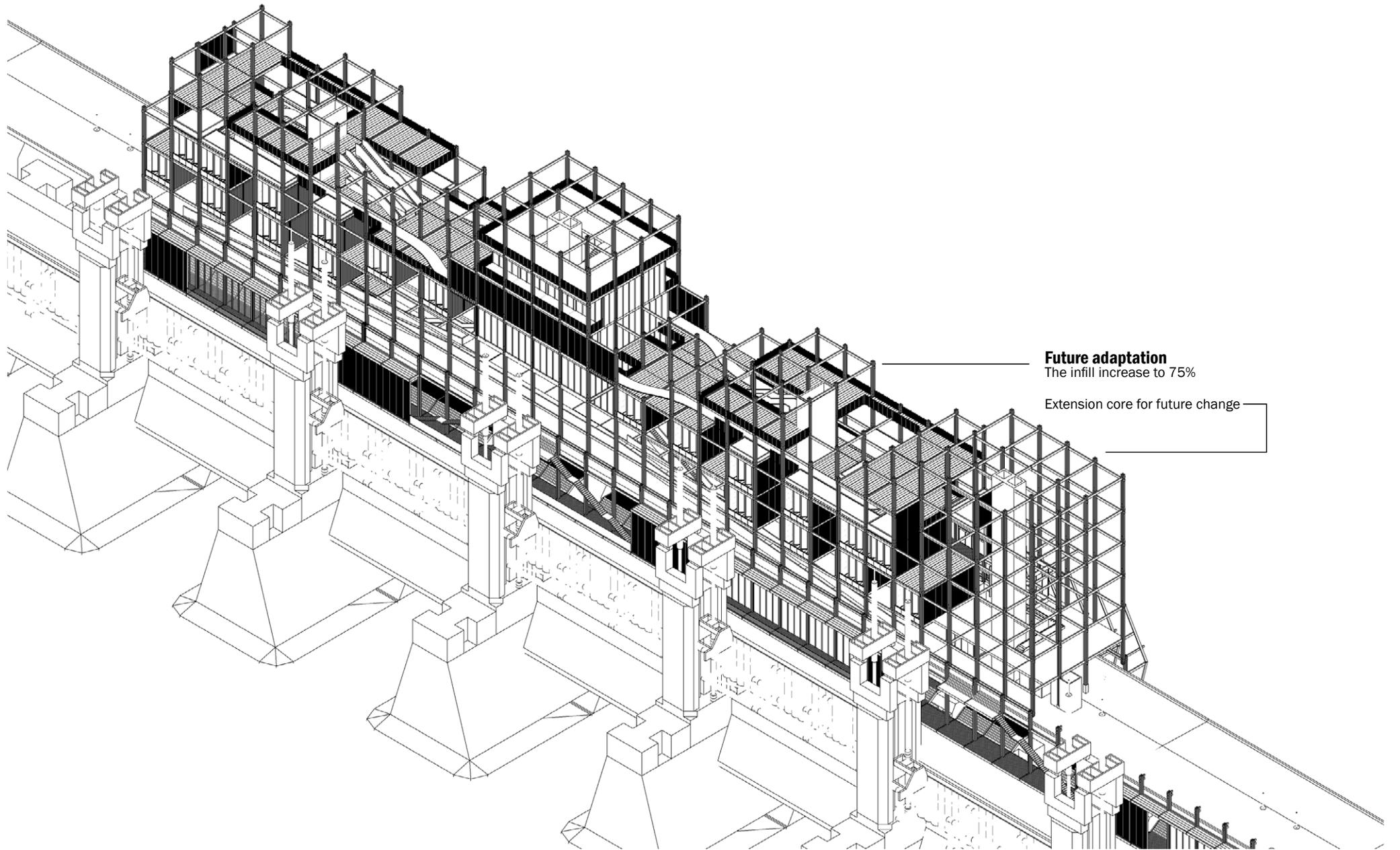
Phase 4
Modular system
Main structure



Phase 5
The infill 50%
Holiday house

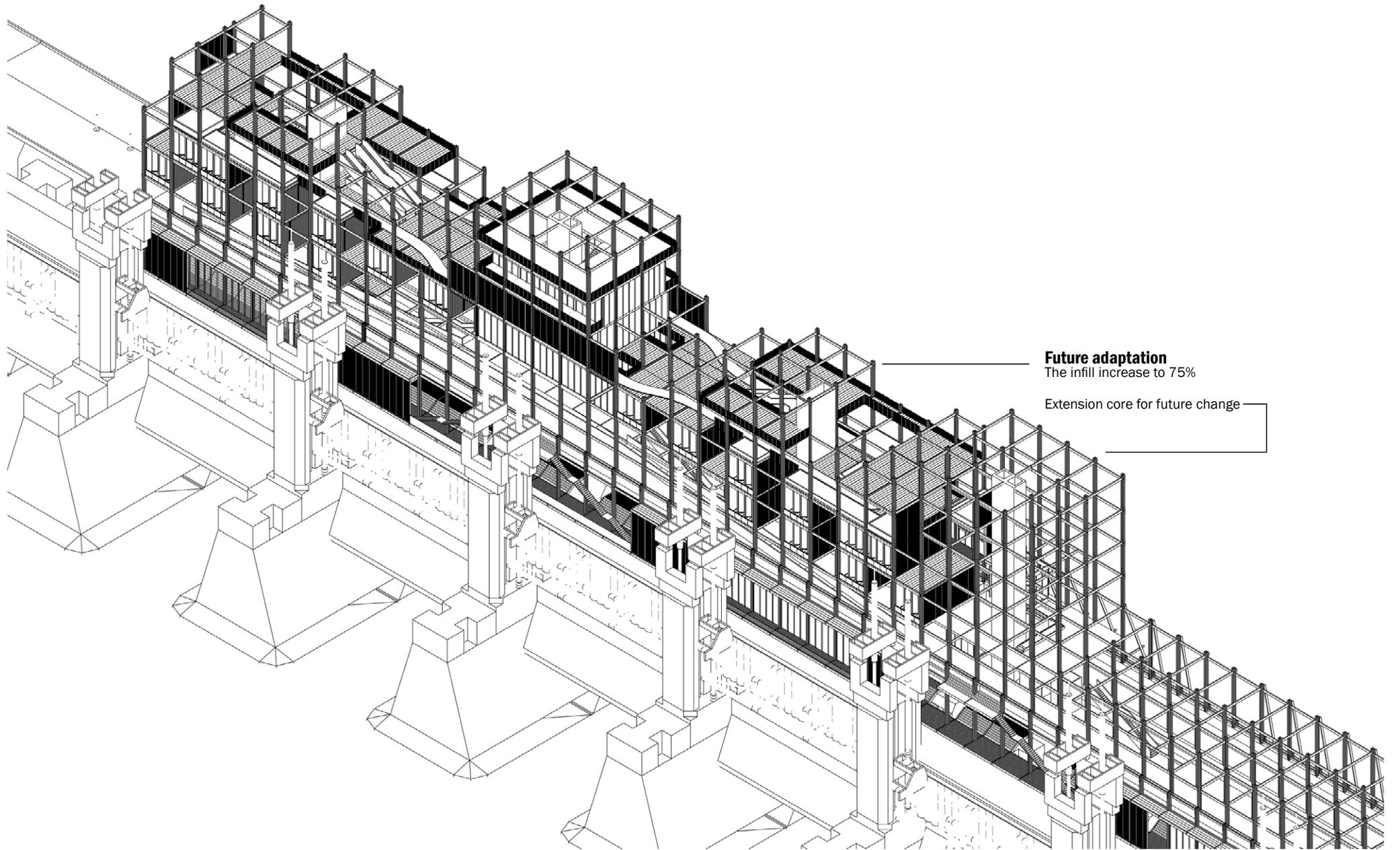


Phase 6
Rooftop level



Future adaptation
The infill increase to 75%

Extension core for future change



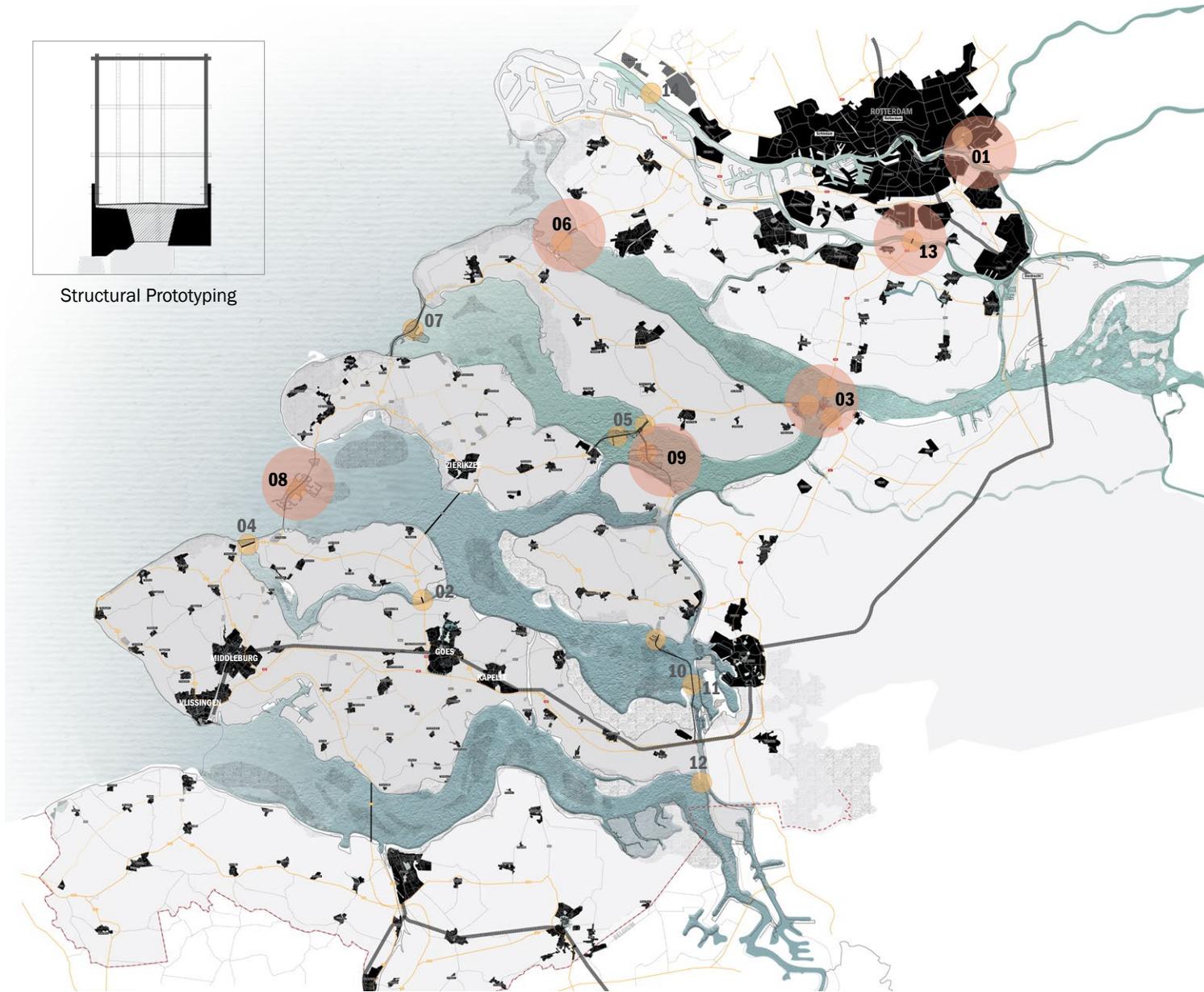
Future adaptation
The infill increase to 75%

Extension core for future change

FUTURE ADAPTATION



Structural Prototyping





1969

Volkerakdam



1971

Haringvlietdam



1987

Philipsdam



1997

Hartelkering



THANK YOU FOR YOUR ATTENTION!