INFLUENCE OF CLIMATE CHANGE

Hong Kong Climate Change Report 2015 released by the Environment Bureau reveals a cruel truth that all Hong Kong people and our offspring are and will be facing in the coming future: that we will suffer from a catastrophic disaster to our city caused by climate change. There are a few important things to be pointed out:

1. Temperature is rising gradually. Compared with the data recorded in 1880, the temperature in 2010 has been risen by about 1.5 °C. The annual number of hot nights and very hot days is increased significantly from less than 5 days in total in 1885-1914 to more than 30 days in 1985-2014, and the chance of having daily maximum temperature larger than 35 °C is 22% in early 21st century compared with 3% in early 20th century.

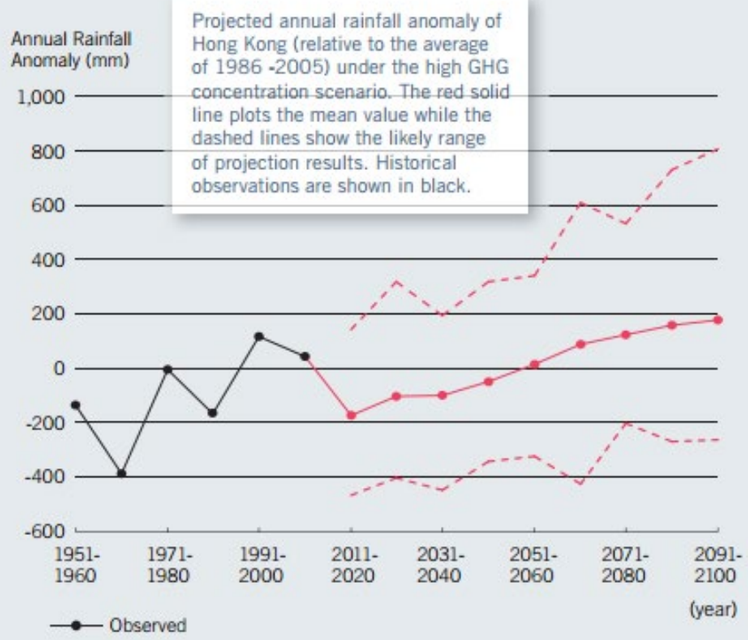
2. More extreme rainfall. As estimated, the number of extremely wet years is expected to increase from 3 in 1995-2005 to about 12 in 2006-2100. Besides the annual rainfall in last 21st century is expected to rise about 180 mm when compared to the 1986-2005 average abnormal annual rainfall. Extreme rainfall events will also become more frequent this century. Heavier rainfall means larger loading requirement on the drainage system and once the amount of the collected rainwater exceeds the storage capacity of rainwater reservoir and meanwhile the sea level rise above the discharging level, flooding will occur in the city.

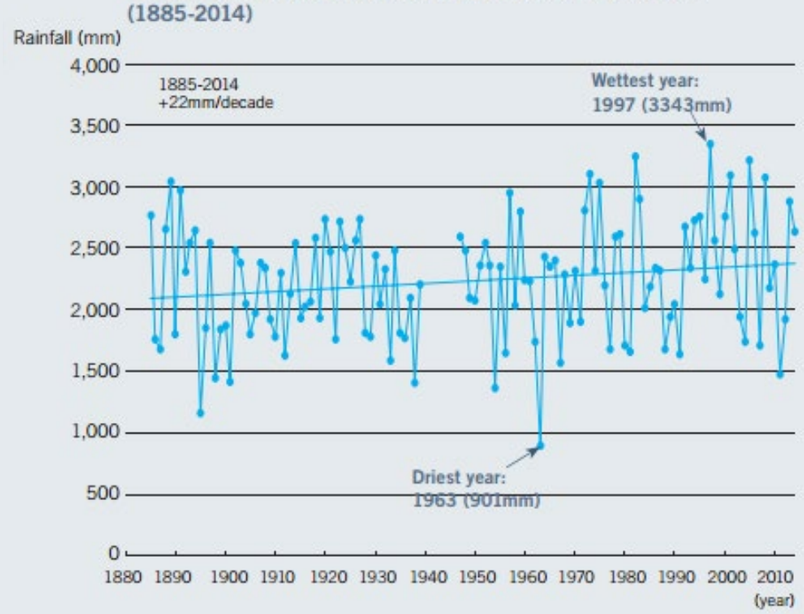
3. Due to global warming, sea level has been recorded constant increase since 1950. Sea level rose at a rate of 30mm per decade in Victoria Harbor and is estimated to reach 1m increase at the end of the century.

"A major impact is an increase in sea flooding associated with storm surges caused by tropical cyclones. The extreme sea level brought by storm surges of the same typhoon will be higher when the mean sea level is raised."

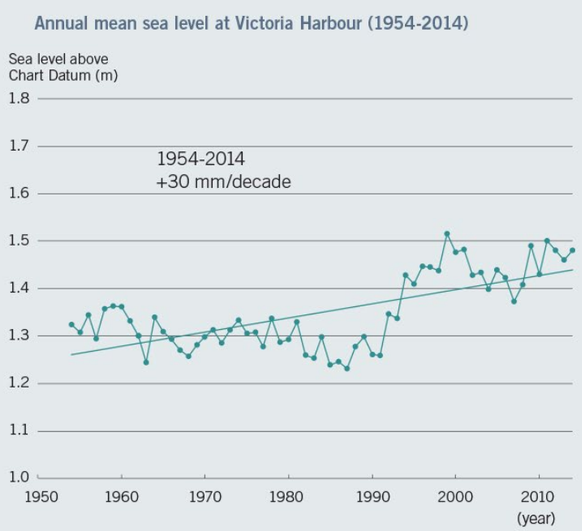
1. RAINFALL

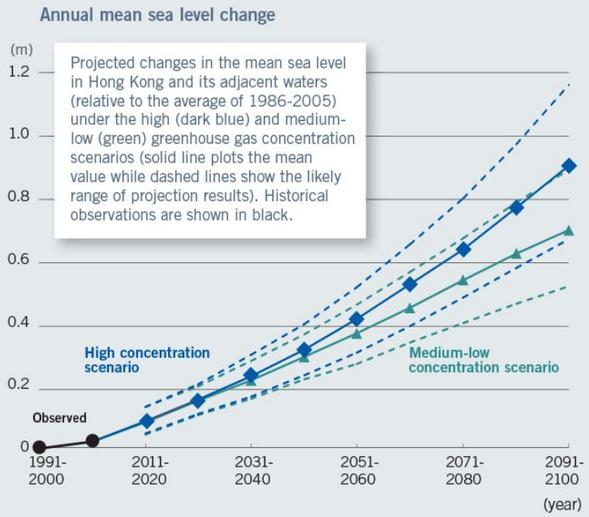
Under the IPCC's latest 'high' global GHG emissions scenario, the number of extremely wet years is expected to increase from 3 in 1885-2005 to about 12 in 2006-2100. Besides, the annual rainfall in late 21st century is expected to rise by about 180 mm when compared to the 1986-2005 average. Extreme rainfall events will also become more frequent this century.



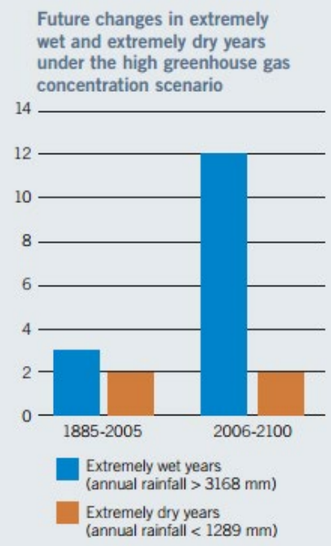


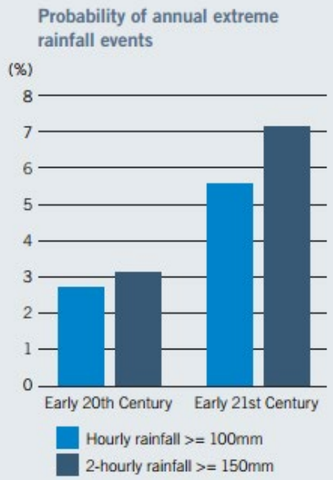
ANNUAL RAINFALL



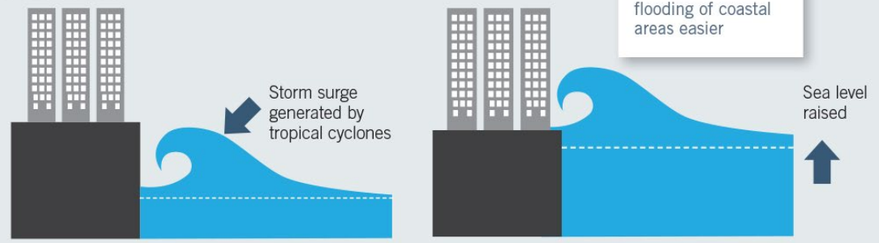


3. EXTREME WEATHER





4. FLOODING



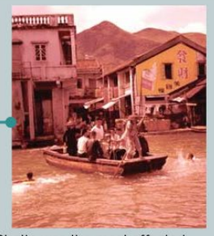
Return period (year)	Extreme sea level above Chart Datum (m)				Historical Typhoons bringing significant storm surges to Hong Kong (Maximum sea level above Chart Datum at Victoria Harbou)
	Current	Sea level rise reaching 0.26m in 2021-2040	Sea level rise reaching 0.53m in 2046-2065	Sea level rise reaching 1.07m in 2081-2100	
1	2.7	3.0	3.2	3.8	T. Hagupit in 2008 (3.53m)
2	2.9	3.2	3.4	4.0	
5	3.1	3.4	3.6	4.2	T. Wanda in 1962 (3.96m)
10	3.3	3.6	3.8	4.4	Typhoon in 1937 (4.05m)
20	3.4	3.7	3.9	4.5	
50	3.5	3.8	4.0	4.6	

Projected changes in return values of extreme sea level events in 2021-2040, 2046-2065 and 2081-2100 under the high GHG concentration scenario

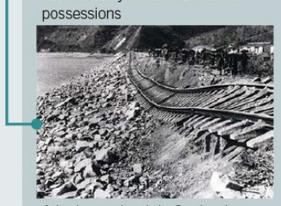
Severe Flooding in Tai O during passage of Typhoon Hagupit in 2008

Damages to ships and piers at Central, Hong Kong Island, brought by severe storm surge during the great typhoon of 1874 (The maximum sea level above Chart Datum might reach 5.2m as estimated by model simulation)

(Photo courtesy: Mr Shun Chi-ming)



Shatin was the most affected area, with 150 people killed, 100 injured and 100 missing during the passage of Wanda in 1962. Streets and houses were flooded and destroyed. Boats were used to ferry families and their possessions



A typhoon struck in September 1937, causing the loss of more than 10,000 lives. The Kowloon-Canton Railway track at Shatin was damaged by storm surge brought by the Typhoon.

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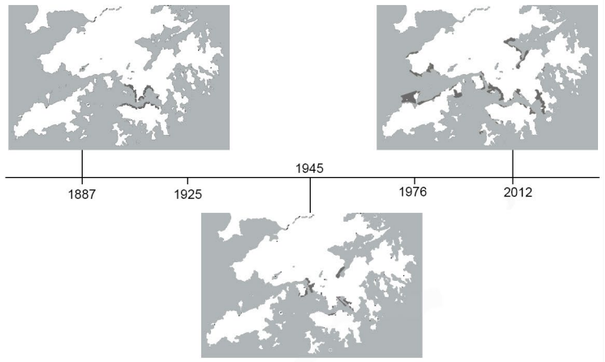
RECLAMATION AND FLOODING



HISTORICAL COASTAL LINE SHIFTING

Due to constant pressure of population growth, the need for residential and commercial expansion and the consequential issues such as traffic, rent, commuting time have became more and more imminent. Hong Kong Government had adopted multiple reclamation projects since 1860s to expand the city.

RECLAMATION PROBLEM

Reclamation involves in creation of large area of flat land with altitude only a few meters above sea water, which will lead to flooding problems if the coastal area is hit by storm and typhoon. The situation will become more and more frequnt in the future because of climate change

SUPER TIDE

Super Typhoon has once caused high tide and therefore flooding in Hong Kong.

As climate change continues and sea level rises constantly, super tides will be created by another super Typhoon at end of the century which will be 8 meter high and flood all the low-lying coastal area of Hong Kong.

STRENGTHENING WAVE

A few centermeters rises in sea level will cause multiple times of rises of wave under the rages of storms and typoon

POTENTIAL FLOODING ZONE

High → Low

3.7 *Times*
2005-2100
66.3 to 113mm
1954-2014
30mm

Sea Level Change per Decade

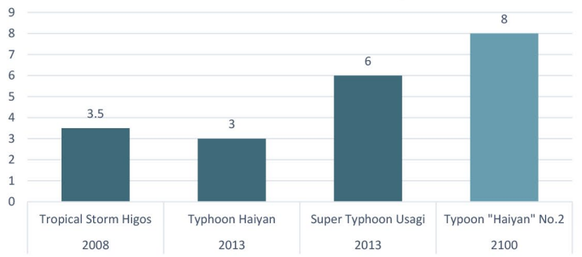
2.49 *meters*
2081-2100
rise 0.63m to 1.07m
1986-2005
1.42mm

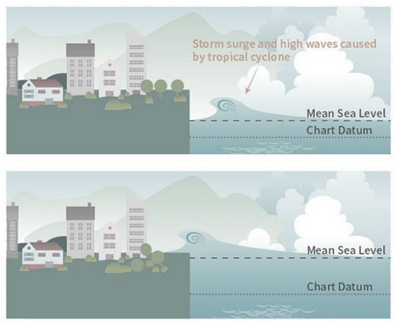
Sea Level Average Altitude

1.42 *meters*
Sea Level (above Chart Datum)

Sea Level in 2014

Tidal Height Caused by Super Typhoon



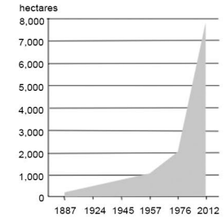


MAINLAND
DEEP BAY
Plover Cove Reservor
4,750 hectares
NEW TERITORIES AND KOWLOON
TAI PO
NEW TERRITORIES
MA LIU SHUI
MA ON SHAN
SHA TIN
SAI KONG
TSUEN MUM
TSUEN WAN
TSING YI
300 hectares
TSING YI
KOWLOON BAY
KOWLOON
DISNEY LAND
DISCOVERY BAY
HONG KONG ISLAND
CYBERPORT
ABERDEEN
1795 hectares
LANTAU ISLAND
LAMMA ISLAND
LAMMA ISLAND
66 hectares
HONG KONG ISLAND
826 hectares

1.2m
1.0m
0.8m
0.6m
0.4m
0.2m
0.0m
-0.2m
-0.4m
-0.6m

1991-2000
2011-2020
2031-2040
2051-2060
2071-2080
2091-2100

TOTAL
7,737 hectares reclamation since 1837



Medium-low concentration scenario
High concentration scenario

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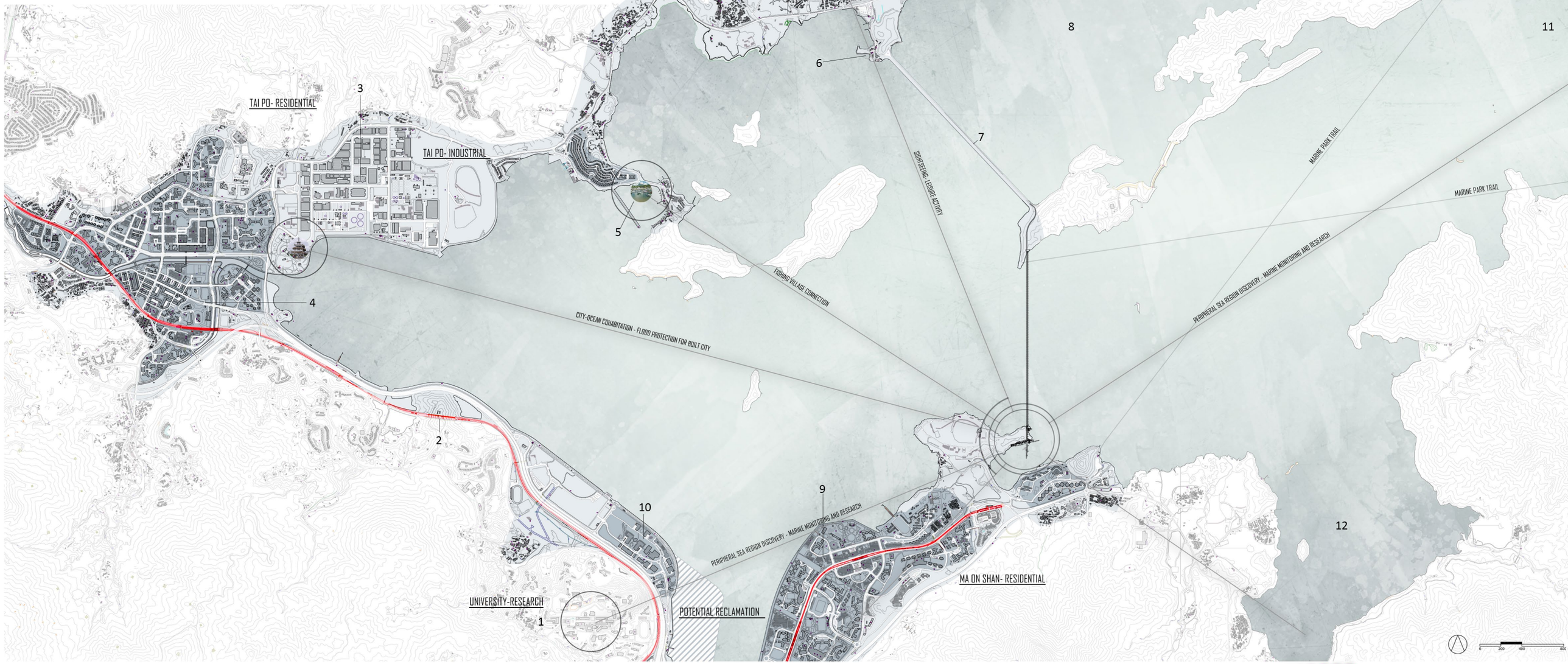
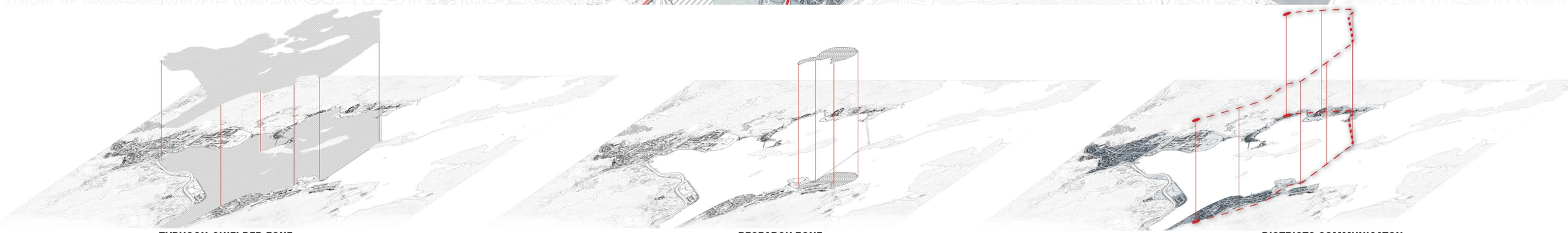
1 Chinese University of Hong Kong
2 MTR Line
3 Tai Po Industrial Area
4 Tai Po Residential Area
5 Sam Mum Tsai Fishing Village
6 Tai Mei Tuk Sports Centre
7 PLover Cove Dam
8 Plover Cove Reservoir
9 Ma On Shan Residential Area
10 Science Park
11 Exit to Mires Bay
12 Three Pathoms Cove





TYPHOON-SHIELDED ZONE
Protected by flooding control structure across Tolo Harbor

RESEARCH ZONE
A natural shelter which enrich the diversity of marine environment and creatures.

DISTRICTS COMMUNICATON
Connection across the Tolo Harbor allows the communication between coasts.

PROPOSED SITE

This project proposed Tolo Harbour as the site for experimentation. Tolo Harbour is a sheltered harbour in northeast New Territories of Hong Kong. The geographical profile of Tolo Harbour is funnel-shaped with larger inner water surface and a much narrower inlet connecting to the open sea with mountains surrounding on three sides, this will enhance the intensity of wind speed and make Tolo Harbour the most susceptible location to storm surge tide and sea level rise. Records shown that the highest storm tide was 6m in the Tolo Harbour. A deadly typhoon, struck on September 1937, pushed a great tidal surge that flooded the whole Tolo harbor and swamped villages which caused 11,000 people died. In view of the potential flooding risk in Tolo Harbour, this proposal proposed a flood control device built across Tolo Harbour that connects the existing of Plover Cove Dam and the coast of Ma On Shan. The flood control device normally opens to allow the flow of the sea water to flush away the pollutants generated by the sewage from the city but closes when there is a rise of external sea level to prevent the water from pouring into the core area of the city.

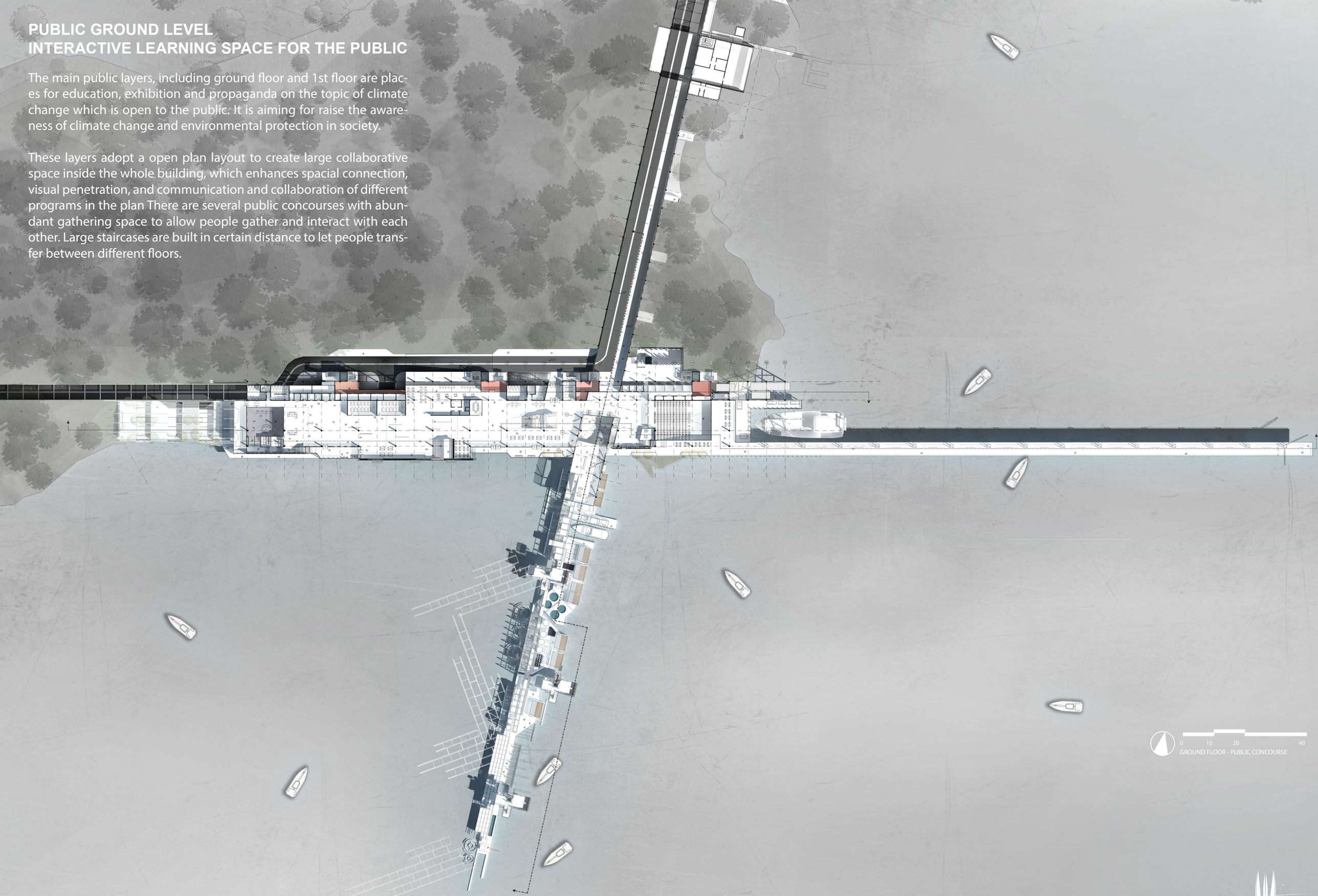
FLOODING CONTROL - COMPREHENSIVE STRATEGY

This proposal is a fully integrated design: Flooding Control structure for flooding control; Research building for marine and climate research and education; Floating platform for on-site experiment and as an experimental model for nearshore development over sea surface. The design tries to generate a vision for the future development/expansion of the city, an alternative method for habitation along the coastal edge while providing flooding protection for the city.

PUBLIC GROUND LEVEL
INTERACTIVE LEARNING SPACE FOR THE PUBLIC

The main public layers, including ground floor and 1st floor are places for education, exhibition and propaganda on the topic of climate change which is open to the public. It is aiming for raise the awareness of climate change and environmental protection in society.

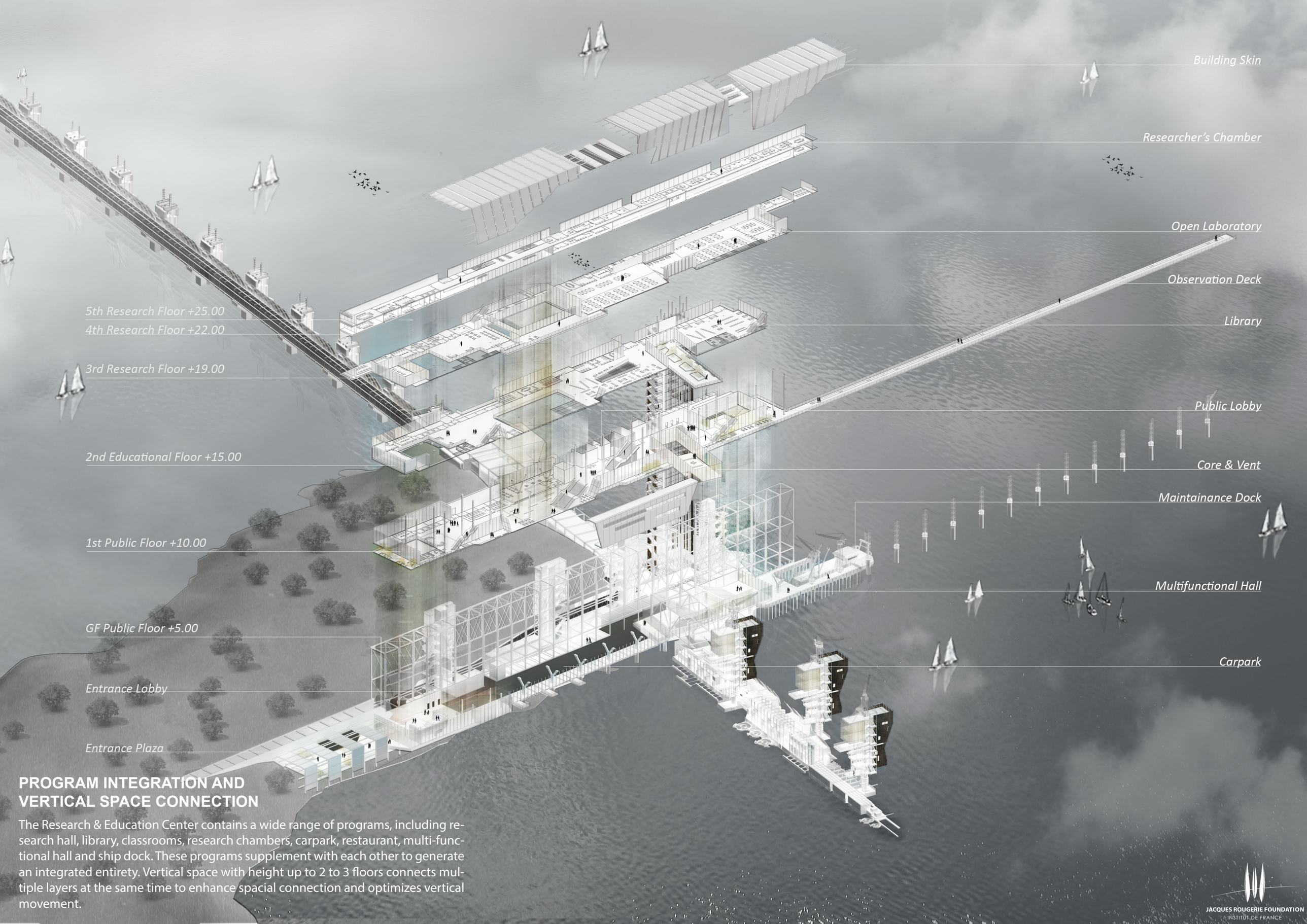
These layers adopt a open plan layout to create large collaborative space inside the whole building, which enhances spacial connection, visual penetration, and communication and collaboration of different programs in the plan There are several public concourses with abundant gathering space to allow people gather and interact with each other. Large staircases are built in certain distance to let people transfer between different floors.



GROUND FLOOR - PUBLIC CONCOURSE

MONITORING TOWER, OBSERVATION DECK AND MAINTENANCE DOCK

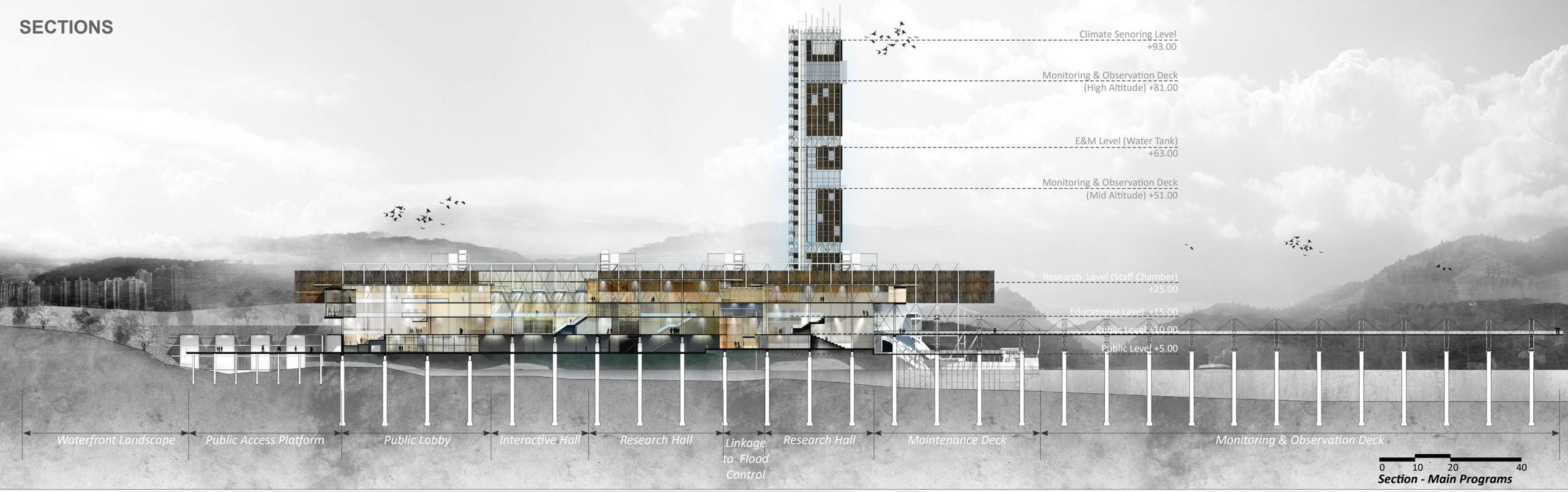
The observation sky-bridge extends from the main research building with height up to 10 meters. It provides an observation and monitoring deck with 70m distance away from the shore and allows small ship passing underneath. The maintenance dock allows docking of maintenance ships for the maintenance works in the flooding control structure.

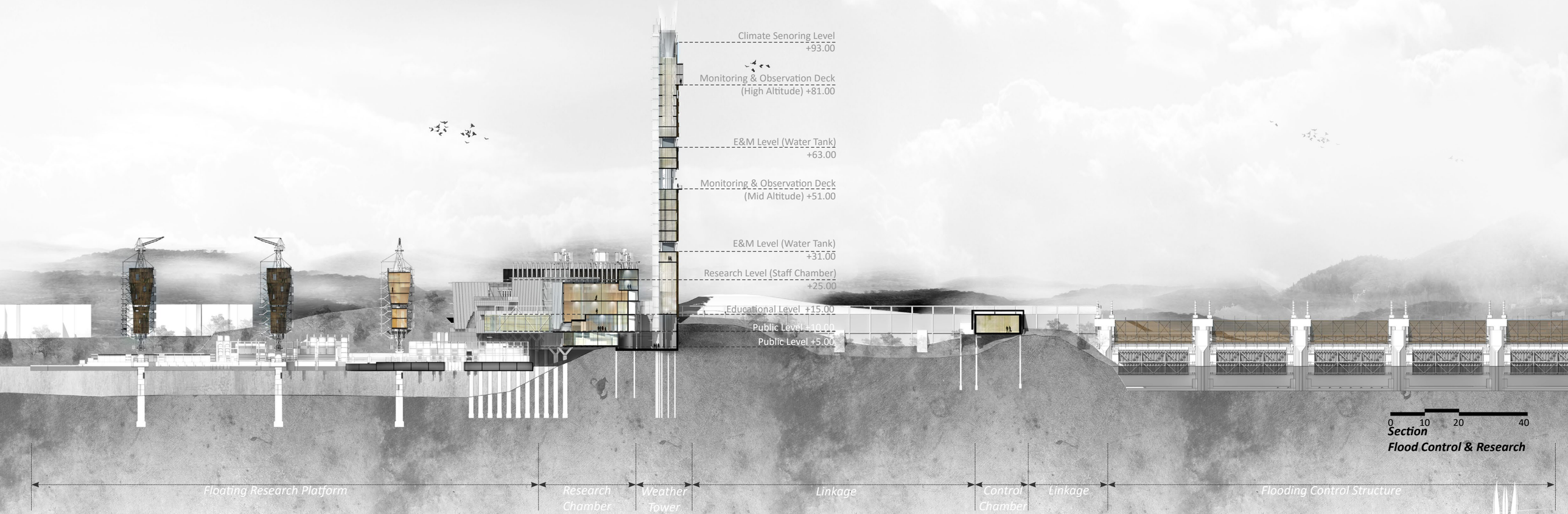


PROGRAM INTEGRATION AND VERTICAL SPACE CONNECTION

The Research & Education Center contains a wide range of programs, including research hall, library, classrooms, research chambers, carpark, restaurant, multi-functional hall and ship dock. These programs supplement with each other to generate an integrated entirety. Vertical space with height up to 2 to 3 floors connects multiple layers at the same time to enhance spacial connection and optimizes vertical movement.

SECTIONS

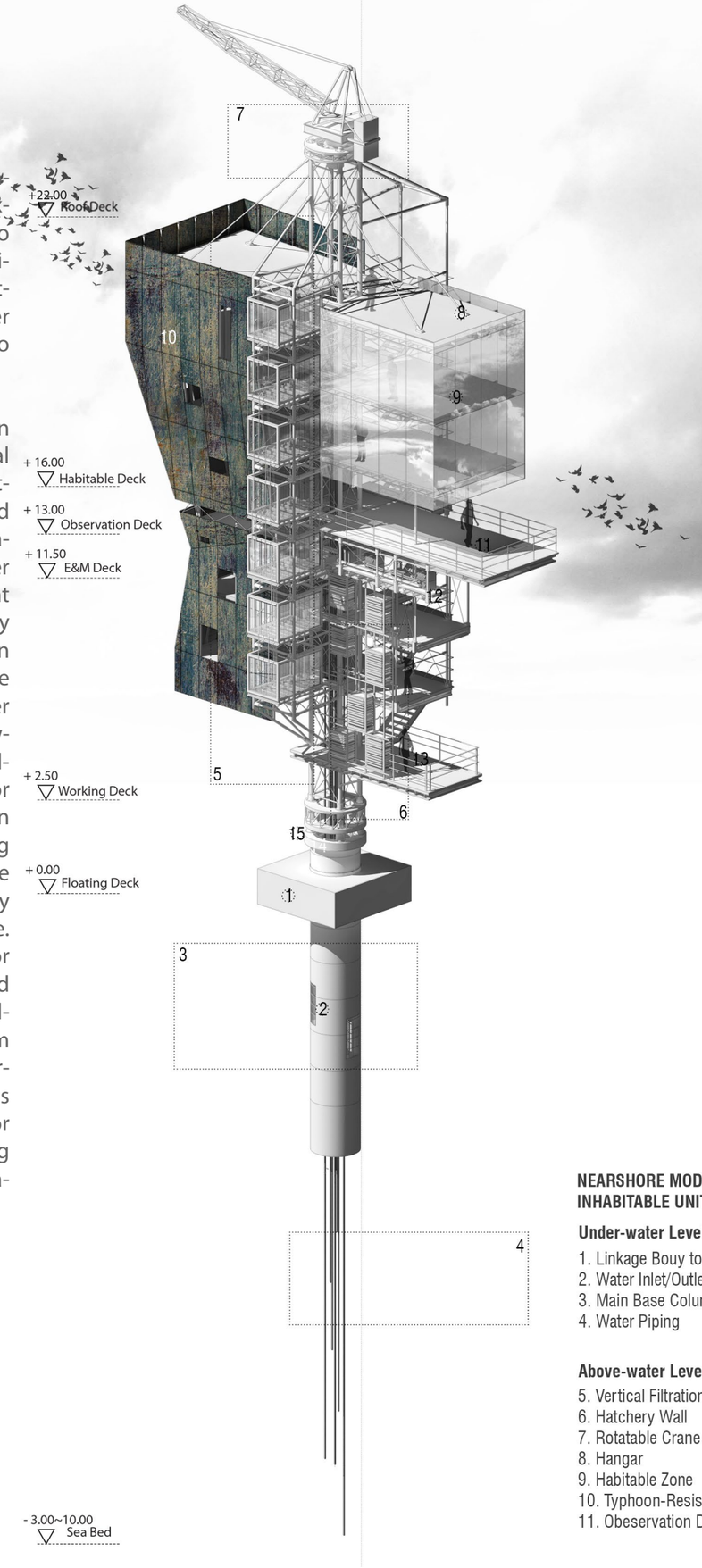




NEARSHORE MODULARIZING INHABITABLE UNIT

The modularizing inhabitable unit is an experimental prototype to demonstrate the possibility of building inhabitable structure over water so as to allow people to live and work nearshore.

For the model shown left, it consists of several working decks protected by this wind-shielded facade, a vertical filtration system for the water treatment for experiment purpose, and a hatchery wall to for the cultivation of aqua creatures. The upper part of the tower is connected to the lower main structural column with base isolator installed in the junction which is for absorbing vibration from the wave and maintaining stability of the whole structure. Water pipe and sensor pass through the void in the middle of the column and reach out from the inlet/outlet underwater. This platform acts as a small workshop or research chamber being built in the nearshore water area.



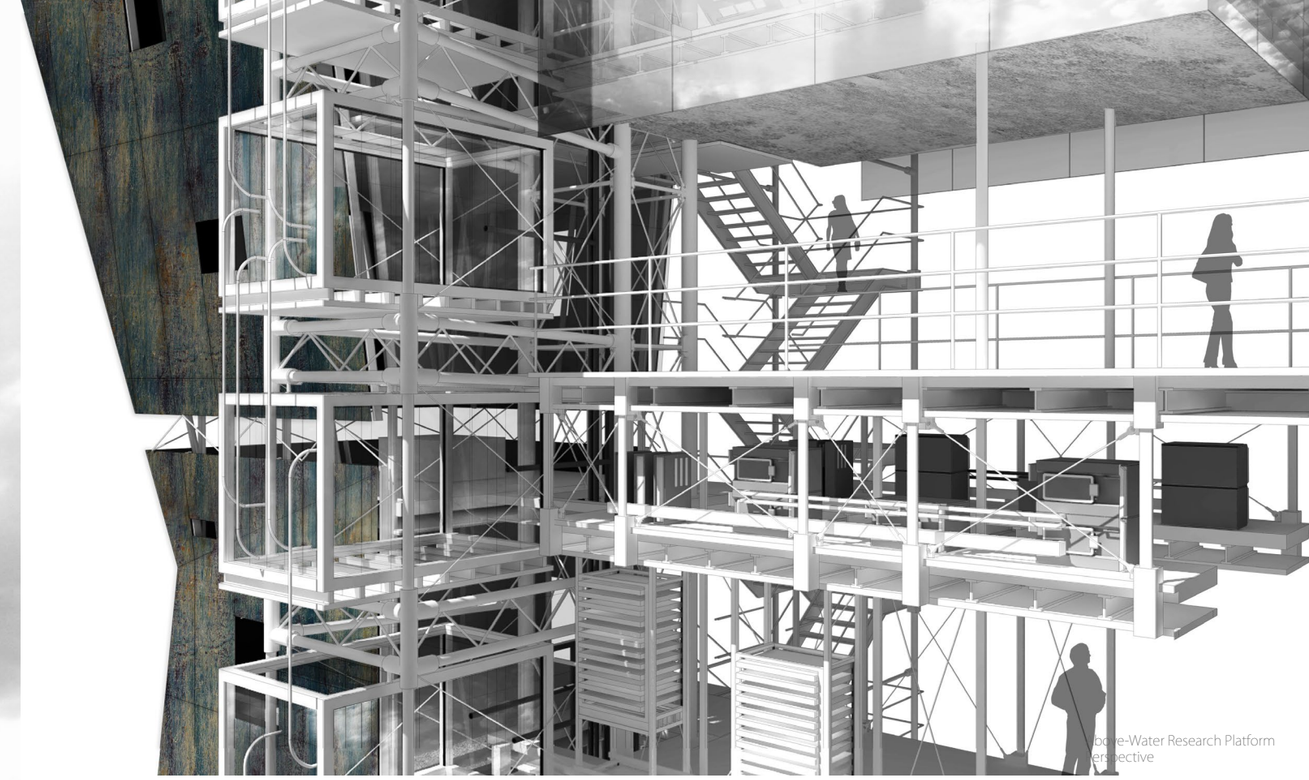
NEARSHORE MODULARIZING INHABITABLE UNIT

Under-water Level

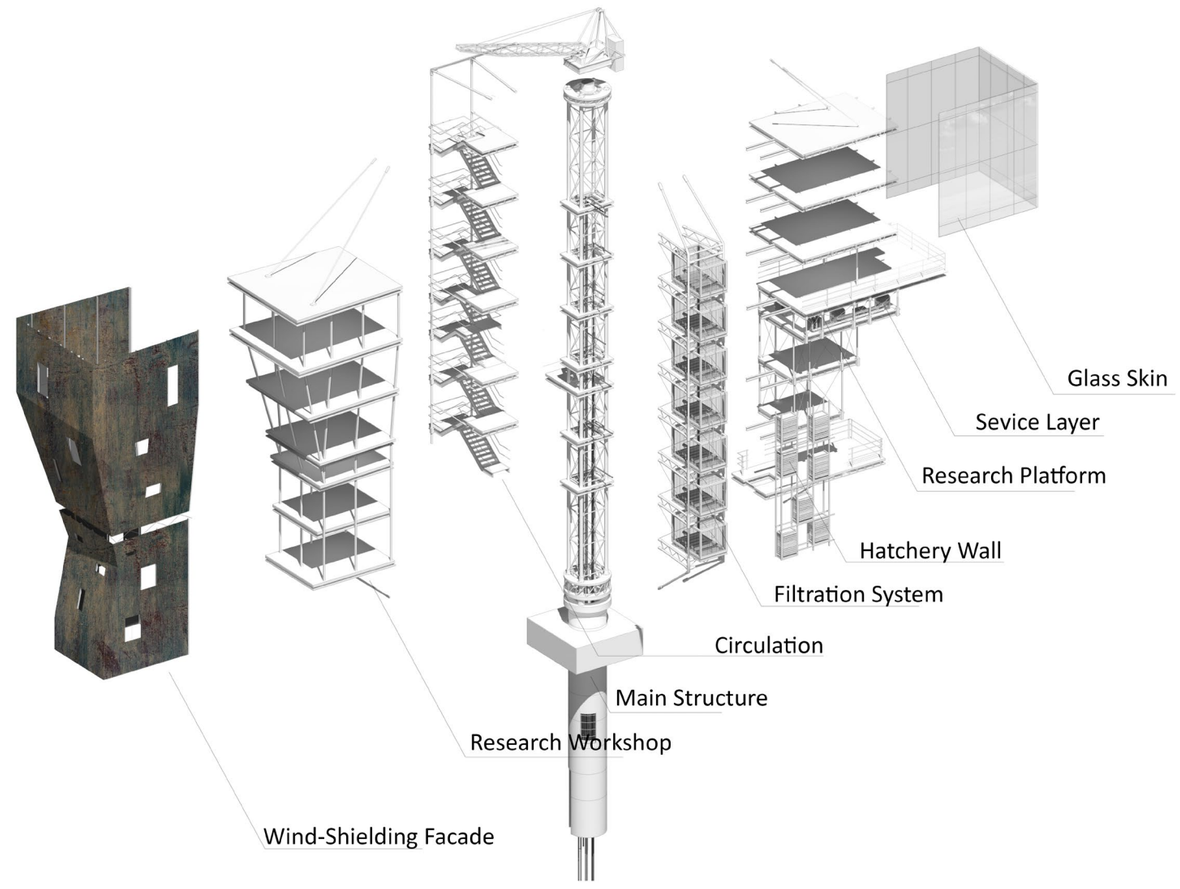
1. Linkage Bouy to the Floating Platform
2. Water Inlet/Outlet
3. Main Base Column
4. Water Piping

Above-water Level

5. Vertical Filtration System
6. Hatchery Wall
7. Rotatable Crane
8. Hangar
9. Habitable Zone
10. Typhoon-Resistant Facade
11. Obeservation Deck



Above-Water Research Platform Perspective



The modularizing inhabitable unit is designed to be assembled by modularizing units which allow it to change its function according to different needs and the requirement of the site. That means the unit has the possibility to be installed in different locations and conditions.

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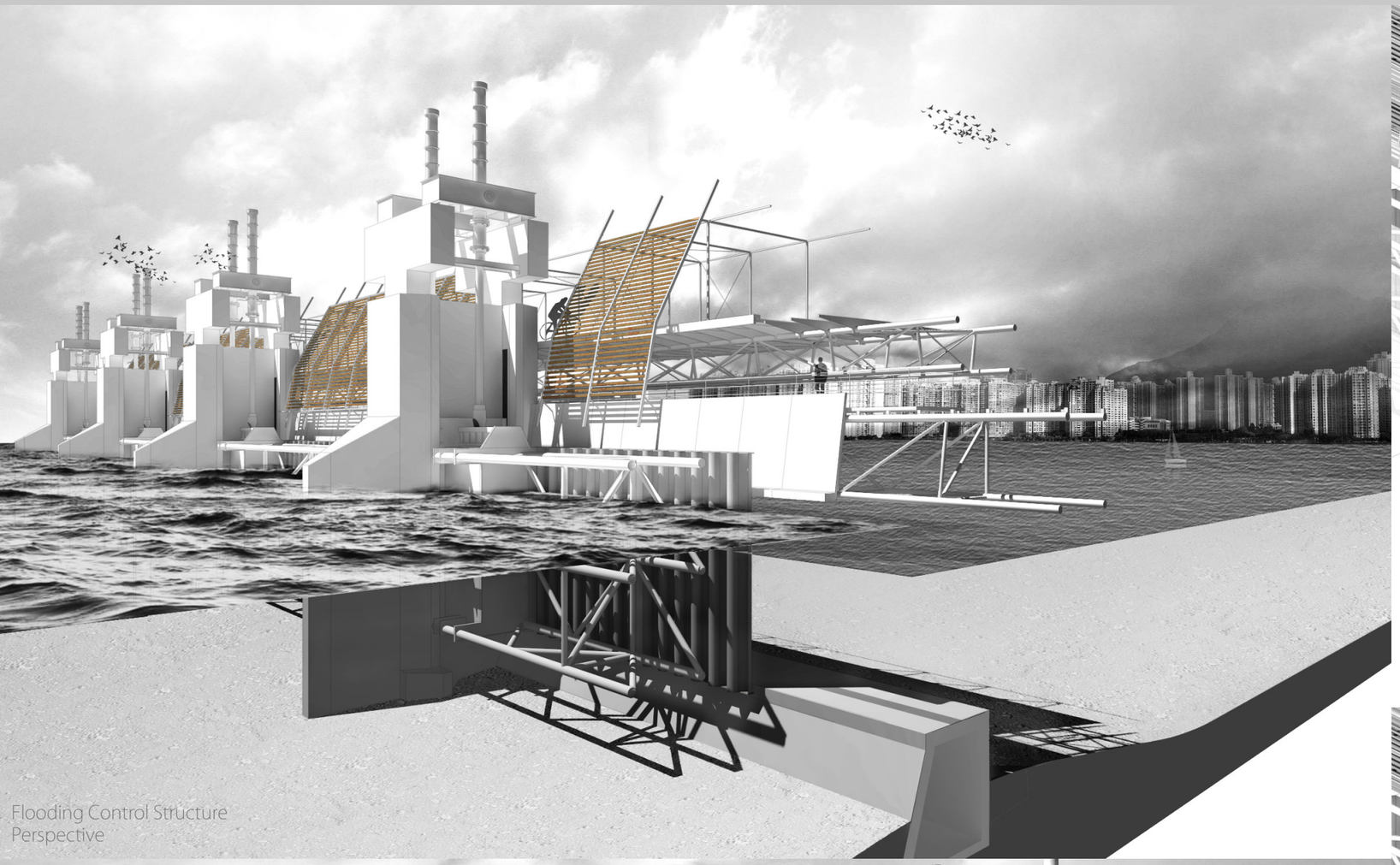
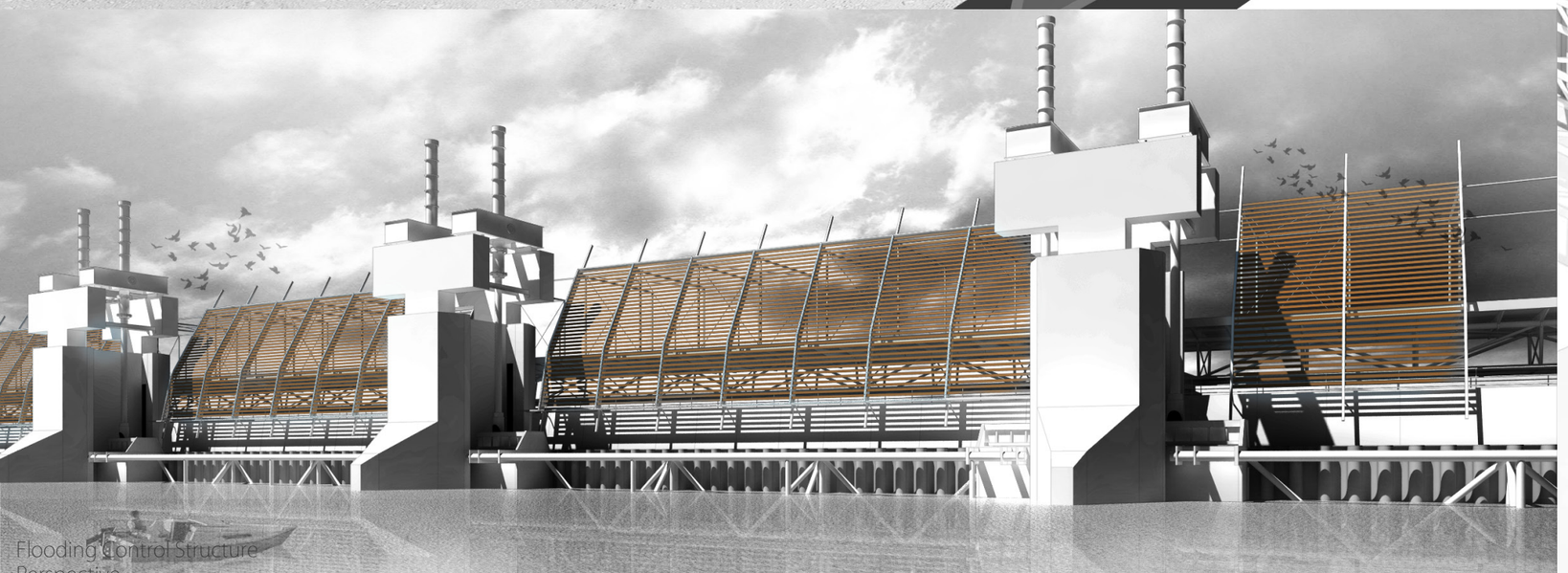
FLOODING CONTROL STRUCTURE

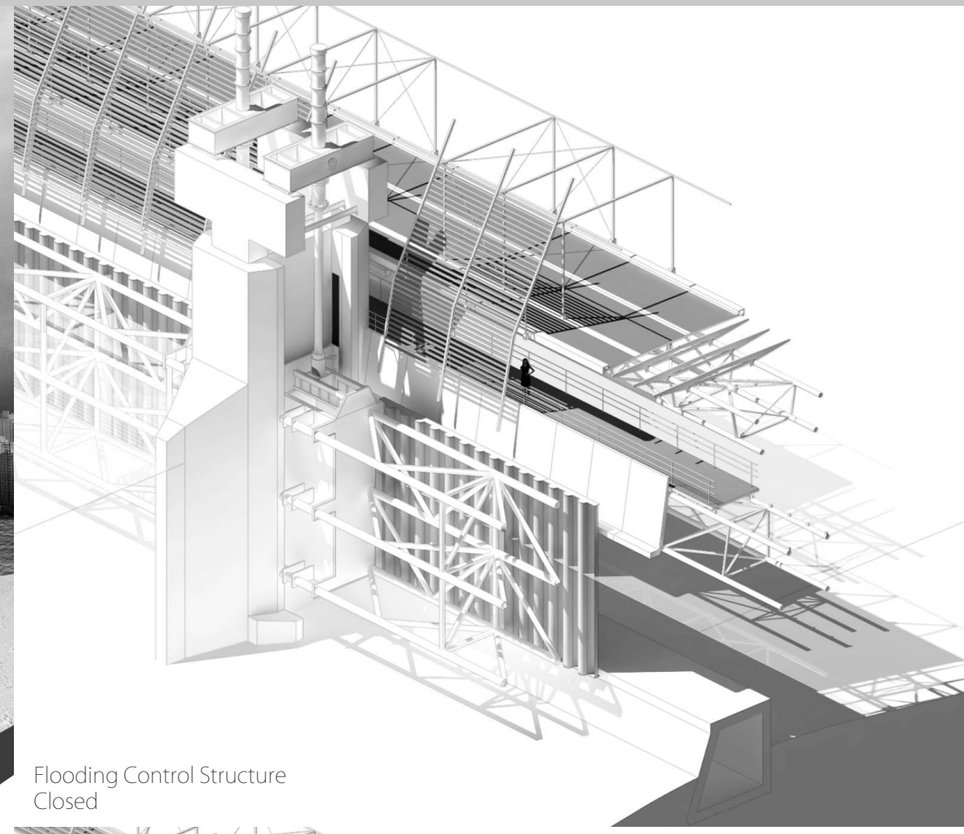
The Flooding Control Structure connects the north point in Ma On Shan and the Plover cove Dam to the North. The structure will open up to allow exchange of water in usual days, and close up to block off the rising tide during typhoon and storm. The structure makes use of the existing plover cove dam connection to allow pedestrian and cyclists to move along the structure, traveling between Ma On Shan and the other side of the Tolo harbour in a short time. The upper layer of the structure is the vehicle pathway and the middle part is the pedestrian walkway. Wind-proofing screen is installed in the windward side to protect the activities on the structure.



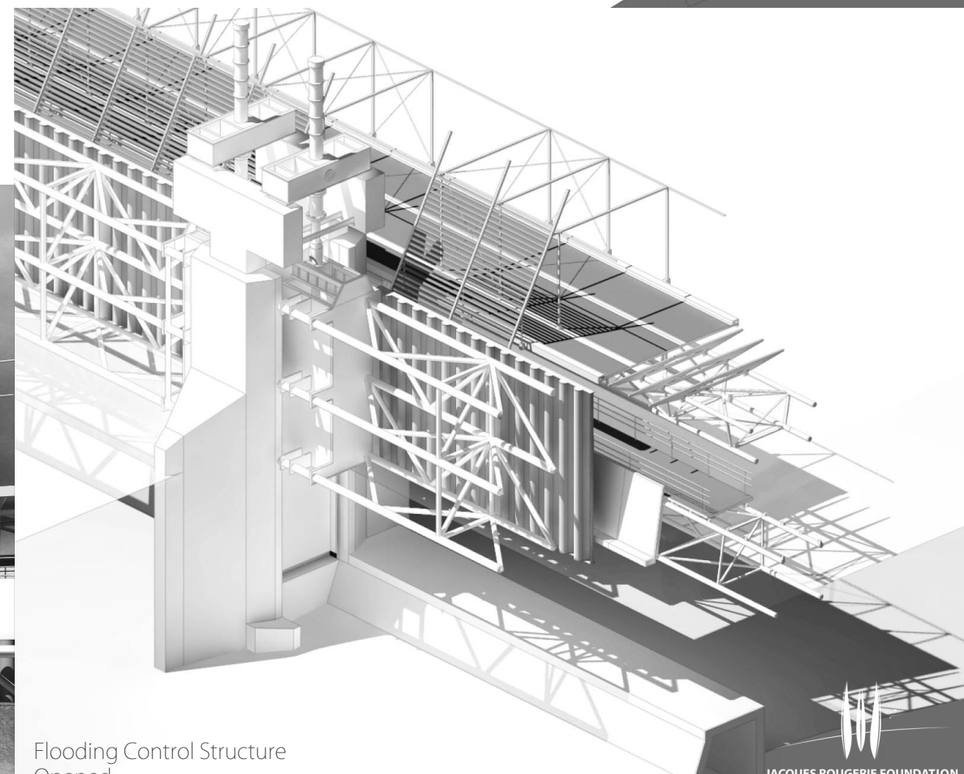
Flooding Control Structure
Perspective



Flooding Control Structure
Perspective



Flooding Control Structure
Closed



Flooding Control Structure
Opened