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TECHNISCHE UNIVERSITÄT WIEN
Vienna | Austria

DIPLOMARBEIT

HK-XL
Kowloon City Hyperloop Terminus

ausgeführt zum Zwecke der Erlangung des akademischen Grades
eines Diplom-Ingenieurs/ Diplom-Ingenieurin
unter der Leitung von

Manfred Berthold
Prof Arch DI Dr

E253

Architektur und Entwerfen

eingereicht an der Technischen Universität Wien

Fakultät für Architektur und Raumplanung

von
Mahsa Asaei

e1228428
Wien, am 23.03.2017

UNTERSCHRIFT

Abstract

The idea of traveling at higher speed has always been alluring to people for its sense of glamour. Down to the present day, the only mean of transportation, which has made this phenomenon possible, have been airplane. However, it is not easy to neglect the significance of the tedium and time consumption associated with air travel. Most of the today's airports are relatively distant from city centers, which effectively defeats the very basic concept of the modern city: the idea of seamless and smooth direct access, in and inter dense urban fabrics and in a larger scale within the metropolitan areas.

From this point of view, the concept of Hyperloop rises as a serious contender among other competing ideas in a sense that one can experience travel on the ground with the very same speed as of the airplane, and yet not to concern about all deficiencies associated with the experience of flight.

From my point of view, the idea of Hyperloop, will affect the impression of the cities and introduce a new style of modern life. People using subways today for intra-urban transportation, will be able to use Hyperloop to access longer distances, which in turn would provide them with more chances to work, do business and recreate while maintaining their daily lives in their hometowns.

HK-XL is the shaped upon idea of elevating an urban scale transportation hub up to a regional level, by means of generating a hyper-rapid regional link between the Pearl River Delta, the largest urban area in the world in both size and population, and two of the most vibrant metropolitan areas in East Asia: Shanghai and Tokyo. The project is located in the former Kai-Tak international airport and is designed as a building complex of a large-scale Hyperloop terminal comprising two sets of 14 platforms for domestic and international travelers and an office tower as a preliminary back-up structure. The whole complex can potentially open up to a 20 million-sqm mega structure at the back (proposed only as a scheme).

Die Idee des Reisens mit höherer Geschwindigkeit war schon immer verlockend für die Menschen. Sie prägt den Sinn für Geschwindigkeit und Glamour. Bis zum heutigen Tag ist das einzige Verkehrsmittel des Transportes, welches dieses Phänomen der Reise mit höchster Geschwindigkeit von einem Ort zum anderen ermöglicht, Flugzeuge. Jedoch ist es nicht leicht, die Bedeutung des Zeitverbrauchs und der Langeweile im Zusammenhang mit Flugreisen zu vernachlässigen. Die meisten der heutigen Flughäfen sind relativ weit entfernt von Stadtzentren, die effektiv, das Grundkonzept der modernen Stadt konterkariert. Die Idee der nahtlosen und flüssigen Verbindung, in einem dichten städtischen Gewebe, von Metropolregionen ist leistungsfähig durch das Konzept der Hyperloops möglich.
Unter diesem Gesichtspunkt erhebt sich das Konzept der Hyperloop als ein ernstzunehmender Anwärter unter anderen konkurrierenden Ideen, in gewisser Weise, dass man Reisen auf dem Boden mit der gleichen Geschwindigkeit wie das Flugzeug erleben kann, und nicht über die im Zusammenhang verbundenen Mängel des Fluges besorgt ist.
Aus meiner Sicht wird die Idee der Hyperloops die Situation der Städte beeinflussen und einen neuen Stil des modernen Lebens einführen. Menschen nutzen selbstverständlich U-Bahnen heutzutage für den innerstädtischen Nahverkehr. Sie werden künftig in der Lage sein die Hyperloops zu verwenden, um längere Strecken zurück zu legen. Dies wiederum bietet ihnen mehr Chancen zu arbeiten und Geschäfte zu machen, während Sie ihr tägliches Leben in ihren Heimatorten beibehalten.
HK-XL ist die in Form gegossene Idee eines städtischen Verkehrssystems auf regionaler Ebene. Durch generieren eine Hyper-Rapid-regionalen Verbindung zwischen Pearl River Delta, die größte Stadtregion in der Welt, werden zwei der aufregendsten Metropolen in Ost-Asien: Shanghai und Tokio verbunden. Das Projekt befindet sich auf dem Areal des ehemaligen Flughafens Kai-Tak und dient in Form eines zusammenhängenden Gebäudekomplexes für den groß angelegten Hyperloop Terminal, bestehend aus zwei Gruppen von 14 Plattformen für nationale und internationale Reisende und einen Büroturm als vorläufige Backup-Struktur. Die gesamte Anlage trägt das Potential in sich der zukünftigen Weiterentwicklung zu einer 20 Millionen Quadratmeter neu zu bebauenden Stadtstruktur.

Table of Contents


HYPERLOOP

Hyperloop

image #1

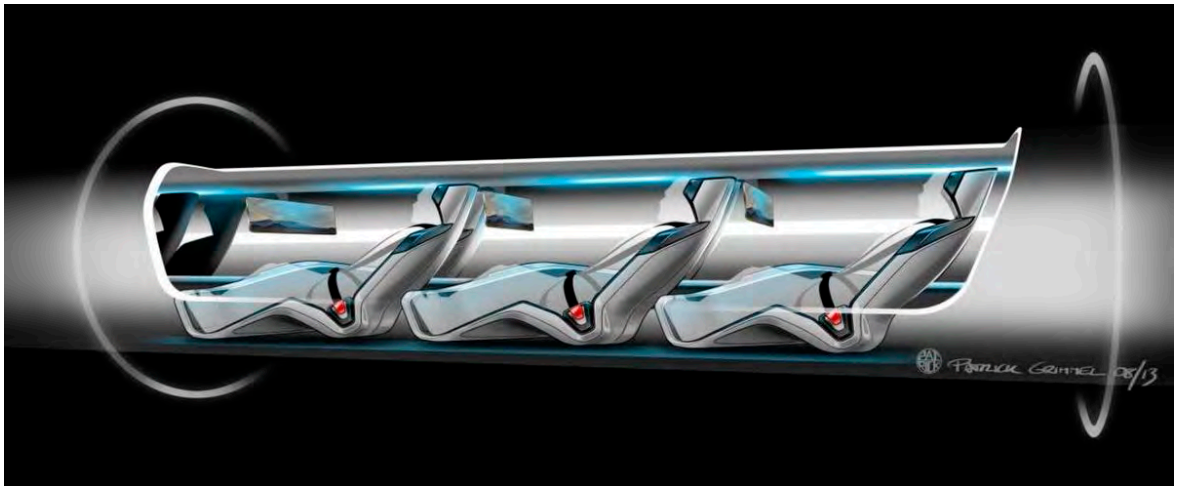
Musk's Hyperloop Idea

Hyperloop is a tube-based transportation system for inter- and intra-city transport. With a drastic reduction of air pressure in the tube, motion is achieved with nearly zero friction allowing passengers to safely accelerate to airplane speeds. The system is powered by a combination of renewable energy and energy conservation systems.

Using a custom electric motor to accelerate and decelerate a levitated pod through a low-pressure tube, it can transport people and things with supersonic speed up to 1200 km/h (745 mph), reducing both travel time and travel cost – e.g., Los Angeles to San Francisco in thirty minutes.

By employing a high-tech mix of physics, material science, and highly efficient engineering principles, Hyperloop provides clean, safe, affordable, intra-urban travel at high speed and minimal impact on the environment.[1]

1 http://www.assignmentpoint.com/science/technology/hyperloop-the-next-big-thing-in-transportation.html



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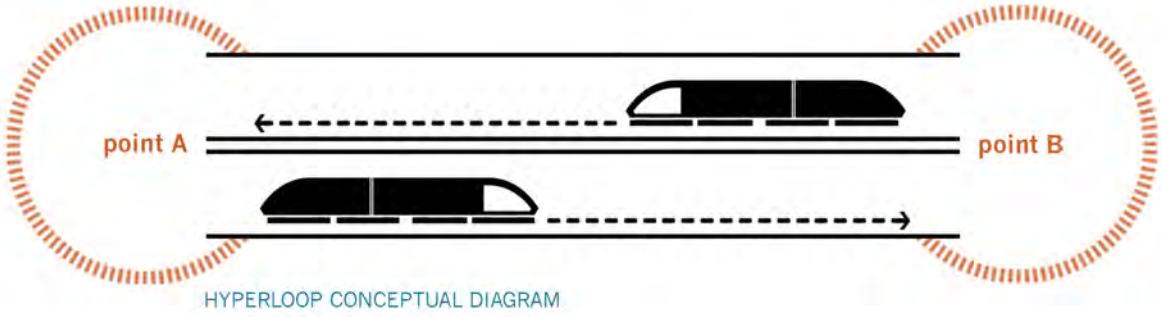


image #3

Historical Precedents

The concept of transportation of passengers in pneumatic tubes is not new. The first patent to transport goods in tubes was taken out in 1799 by the British mechanical engineer and inventor George Medhurst. In 1812, Medhurst wrote a book detailing his idea of transporting passengers and goods through air-tight tubes using air propulsion.
In the early 1800s, there were other similar systems proposed or experimented with and were generally known as an Atmospheric railway.[2]
The Crystal Palace pneumatic railway

2 https://en.wikipedia.org/wiki/Hyperloop

image #4: A boy lying in a crate inside one end of a pneumatic tube in an industrial room in Chicago, Illinois, in 1908. Photographer: Chicago History Museum/Getty Images

image #5

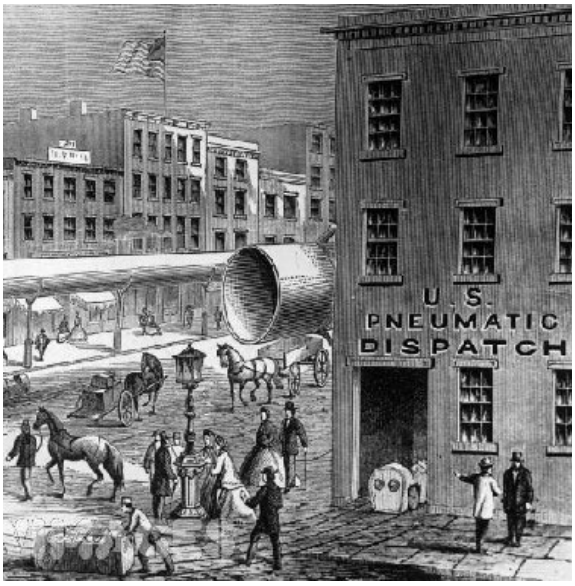


image #6

operated in London around 1864 and used large fans, some 22 ft (6.7 m) in diameter, that were powered by a steam engine. The tunnels are now lost but the line operated successfully for just two months.[3]

Operated from 1870 to 1873, the Beach Pneumatic Transit was a one block-long prototype of an underground tube transport public transit system in New York City. The system worked at near-atmospheric pressure, and the passenger car moved by means of higher-pressure air applied to the back of the car while somewhat lower pressure was maintained on the front of the car.

In the 1910s, vacuum trains were first described by American rocket pioneer Robert Goddard. While the Hyperloop

3 https://www.slideshare.net/NiranjanT1/hyperloop-35888420

has significant innovations over early proposals for reduced pressure or vacuum-tube transportation apparatus, the work of Goddard "appears to have the greatest overlap with the Hyperloop".

Princeton Physicist Gerard K. O'Neill wrote about transcontinental trains using magnetic propulsion in his book "2081: A Hopeful View of the Human Future". While a work of fiction, this book was an attempt to predict future technologies in everyday life. In his prediction he envisioned these trains which used magnetic levitation running in underground tunnels which had much of the air evacuated to increase speed and reduce friction. He also demonstrated a scale prototype device that accelerated a mass using magnetic propulsion to high speeds. It was called a mass driver and was a central theme in his non-fiction book on space colonization "The High Frontier".

Swiss metro was a proposal to run a maglev train in a low-pressure environment. Concessions were granted to Swiss metro in the early 2000s to connect the Swiss cities of St. Gallen, Zurich, Basel, and Geneva. Studies of commercial feasibility reached differing conclusions and the vactrain were never built.

China was reported to be building a vacuum based 600 mph (1,000 km/h) maglev train in August 2010 according to a laboratory at Jiaotong University. It was expected to cost CN¥10–20 million (US$2.95 million at the August 2010 exchange rate) more per kilometer than regular high speed rail. As of April 2016, it has not been built.[4]

4 https://en.wikipedia.org/wiki/Hyperloop

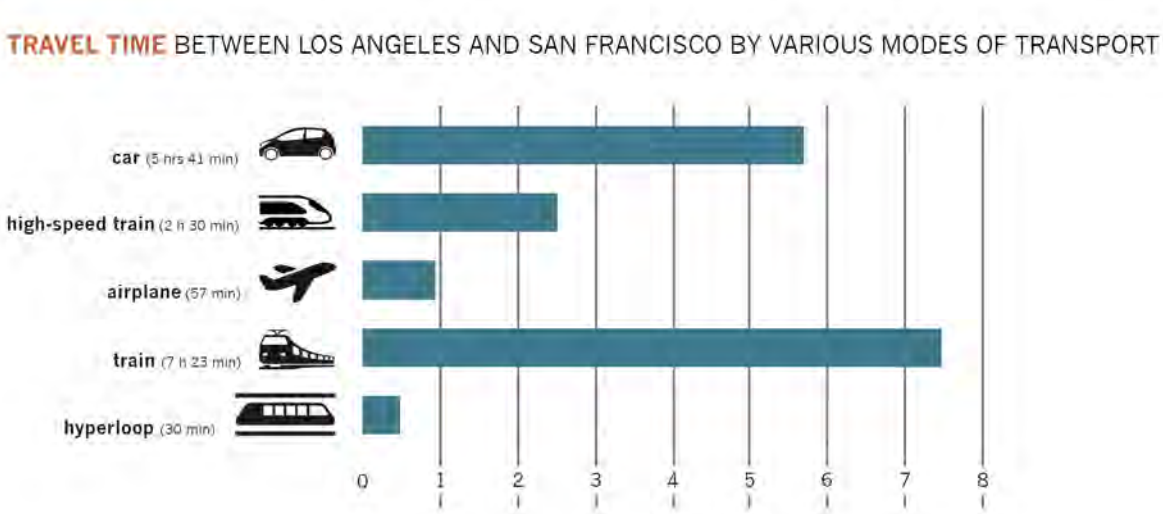
image #7

Hyperloop 2013

The idea was promoted by Elon Musk (the billionaire chairperson and chief executive officer of electric-vehicle maker Tesla Motors Inc.) back in 2013 as a reaction to the California High-speed Rail system.
It consists of several distinct components, including:

- Capsule
- Tube
- Propulsion[5]

5 http://www.spacex.com/sites/spacex/files/hyperloop_alpha.pdf



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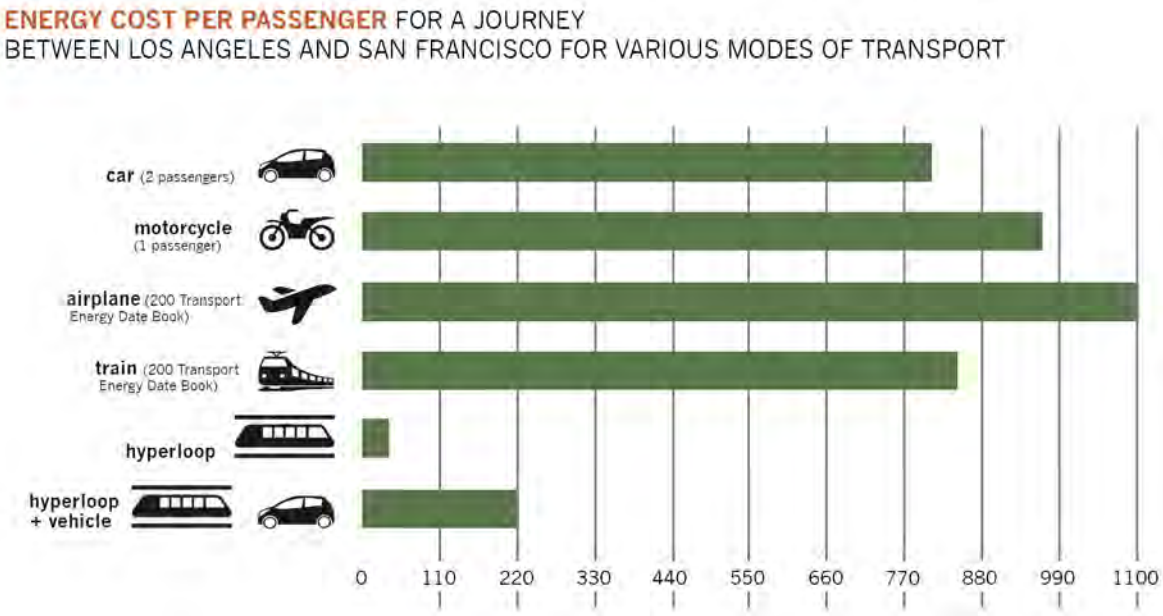


image #9

Capsule

Two versions of the Hyperloop capsules are being considered: a passenger only version and a passenger plus vehicle version. Hyperloop Passenger Capsule Assuming an average departure time of 2 minutes between capsules, a minimum of 28 passengers per capsule are required to meet 840 passengers per hour.
It is possible to further increase the Hyperloop capacity by reducing the time between departures. The current baseline requires up to 40 capsules in activity during rush hour, 6 of which are at the terminals for loading and unloading of the passengers in approximately 5 minutes.
Hyperloop Passenger Plus Vehicle Capsule:
The passenger plus vehicle version of the Hyperloop will depart as often as the passenger only version, but will accommodate 3 vehicles in addition to the passengers. All subsystems discussed in the following sections are featured on both capsules.

Mechanism:
For travel at high speeds, the greatest power requirement is normally to overcome air resistance. Aerodynamic drag increases with the square of speed, and thus the power requirement increases with the cube of speed. For example, to travel twice as fast a vehicle


mkb brandstof
TU Delft
DHL
CGI
amsix
MODEC
CONRAD
TENCATE
materials that make a difference
StuD Fonds
DELFT
HYPERLOOP
TWD

image #10

must overcome four times the aerodynamic resistance, and input eight times the power.

Just as aircraft climb to high altitudes to travel through less dense air, Hyperloop encloses the capsules in a reduce pressure tube. The pressure of air in Hyperloop is about 1/6 the pressure of the atmosphere on Mars. This is an operating pressure of 100 Pascal, which reduces the drag force of the air by 1,000 times relative to sea level conditions and would be equivalent to flying above 150,000 feet altitude. A hard vacuum is avoided as vacuums are expensive and difficult to maintain compared with low-pressure solutions. Despite the low pressure, aerodynamic challenges must still be addressed. These include managing the formation of shock waves when the speed of the capsule approaches the speed of sound, and the air resistance increases sharply. Close to the cities where more turns must be navigated, capsules travel at a lower speed. This reduces the accelerations felt by the passengers, and also reduces power requirements for the capsule. The capsules travel at 760 mph (1220 K/h).
The proposed capsule geometry houses several distinct systems to reside within the outer mold line.
The vehicle is streamlined to reduce drag and features a compressor at the leading face to ingest oncoming air for levitation and to a lesser extent propulsion. Aerodynamic simulations have demonstrated the validity of this 'compressor within a tube's concept. [6]

6 http://www.spacex.com/sites/spacex/files/hyperloop_alpha.pdf

image #11

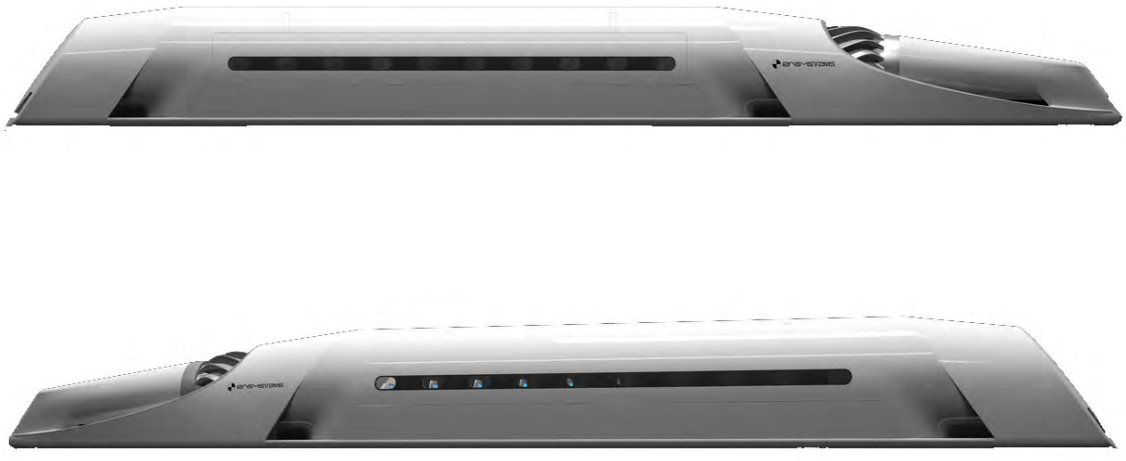


image #12

Hyperloop Passenger Capsule

The maximum width is 4.43 ft (1.35 m) and maximum height is 6.11 ft (1.10 m). With rounded corners, this is equivalent to a 15 ft2 (1.4 m2) frontal area, not including any propulsion or suspension components. about the same force as the weight of one oversized checked bag at the airport. The doors on each side will open in a gullwing (or possibly sliding) manner to allow easy access during loading and unloading. The luggage compartment will be at the front or rear of the capsule. The overall structure weight is expected to be near 6,800 lb (3,100 kg) including the luggage compartments and door mechanism. The overall cost of the structure including manufacturing is targeted to be no more than $245,000.

Hyperloop passenger + Vehicle Capsule

The passenger plus vehicle version of the Hyperloop capsule has an increased frontal area of 43 ft2 (4.0 m2), not including any propulsion or suspension components. This accounts for enough width to fit a vehicle as large as the Tesla Model X. The doors on each side will open in a gullwing (or possibly sliding) manner to allow accommodate loading of vehicles, passengers, or freight. The overall structure weight is expected to be near 7,700 lb (3,500 kg) including the luggage compartments and door mechanism. The overall cost of the structure including manufacturing is targeted to be no more than $275,000.
The interior of the capsule is specifically designed with passenger safety and comfort in mind. The seats conform well to the body to maintain comfort during the high speed accelerations experienced during travel. Beautiful landscape will be displayed in the cabin and

image #13

image #14

Tube

each passenger will have access their own personal entertainment system.

The tube will be supported by pillars, which constrain the tube in the vertical direction but allow longitudinal slip for thermal expansion as well as dampened lateral slip to reduce the risk posed by earthquakes. In addition, the pillar to tube connection nominal position will be adjustable vertically and laterally to ensure proper alignment despite possible ground settling. These minimally constrained pillars to tube joints will also allow a smoother ride. Specially designed slip joints at each stations will be able take any tube length variance due to thermal expansion. This is an ideal location for the thermal expansion joints as the speed is much lower nearby the stations. It thus allows the tube to be smooth and welded along the high speed gliding middle section. The spacing of the Hyperloop pillars retaining the tube is critical to achieve the design objective of the tube structure. The average spacing is 100 ft (30 m), which means there will be near 25,000 pillars supporting both tubes and solar panels. The pillars will be 20 ft (6 m) tall whenever possible but may vary in height in hilly areas or where obstacles are in the way. Also, in some key areas, the spacing will have to vary in order to pass over roads or other obstacles. Small spacing between each support reduces the deflection of the tube keeping the capsule steadier and the journey more enjoyable. In addition, reduced spacing has increased resistance to seismic loading as well as the lateral acceleration of the capsule. Due to the sheer quantity of pillars required, reinforced concrete was selected as the construction material due to its very low cost per volume. In some short areas, tunneling may be required to avoid going over mountains and to keep the route as straight as possible. [7]

7 http://www.spacex.com/sites/spacex/files/hyperloop_alpha.pdf

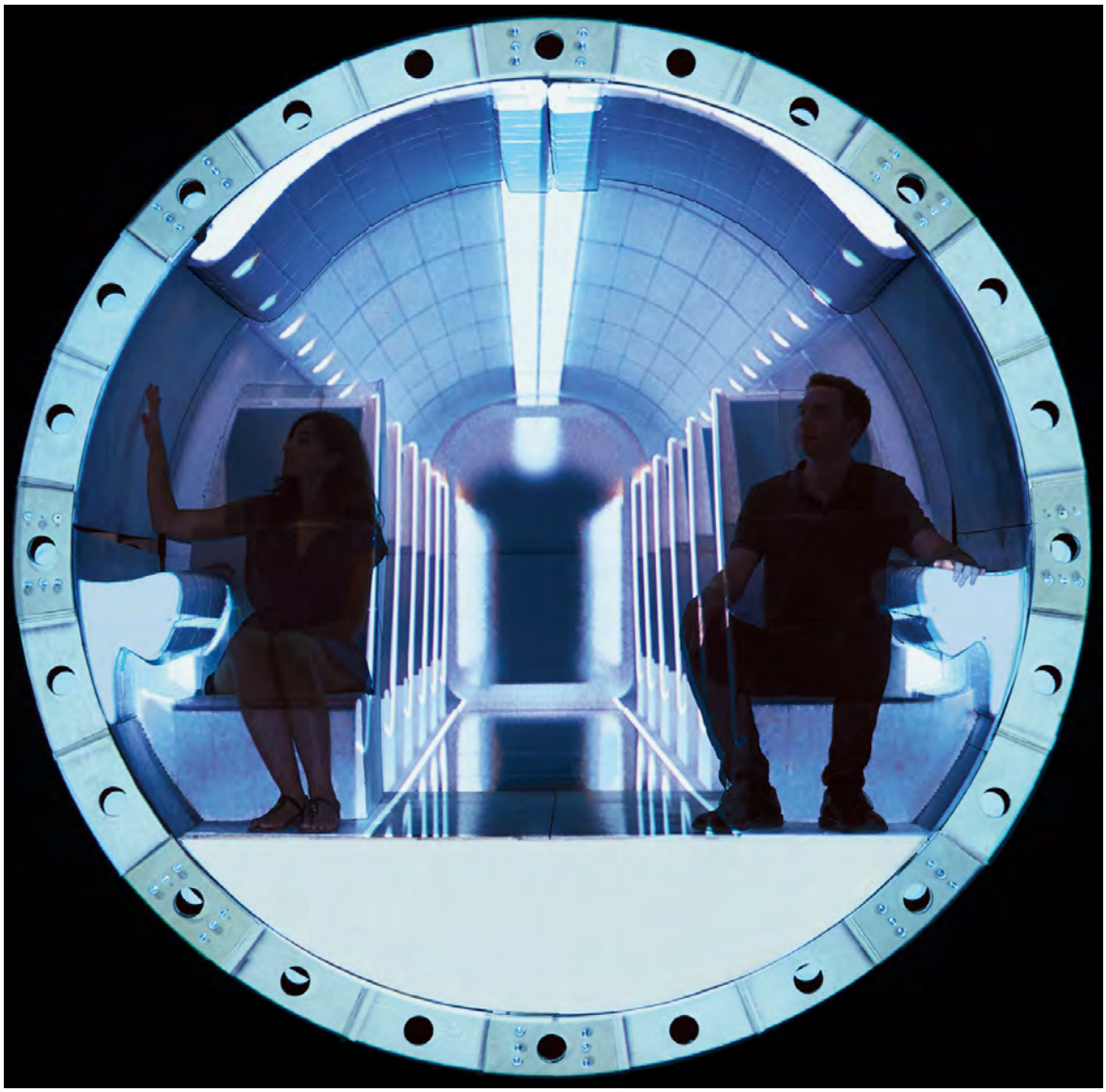
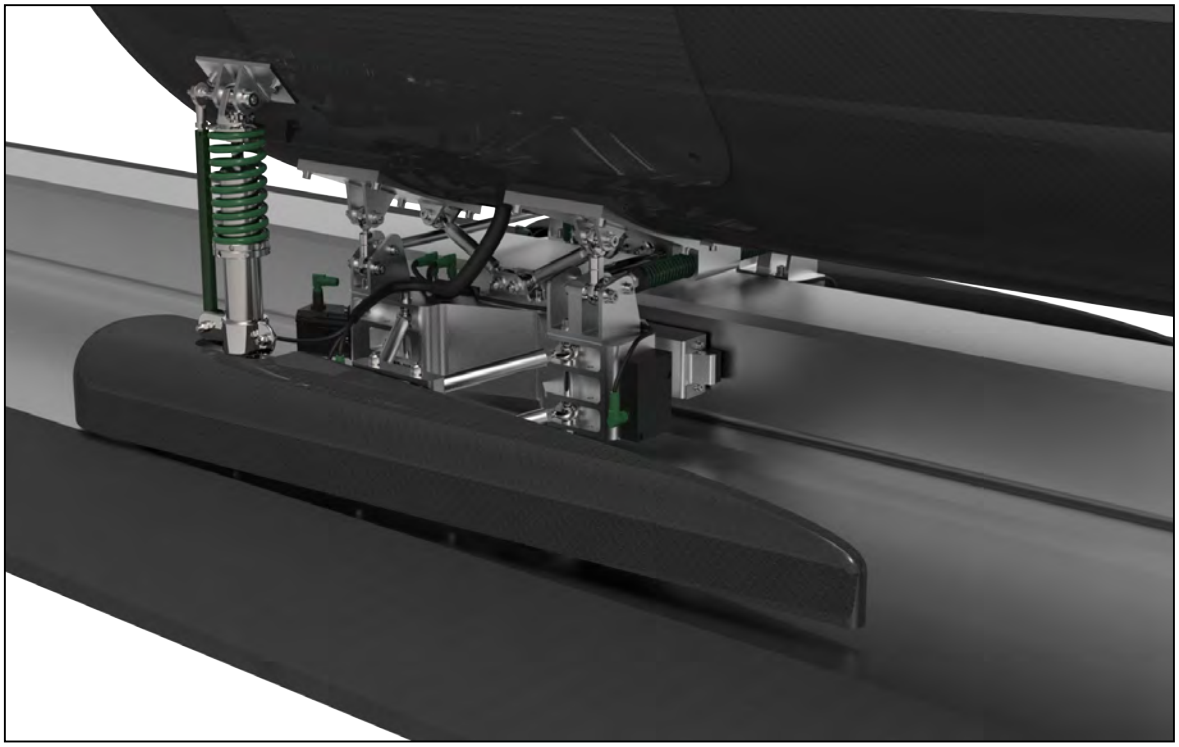


image #15

image #16

Propulsion

The propulsion system has these basic requirements:
a. Accelerate the capsule from 0 to 300 mph (480 kph) for relatively low speed travel in urban areas.
b. Maintain the capsule at 300 mph (480 kph) as necessary, including during ascents over the mountains surrounding Los Angeles and San Francisco.
c. To accelerate the capsule from 300 to 760 mph (480 to 1,220 kph) at 1g at the beginning of the long coasting section along the I-5 corridor.
d. To decelerate the capsule back to 300 mph (480 kph) at the end of the I-5 corridor.



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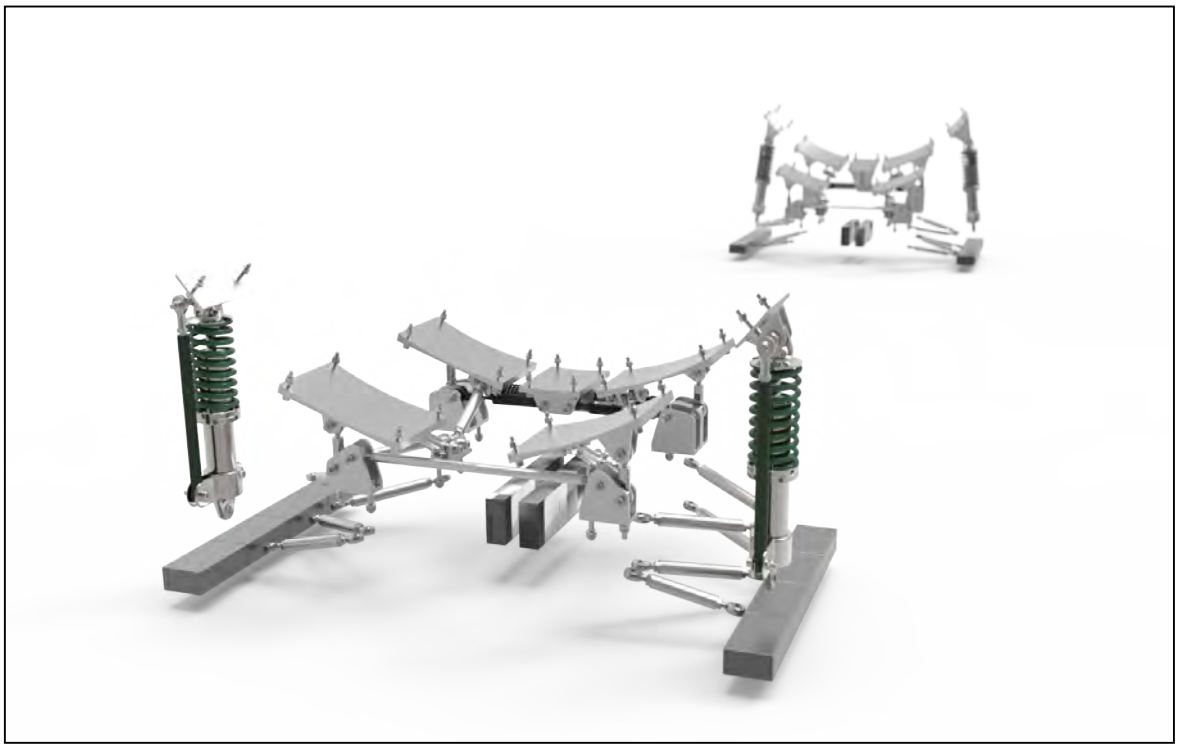


image #18

Terminal Design

The intention for Hyperloop stations is for them to be minimalist but practical and with a boarding process and layout much simpler than airports. Due to the short travel time and frequent departures, it is envisaged that there will be a continual flow of passengers through each Hyperloop station, in contrast to the pulsed situation at airports, which, leads to lines and delays. Safety and security are paramount, and so security checks will still be made in a similar fashion as TSA does for the airport. The process could be greatly streamlined to reduce wait time and maintain a more continuous passenger flow. The transit area at a Hyperloop terminal would be a large open area with two large airlocks signifying the entry and exit points for the capsules. An arriving capsule would enter the incoming airlock, where the pressure is equalized with the station, before being released into the transit area. The doors of the capsule would open, and the passengers could disembark. The luggage pod would be quickly unloaded by the Hyperloop staff or separated from the capsule so that baggage retrieval would not interfere with the capsule turn around. Once vacated, the capsule would be rotated on a turntable, and aligned for reentry into the Hyperloop tube. The departing passengers, and their pre-loaded luggage pod, would then enter the capsule. A Hyperloop attendant will then perform a safety check of each passenger's seat belts before the capsule is cleared for departure. At this point the capsule would then be moved forward into the exit airlock, where the pressure is lowered to the operating level of the Hyperloop, and then sent on its way. Note that loading and unloading occurring in parallel with up to three capsules at a given station at any time. The expected cost for each station is expected to be around $125 million for a total of $250 million USD initially.

Compared to existing modes of transportation, Hyperloop systems are faster, safer, more convenient and immune to adverse weather conditions. With proper engineering, they also show a high resistance to earthquakes. In terms of their environmental sustainability, Hyperloop systems are more energy efficient and less disruptive for

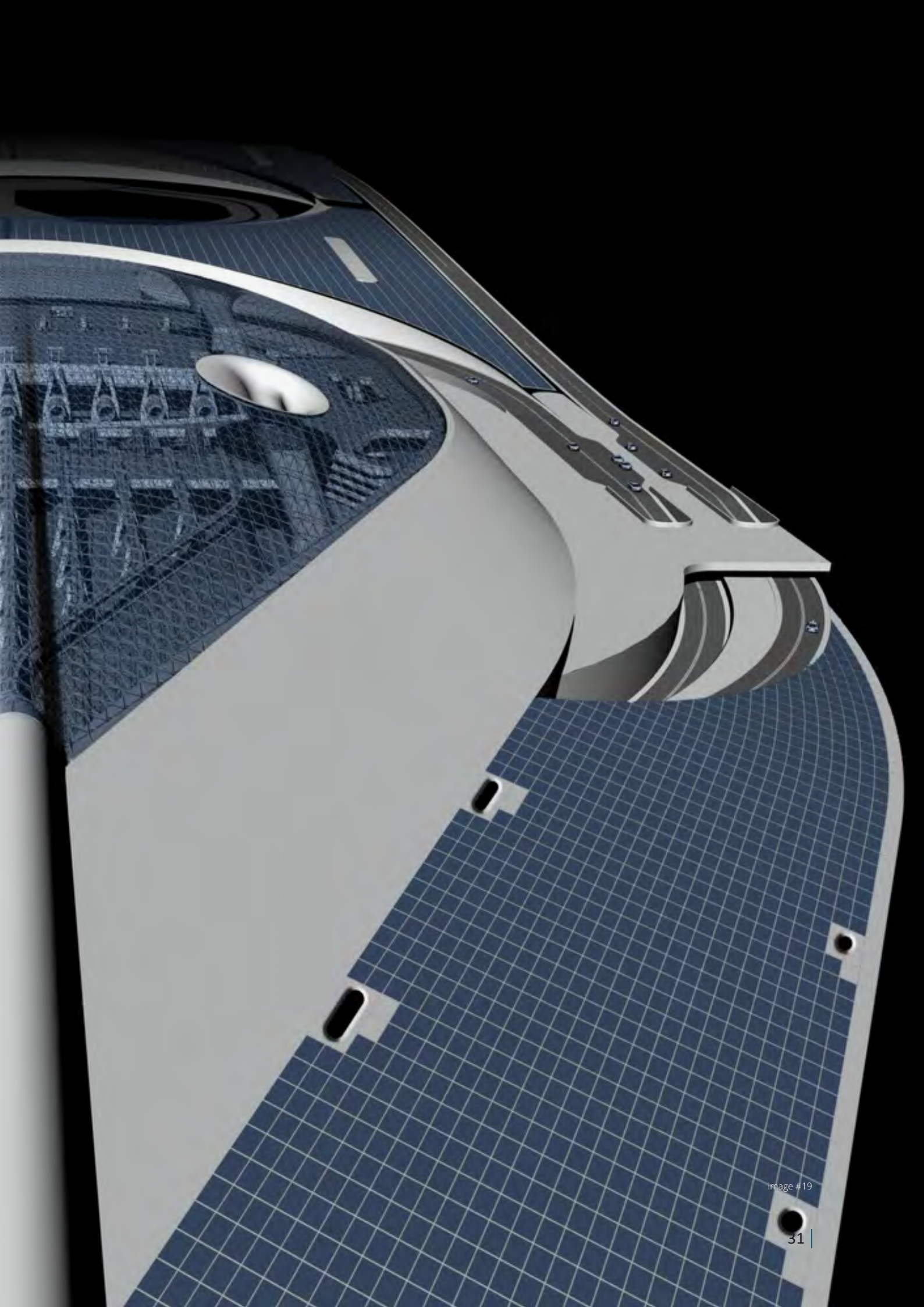


image #19

the communities along the route.[8]
A number of routes have been proposed for Hyperloop systems that meet the approximate distance conditions for which a Hyperloop is hypothesized to provide improved transport times.
The route suggested in the 2013 alpha-level design document was from the Greater Los Angeles Area to the San Francisco Bay Area. That conceptual system would begin around Sylmar, just south of the Tejon Pass, follow Interstate 5 to the north, and arrive near Hayward on the east side of San Francisco Bay. Several proposed branches were also shown in the design document, including Sacramento, Anaheim, San Diego, and Las Vegas.
Most of the active Hyperloop routes being planned currently are outside of the U.S. Hyperloop One published the world's first detailed business case for a 300-mile (500 km) route between Helsinki and Stockholm, which would tunnel under the Baltic Sea to connect the two capitals in under 30 minutes. Hyperloop One is also well underway on a feasibility study with DP World to move containers from its port of Jebel Ali in Dubai. Hyperloop One on November 8, 2016 announced a new feasibility study with Dubai's Roads and Transport Authority for passenger and freight routes connecting Dubai with the greater United Arab Emirates. Hyperloop One is also working on passenger routes in Moscow and a cargo Hyperloop to connect Hunchun, China to the port of Zarubino on Russia's Far East.
Others have put forward European routes, including a Paris to Amsterdam route proposed by Delft Hyperloop. A Warsaw University of Technology team is evaluating potential routes from Cracow to Gdańsk across Poland proposed by Hyper Poland.
TransPod is exploring the possibility of a Hyperloop route which would connect Toronto and Montreal. The two cities, the largest in Canada, are currently connected by the Highway 401, the busiest highway in North America. HTT are in process to sign a Letter of Intent with the Indian Government for a proposed route between Chennai and Bengaluru. If things goes well, the distance of 345 km could be covered in 30 minutes. Indore-based Dinclix GroundWorks' DGWHyperloop advocates a Hyperloop corridor between Mumbai and Delhi, passing via Indore, Kota and Jaipur.[9]

8 http://www.spacex.com/sites/spacex/files/hyperloop_alpha-20130812.pdf

9 https://en.wikipedia.org/wiki/Hyperloop

image #20

Hong Kong

Kowloon City & KaiTak

image #21

Hong Kong

- Has 7.2 million residents of various nationalities. It is the world's fourth most densely populated sovereign state or territory.
- Has the world's most competitive economy by World Competitiveness Yearbook, and remains one of the world's most significant financial centers with the highest Financial Development Index in 2012
- provides businesses with free trade and low taxation, and has consistently been listed as the freest market economy in the world
- Has the second largest number of high-rise urban agglomeration in the world.
- Has a highly developed public transportation network covering %90 of the population, the widest in the world.
- Ranks within the top 10 in GDP (PPP) per capita, it also suffers from the most severe income inequality among developed economies and has the world's most unaffordable housing. Which in turn, necessitates connecting Hong Kong with other countries in term of Commerce and even solving the residence problem for the people who can not afford living in Hong Kong.[10]

10 data collected from https://en.wikipedia.org/wiki/Hong_Kong

image #22

Hong Kong Among Top Ten Global Financial Centers:

A financial center is a location that is home to a cluster of nationally or internationally significant financial services providers such as banks, investment managers or stock exchangers. A prominent financial centre can be described as an international financial center or a global financial center and is often also a global city.

Financial centers are locations with an agglomeration of participants in financial markets and venues for these activities to take place. Participants can include financial intermediaries (such as banks), institutional investors (such as Trading activity may take place on venues such as exchanges and involve clearing houses, although many transactions take place over-the-counter (OTC), that is directly between participants.[11]

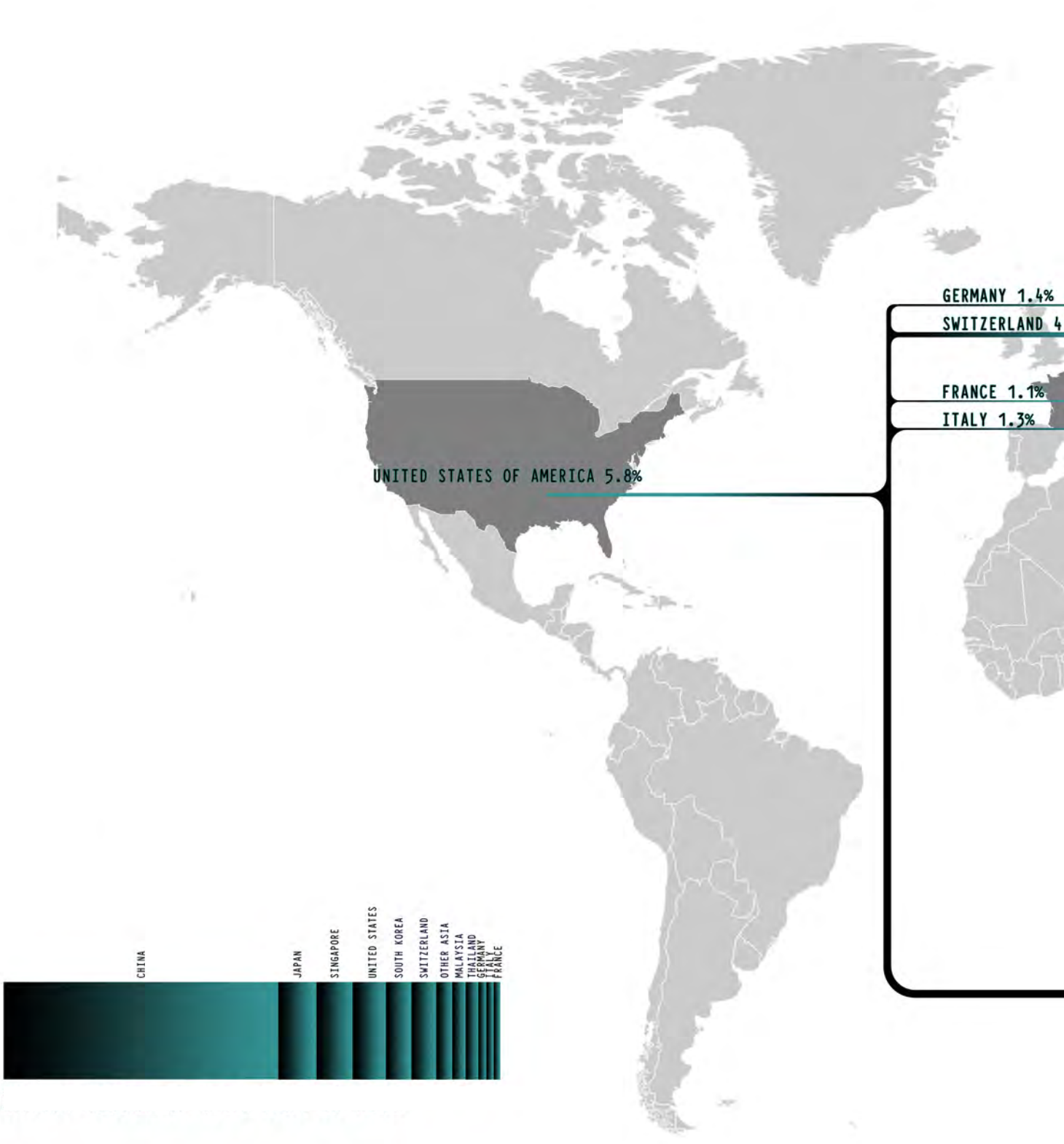
As of March 2016, the top ten global financial centers are

11 https://en.wikipedia.org/wiki/Financial_centre


LONDON
NEW YORK CITY
SINGAPORE
HONG KONG
TOKYO
ZURICH
WASHINGTON, D.C
SANFRANCISCO
BOSTON
TORONTO

image #23

Hong Kong: Major Import Sources in 2016



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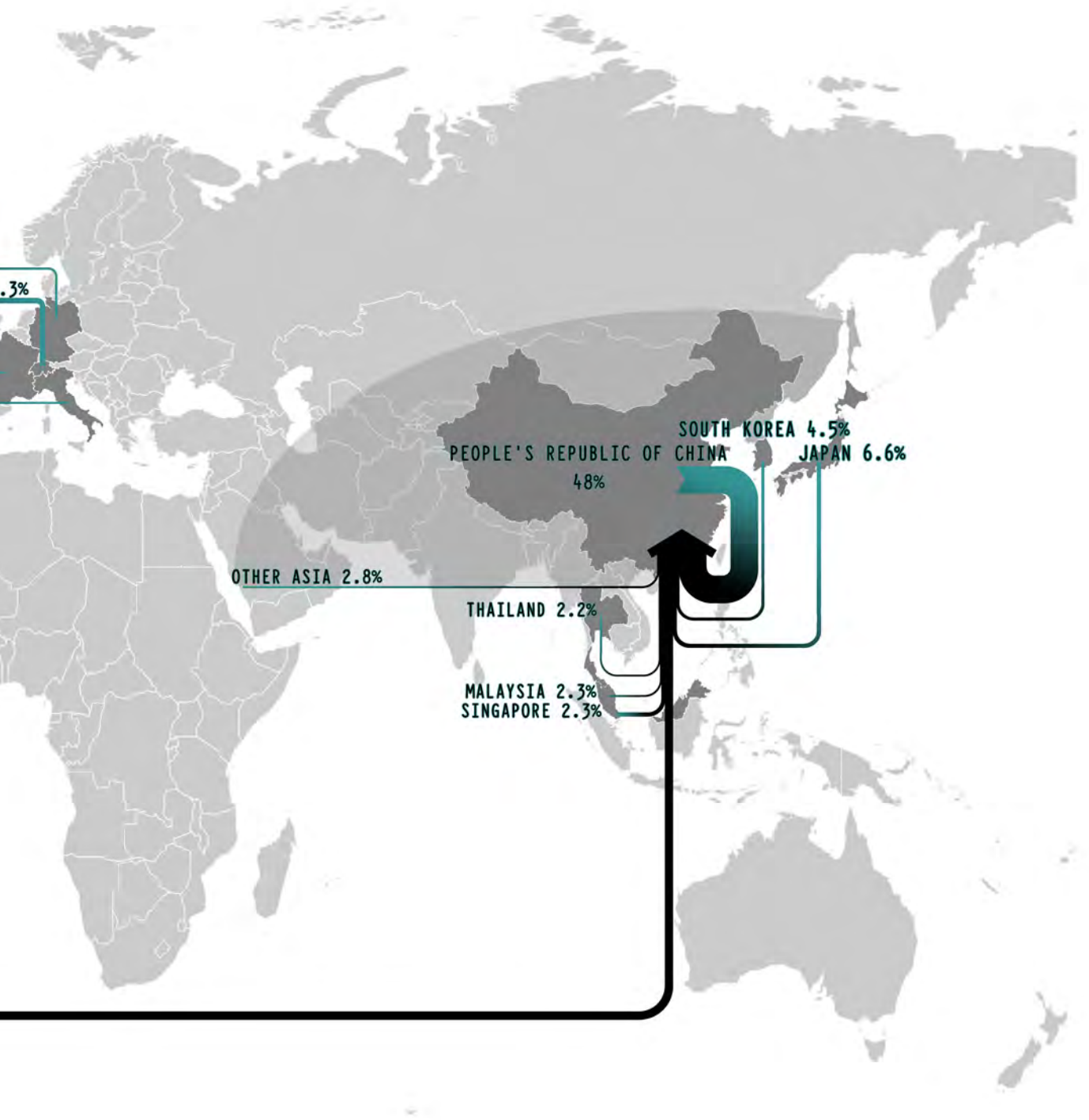
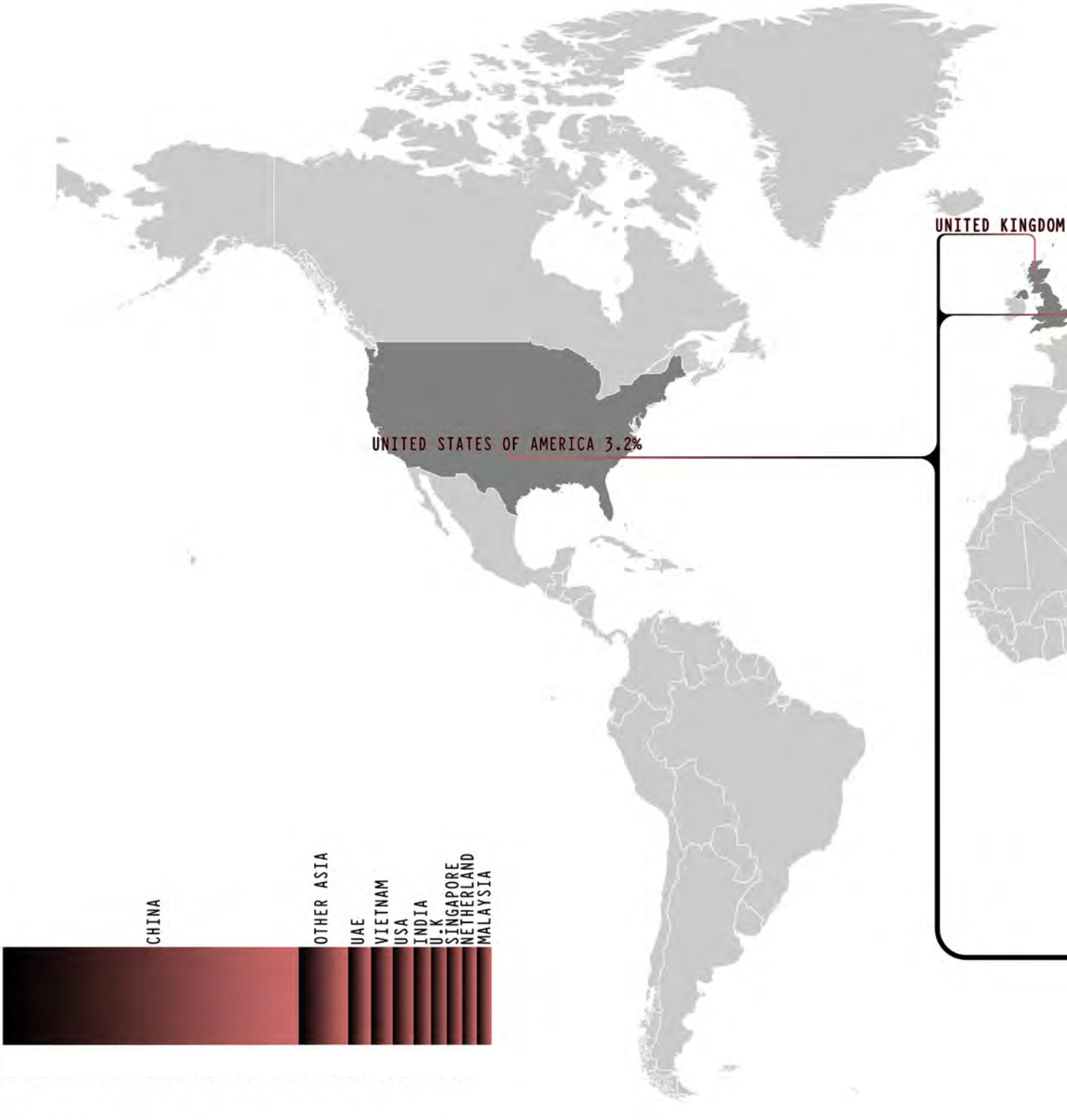

.3%
SOUTH KOREA 4.5%
PEOPLE'S REPUBLIC OF CHINA
48%
JAPAN 6.6%
OTHER ASIA 2.8%
THAILAND 2.2%
MALAYSIA 2.3%
SINGAPORE 2.3%

Hong Kong: Major Export Destinations in 2016



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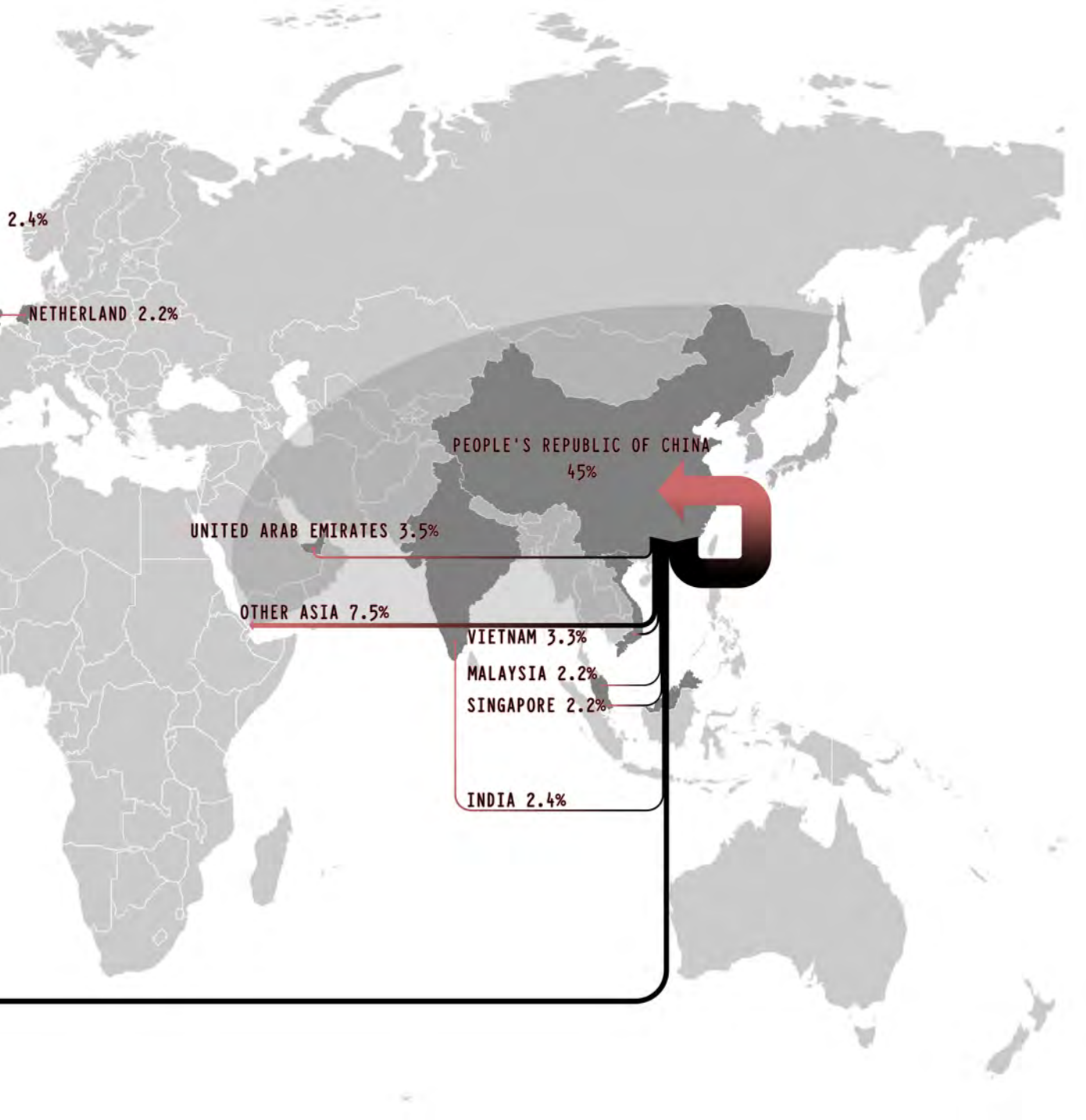

2.4%
NETHERLAND 2.2%
PEOPLE'S REPUBLIC OF CHINA
45%
UNITED ARAB EMIRATES 3.5%
OTHER ASIA 7.5%
VIETNAM 3.3%
MALAYSIA 2.2%
SINGAPORE 2.2%
INDIA 2.4%

Hong Kong: HK International Airport (HKAI) Passengers by Market in 2015

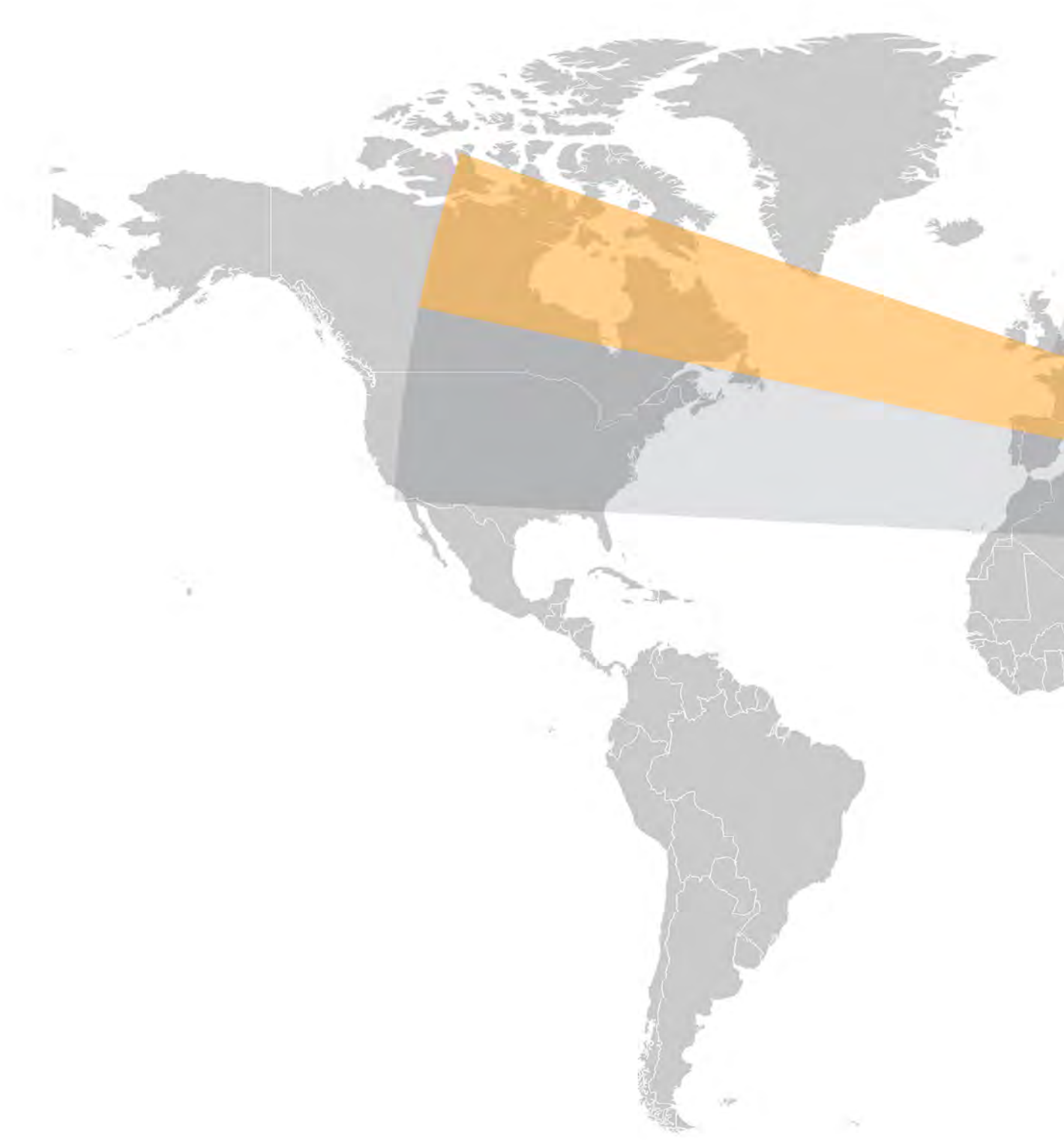


image #26


EUROPE 7%
USA AND CANADA 7%
SOUTH EAST ASIA 26%
CHINA 22%
JAPAN 8%
TAIWAN 14%
AUSTRALASIA 4%

Hong Kong: Hyperloop Proposed Routes

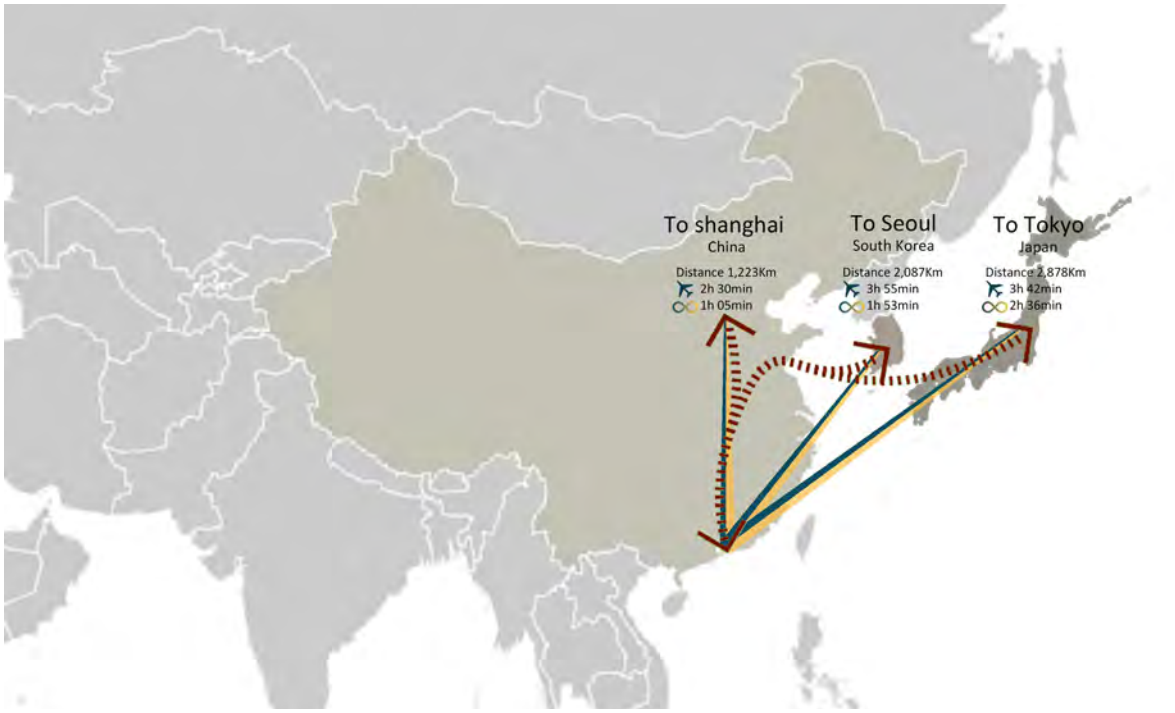


image #27: comparison between Hyperloop and flight duration from Hong Konh to Shang Hai and Tokyo

Pearl River Delta: Hyperloop Potential Area of the Coverage

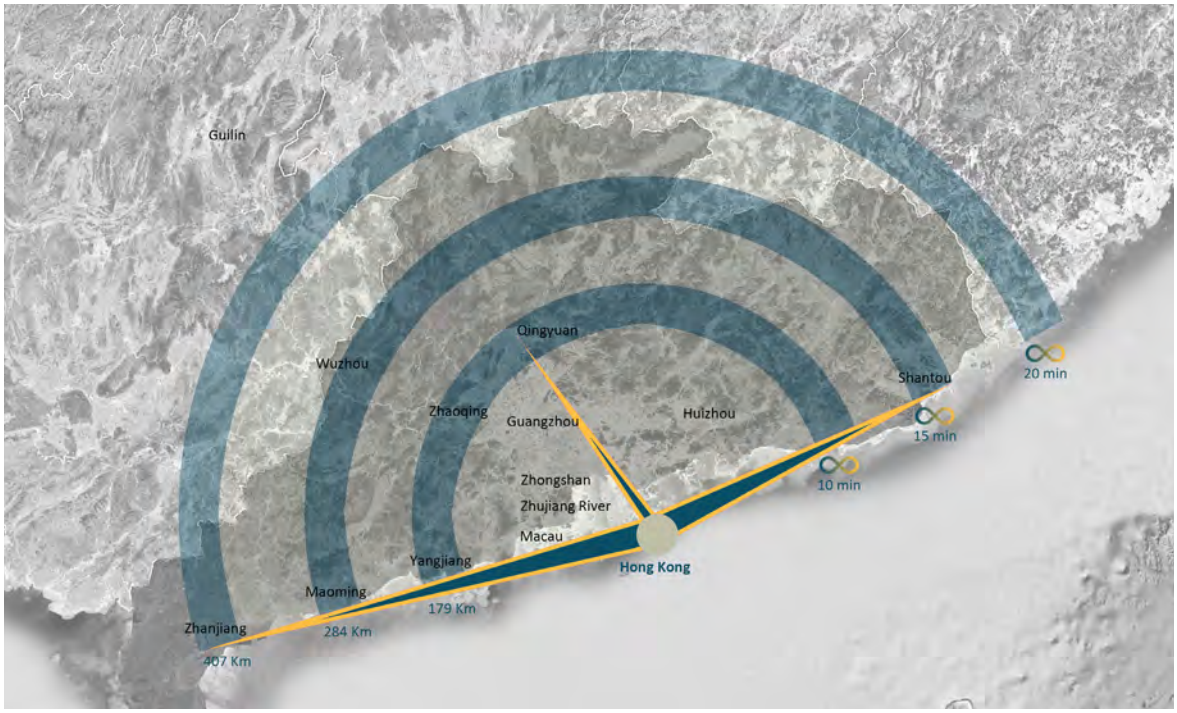


image #28: Hong Kong's potential population provided by hyper-loop connection: 107240000

Using hyperloop for short distances (10-20 minutes), Hong Kong will be linked to the neighboring cities. from the diagram we can consider that this area covers the Pearl River Delta. The Pearl River Delta (PRD) is one of the most densely urbanized regions in the world and is an economic hub of China. This region is often considered an emerging mega-city. The PRD is a megalopolis, with future development into a single mega metropolitan area, yet itself is at the southern end of a larger megalopolis running along the southern coast of China, which include metropolises such as Chaoshan, Zhangzhou-Xiamen, Quanzhou-Putian and Fuzhou. The nine largest cities of PRD had a combined population of 57.15 million at the end of 2013, comprising 53.69% of the provincial population. According to the World Bank Group, the PRD has become the largest urban area in the world in both size and population.[12]

12 https://en.wikipedia.org/wiki/Pearl_River_Delta

Main Regions of Hong Kong

1) New Territories is one of the three main regions of Hong Kong. It makes up %86.2 of Hong Kong›s territory, and contains around half of the population of Hong Kong. Historically, it is the region described in The Convention for the Extension of Hong Kong Territory. According to that the territories comprise the mainland area north of the Boundary Street of Kowloon Peninsula and south of the Sham Chun River which is the border between Hong Kong and Mainland China, as well as over 200 outlying Islands including Lantau Island, Lamma Island, Cheung Chau, and Peng Chau in the territory of Hong Kong.[13]
2) The Kowloon Peninsula is a peninsula that forms the southern part of the main landmass in the territory of Hong Kong. The Kowloon Peninsula and the area of New Kowloon are collectively known as Kowloon.
Geographically, the term «Kowloon Peninsula» may also refer to the area south of the mountain ranges of Beacon Hill, Lion Rock, Tate›s Cairn, Kowloon Peak, etc. The peninsula covers five of the eighteen districts of Hong Kong. Kowloon Bay is located at the northeast of the peninsula.[14]
3) Hong Kong Island is an island in the southern part of Hong Kong. It has a population of 1,289,500 and its population density is 16,390/km², as of 2008. The island had a population of about 3,000 inhabitants scattered in a dozen fishing villages when it was occupied by the United Kingdom in the First Opium War. In 1842, the island was formally ceded in perpetuity to the UK under the Treaty of Nanking and the City of Victoria was then established on the island by the British Force in honour of Queen Victoria.[15]

13 https://en.wikipedia.org/wiki/New_Territories
14 https://books.google.com/books?isbn=146728839X
15 https://en.wikipedia.org/wiki/Hong_Kong_Island

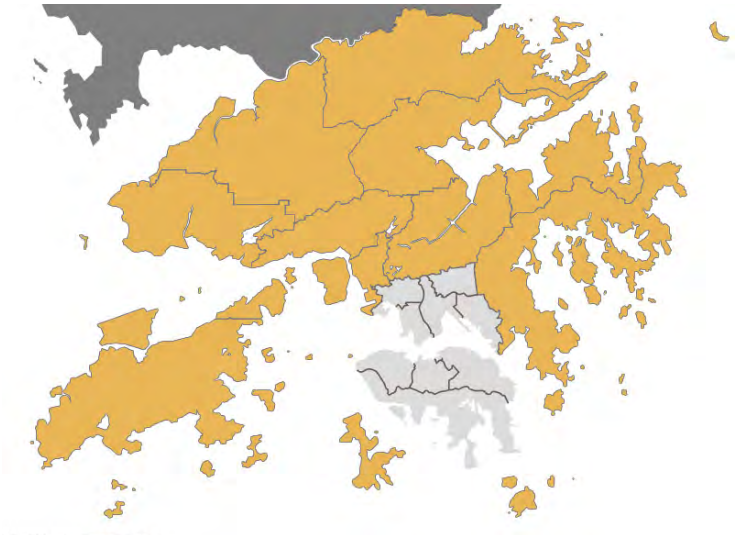


image #29: New Territories

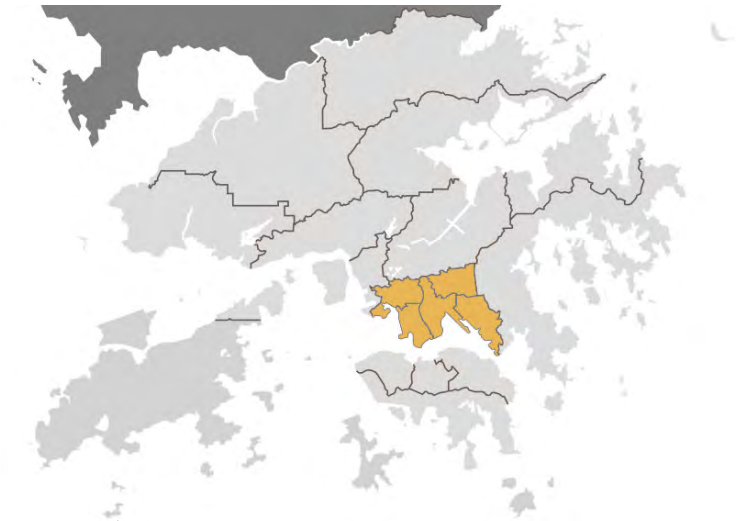


image #30: Kowloon

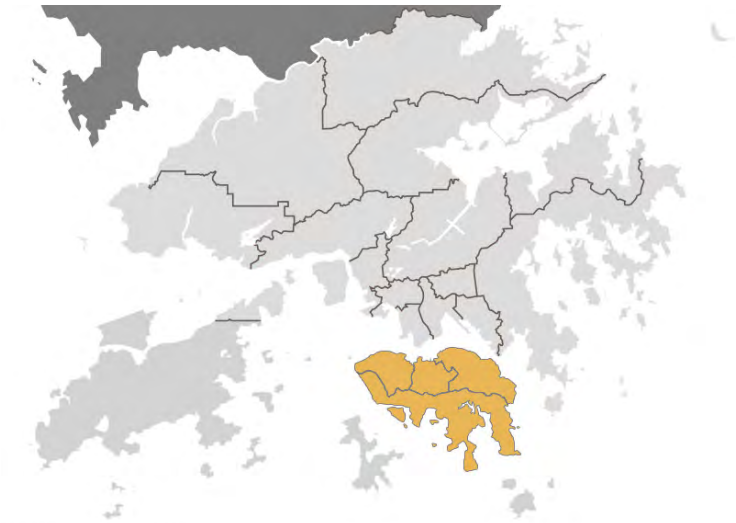


image #31: Hong Kong Island

Kai Tak

Kai Tak Airport was the international airport of Hong Kong from 1925 until 1998. It was officially known as Hong Kong International Airport from 1954 to 6 July 1998, when it was closed and replaced by the new Hong Kong International Airport at Chek Lap Kok, 30 kilometres (19 mi) to the west.
With numerous skyscrapers and mountains located to the north and its only runway jutting out into Victoria Harbour, landings at the airport were dramatic to experience and technically demanding for pilots.
Kai Tak was located on the west side of Kowloon Bay in Kowloon, Hong Kong. The area is surrounded by rugged mountains. Less than 10 km (6.2 mi) to the north and northeast is a range of hills reaching an elevation of 2,000 ft (610 m). To the east of the runway, the hills are less than 5 km (3.1 mi) away. Immediately to the south of the airport is Victoria Harbour, and farther south is Hong Kong Island with hills up to 2,100 ft (640 m).[16]

16 https://en.wikipedia.org/wiki/Kai_Tak_Airport

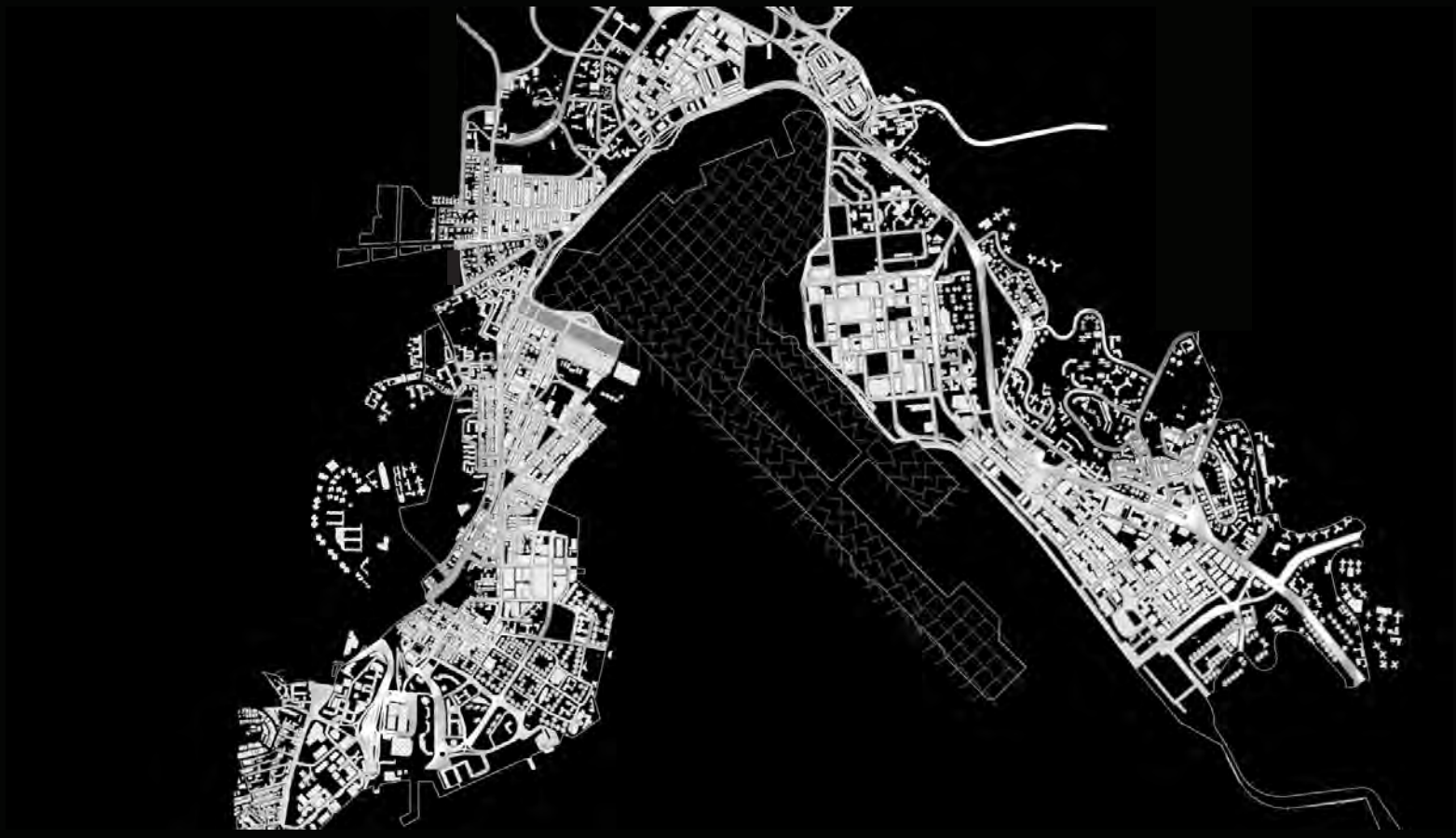


image #32

image #33

Kai Tak- History

The story of Kai Tak started in 1912 when two businessmen Ho Kai and Au Tak formed the Kai Tak Investment Company to reclaim land in Kowloon for development. The land was acquired by the government for use as an airfield after the business plan failed.

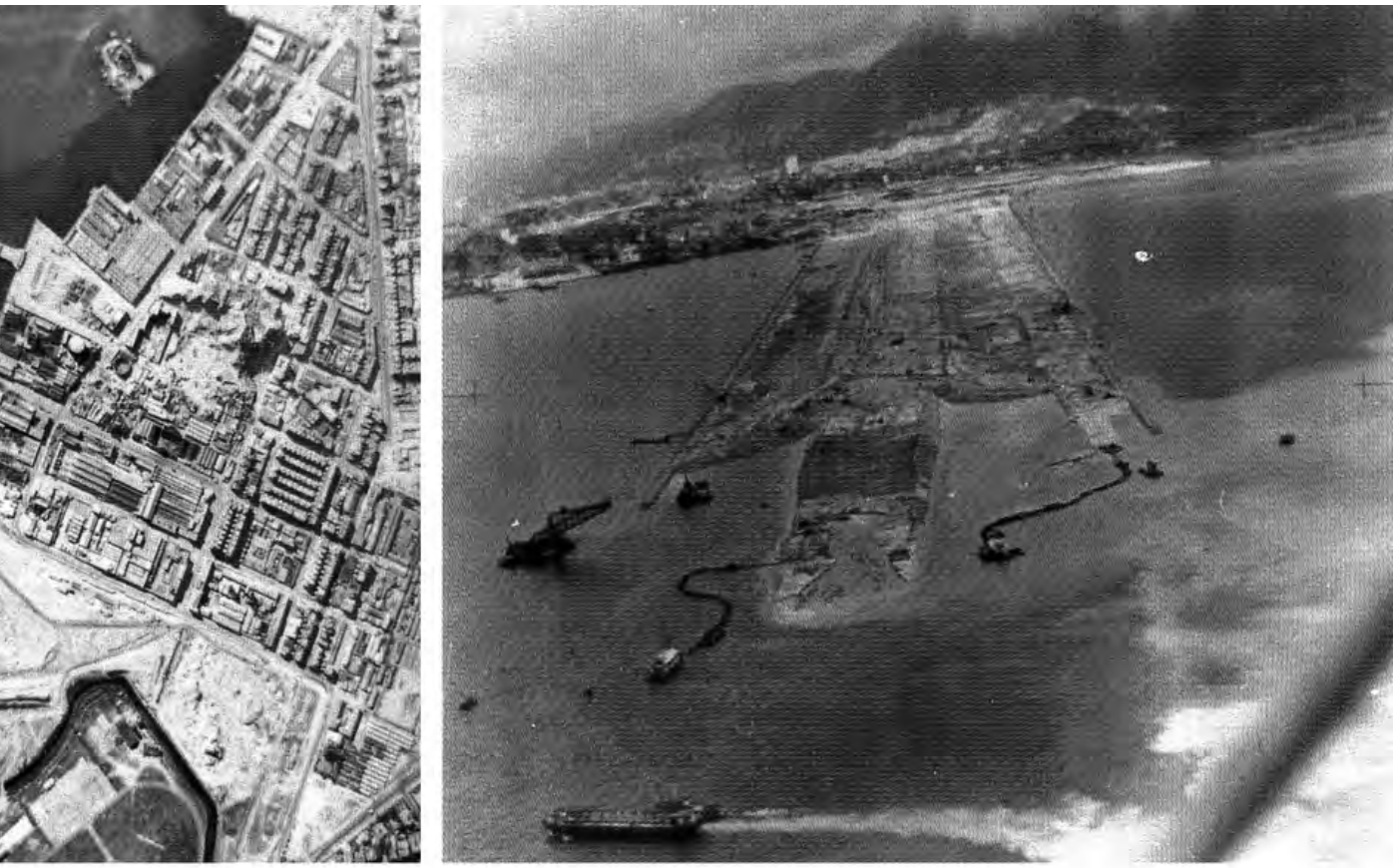
World War II
Hong Kong fell into the hands of the Japanese in 1941 during World War II. In 1942, the Japanese army expanded Kai Tak, using many Allied prisoner-of-war labourers,building two concrete runways, 31/13 and 25/07. Numerous POW diary entries exist recalling the gruelling work and long hours working on building Kai Tak.

1945 to 1970s
A plan to modify Kai Tak into a modern airport was released in 1954. By 1957, runway 31/13 had been extended to 1,664 metres (5,459 ft), while runway 25/7 remained 1,450 metres (4,760 ft) long. Bristol Britannia 102s took over BOAC›s London-Tokyo flights in summer 1957 and were probably the largest airliners at the time to use the old airport. In 1958, the new NW/SE -2,542metre (8,340 ft) long runway extending into the Kowloon Bay was completed by land reclamation. The runway was extended to 3,390 metres (11,120 ft) in 1975. The passenger terminal was completed in 1962.

An Instrument Guidance System (IGS) was installed in 1974 to aid landing on runway 13. Use of the airport under adverse conditions was greatly increased.

Source: 《Airport of the Nine Dragons, Kai Tak, Kowloo
圖片來源: 《Airport of the Nine Dragons, Kai Tak, Kowloo

image #34



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n》

Kai Tak Development in 1956-57

一九五六至五七年間擴建中的啟德機場

Overcrowding in the 1980s and 1990s
The growth of Hong Kong also put a strain on the airport's capacity. Its usage was close to, and for some time exceeded, the designed capacity. The airport was designed to handle 24 million passengers per year, but in 1996, Kai Tak handled 29.5 million passengers, plus 1.56 million tonnes of freight, making it the third busiest airport in the world in terms of international passenger traffic, and busiest in terms of international cargo throughput. Moreover, clearance requirements for aircraft takeoffs and landings made it necessary to limit the height of buildings that could be built in Kowloon. While Kai Tak was initially located far away from residential areas, the expansion of both residential areas and the airport resulted in Kai Tak being close to residential areas. This caused serious noise pollution for nearby residents and put height restrictions, which were removed after Kai Tak closed. A night curfew from midnight to about 6:30 in the early morning also hindered operations.

As a result, in the late 1980s, the Hong Kong Government began searching for alternative locations for a new airport in Hong Kong to replace the aging airport. After deliberating on a number of locations, including the south side of Hong Kong Island, the government decided to build the airport on the island of Chek Lap Kok off Lantau Island. A huge number of resources were mobilised to build this new airport, part of the ten programmes in Hong Kong's Airport Core Programme.[17]

image #35

17 https://en.wikipedia.org/wiki/Kai_Tak_Airport

Kai Tak- Perspective

In october 2006, the Planning Department unveiled a major reworking of its plans for the old Kai Tak airport site on 17 October 2006, containing «a basket of small measures designed to answer a bevy of concerns raised by the public». The revised blueprint will also extend several «green corridors» from the main central park into the surrounding neighbourhoods of Kowloon City, Kowloon Bay and Ma Tau Kok.

The following features are proposed in the revised plan:

two cruise terminals, with a third terminal to be added if the need arises
a luxury hotel complex near the cruise terminals—the complex would sit about seven stories high, with hotel rooms atop commercial or tourist-related spaces
an eight-station monorail linking the tourist hub with Kwun Tong
a large stadium
a «central park» to provide green space
a -200metre (660 ft) high public «viewing tower» near the tip of the runway
a new bridge, likely to involve further reclamation of Victoria Harbour
The following are major changes:

hotel spaces are to be centralised near the end of the runway, and will face into the harbour towards Central
a third cruise terminal could be added at the foot of the hotel cluster if the need arises
a second row of luxury residential spaces is to be

image #36

added facing Kwun Tong, built on an elevated terrace or platform to preserve a view of the harbour
The government has promised that:

the total amount of housing and hotel space will remain the same as proposed in June 2006
plot ratios will be the same as before
the total commercial space on the site will also remain about the same
The new bridge proposed by the government, joining the planned hotel district at the end of the runway with Kwun Tong, could be a potential source of controversy. Under the Protection of the Harbour Ordinance, no harbour reclamation can take place unless the Government can demonstrate to the courts an «overriding public need».

The new Kai Tak blueprint was presented to the Legislative Council on 24 October 2006 after review by the Town Planning Board.[18]

18 https://en.wikipedia.org/wiki/Kai_Tak_Airport

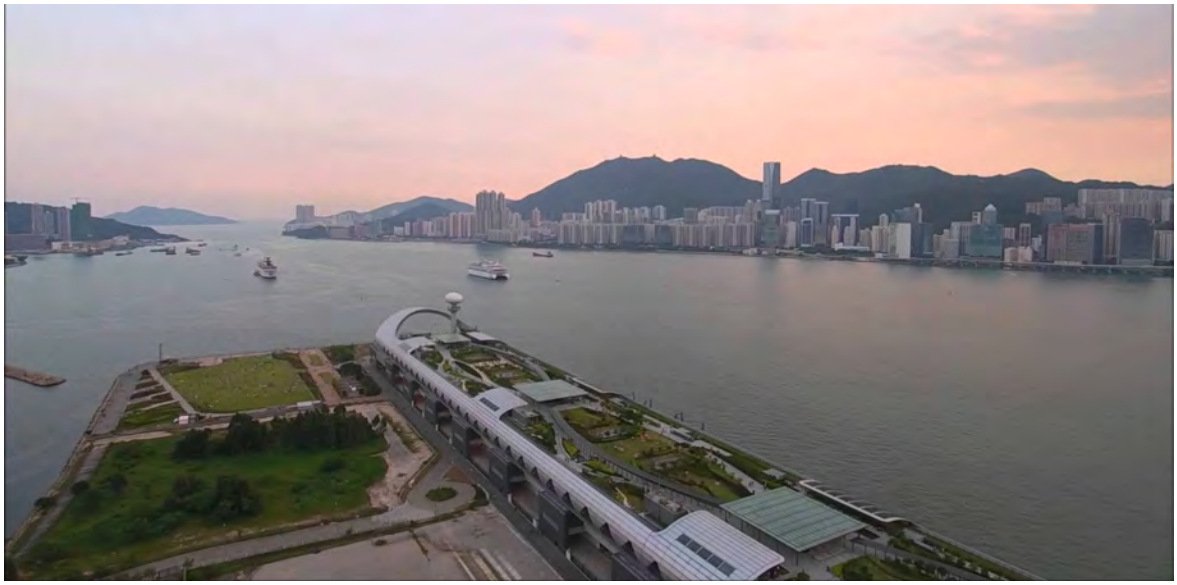


image #37

image #38

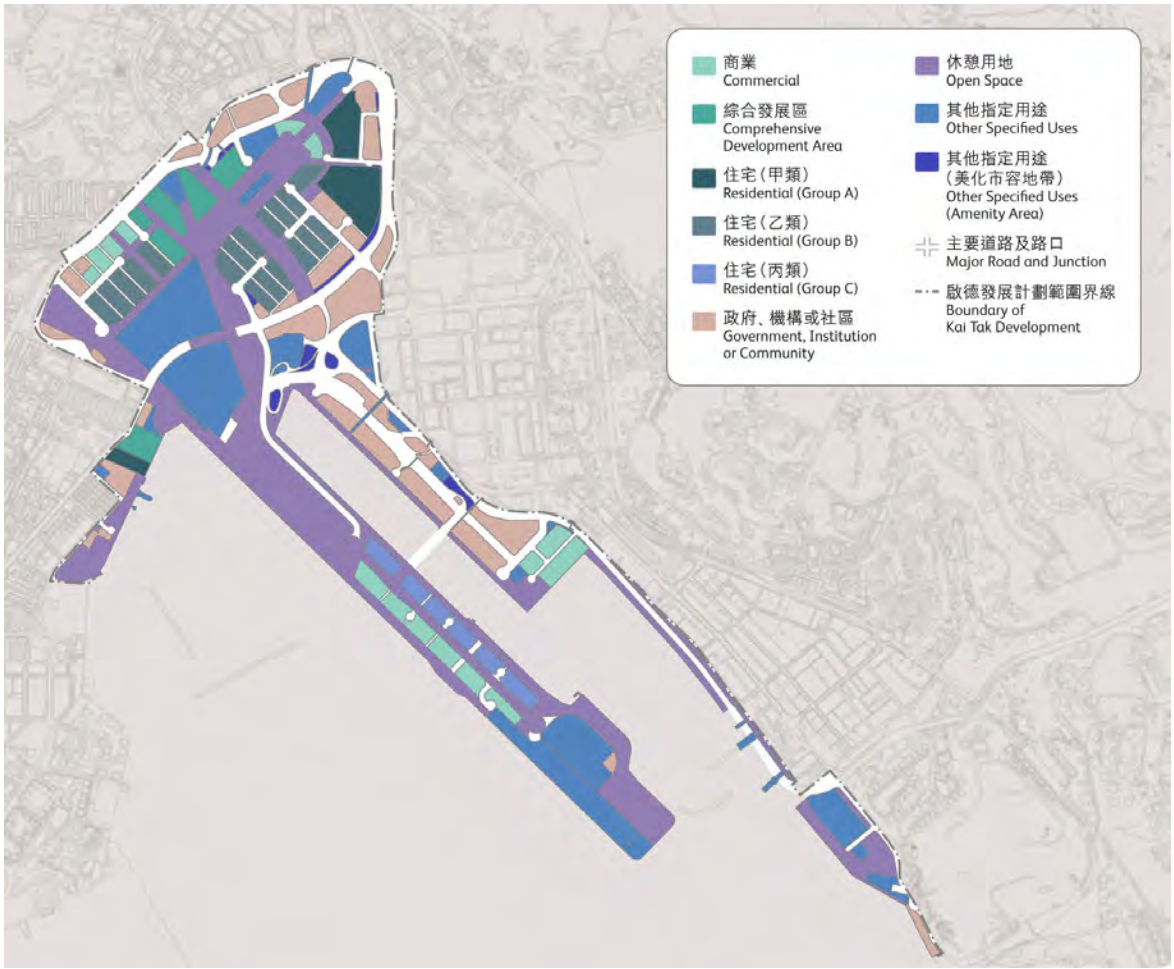


image #39: Overview of Kai Tak Development

image #40: Overview of Kai Tak Development

Site Analysis

image #41

image #42: Population density Diagram

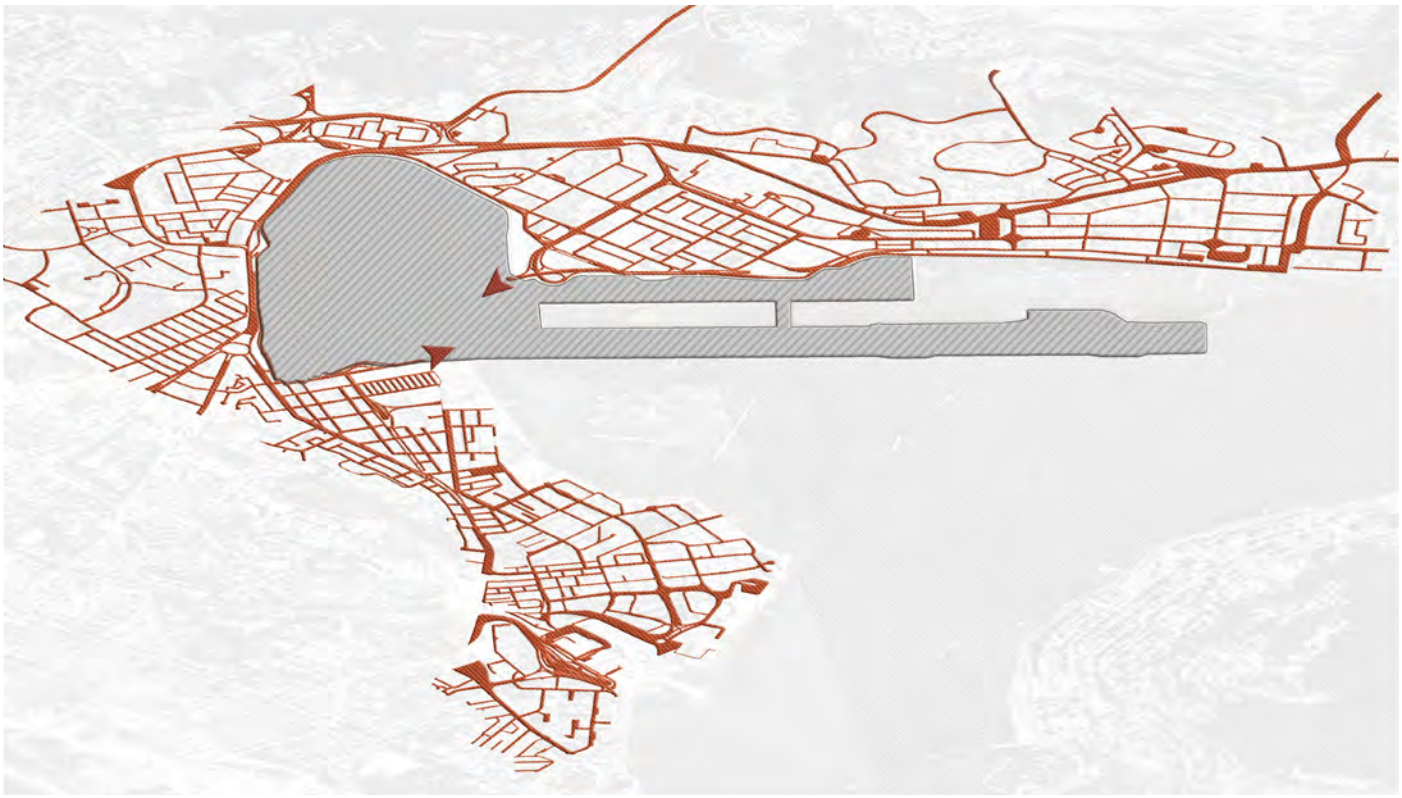


image #43: Site access Diagram

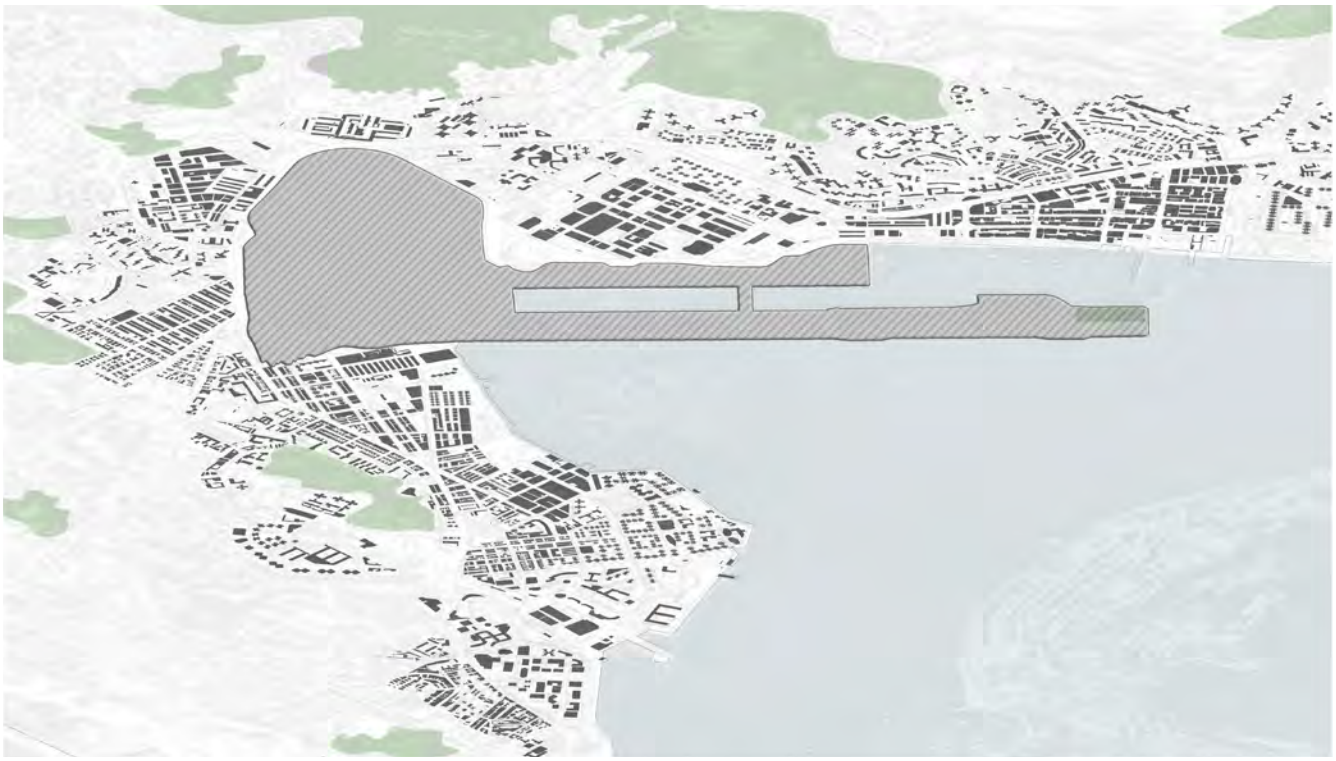


image #44: Green/ Built space proportion Diagram

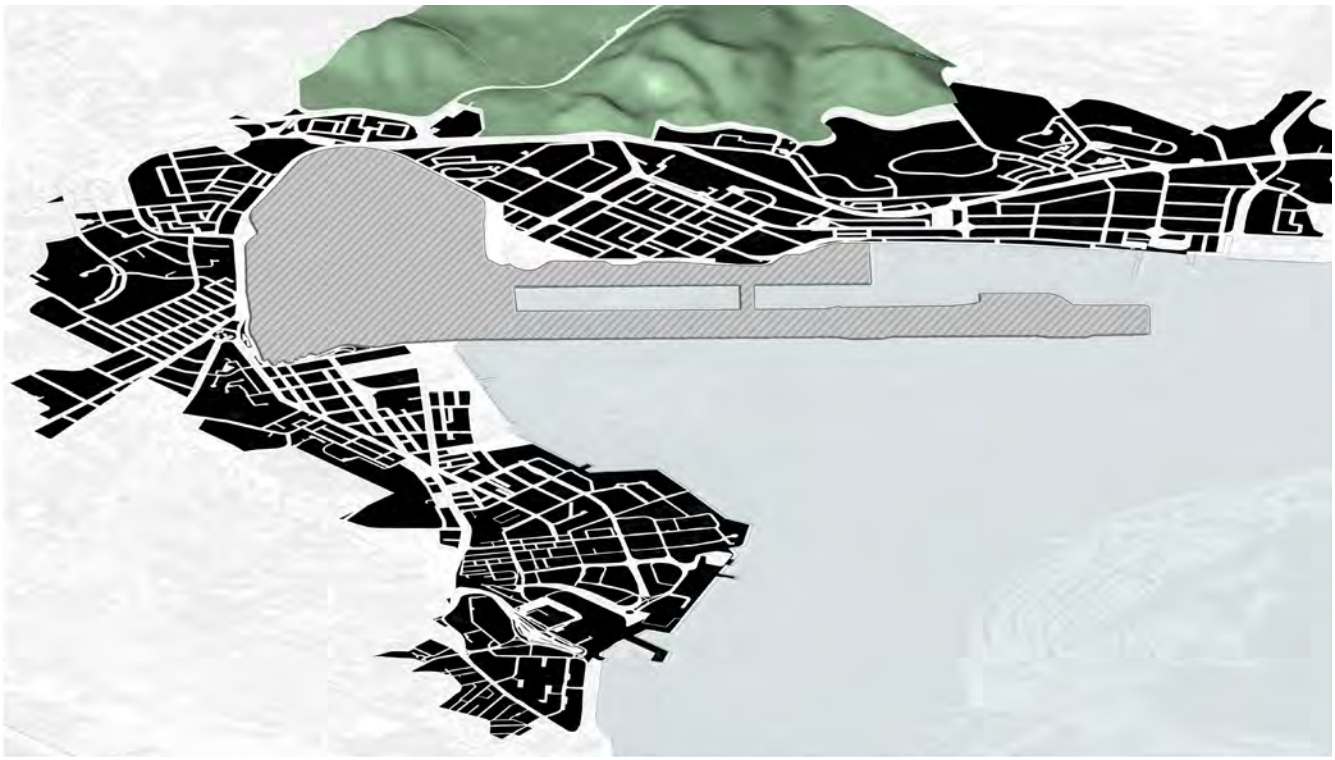
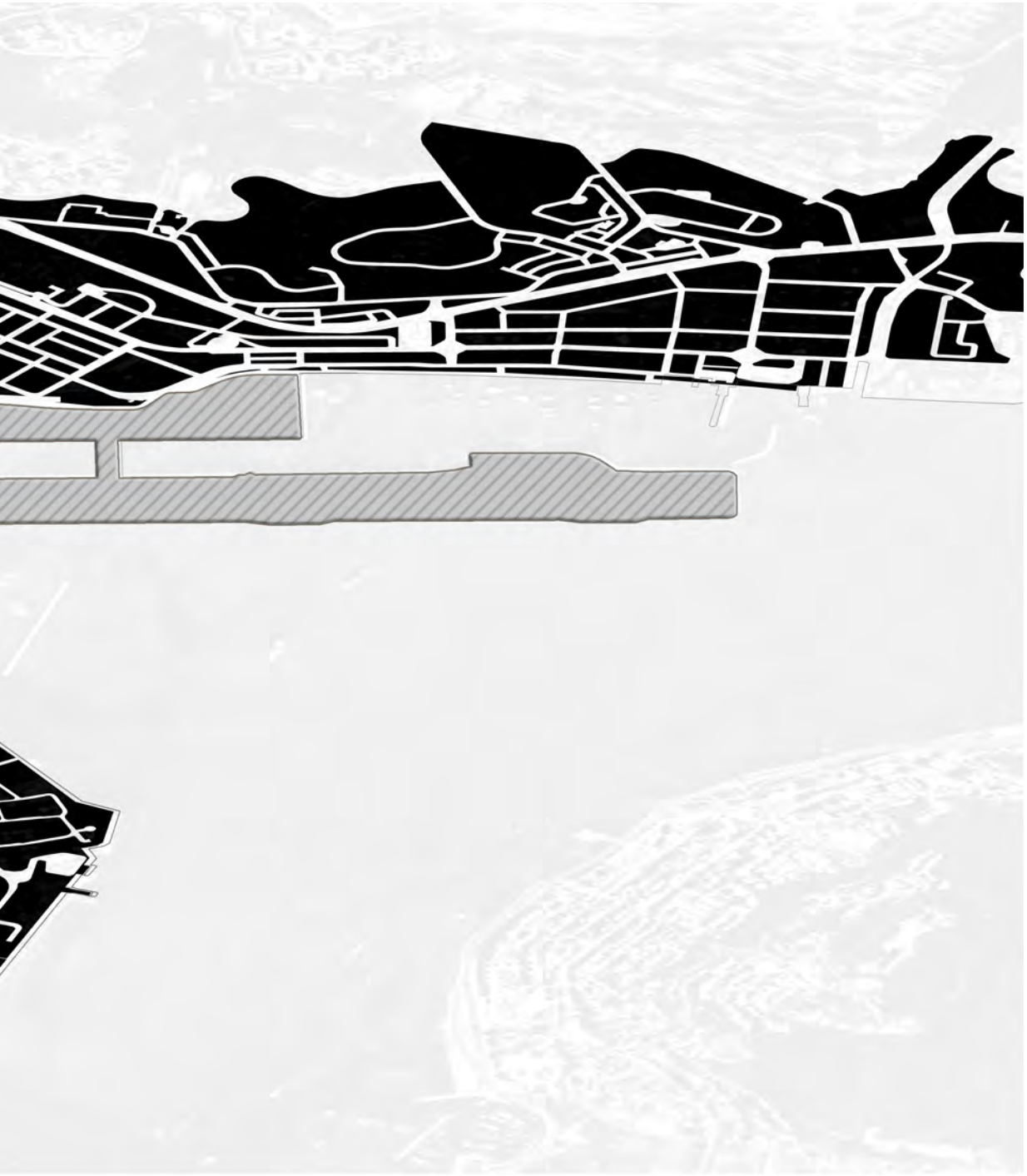
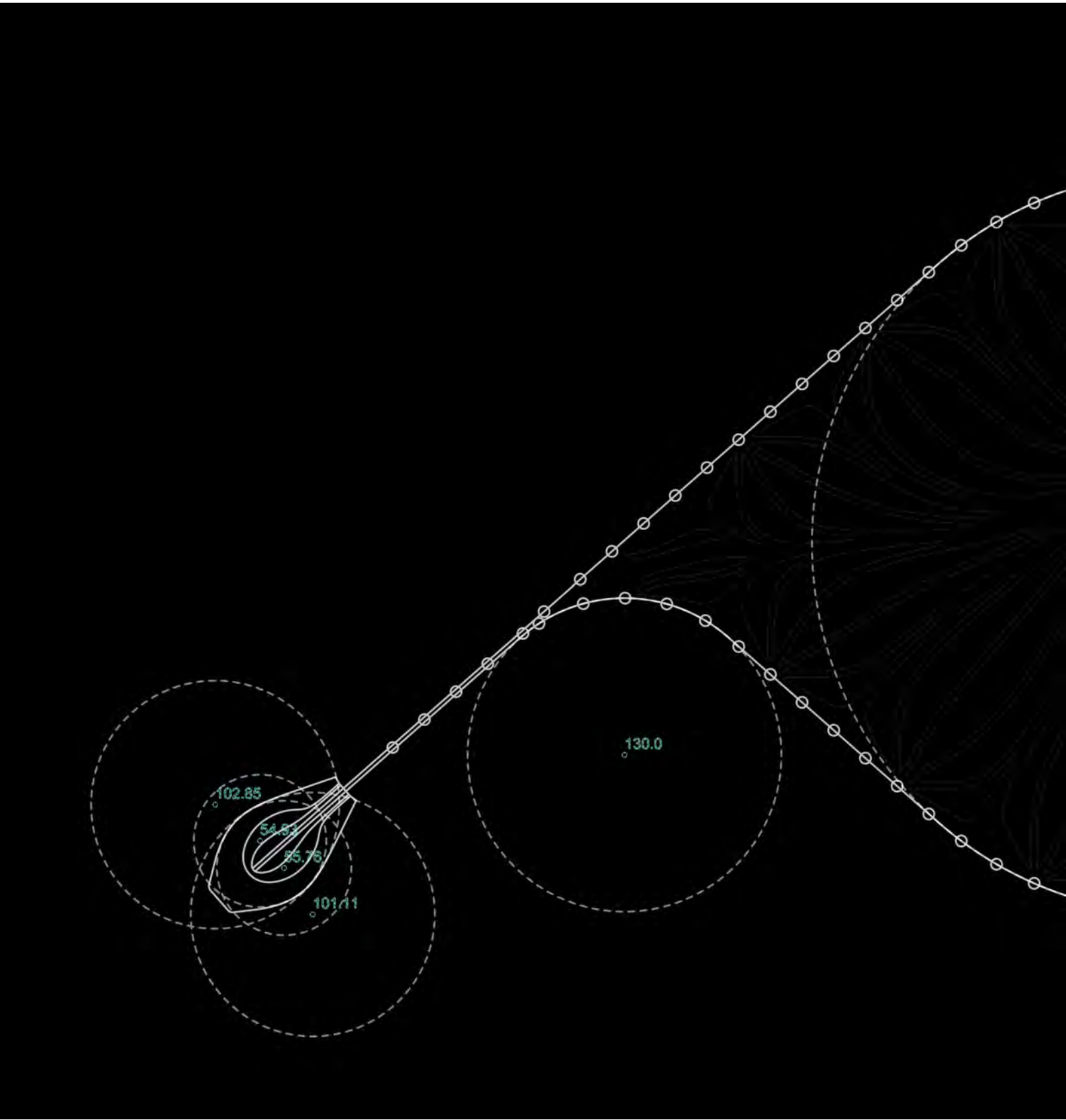


image #45: Figure- Ground Diagram

image #46: Solar Analysis Diagram

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102.85
54.81
35.76
101.11

Design Strategy
& Form Finding

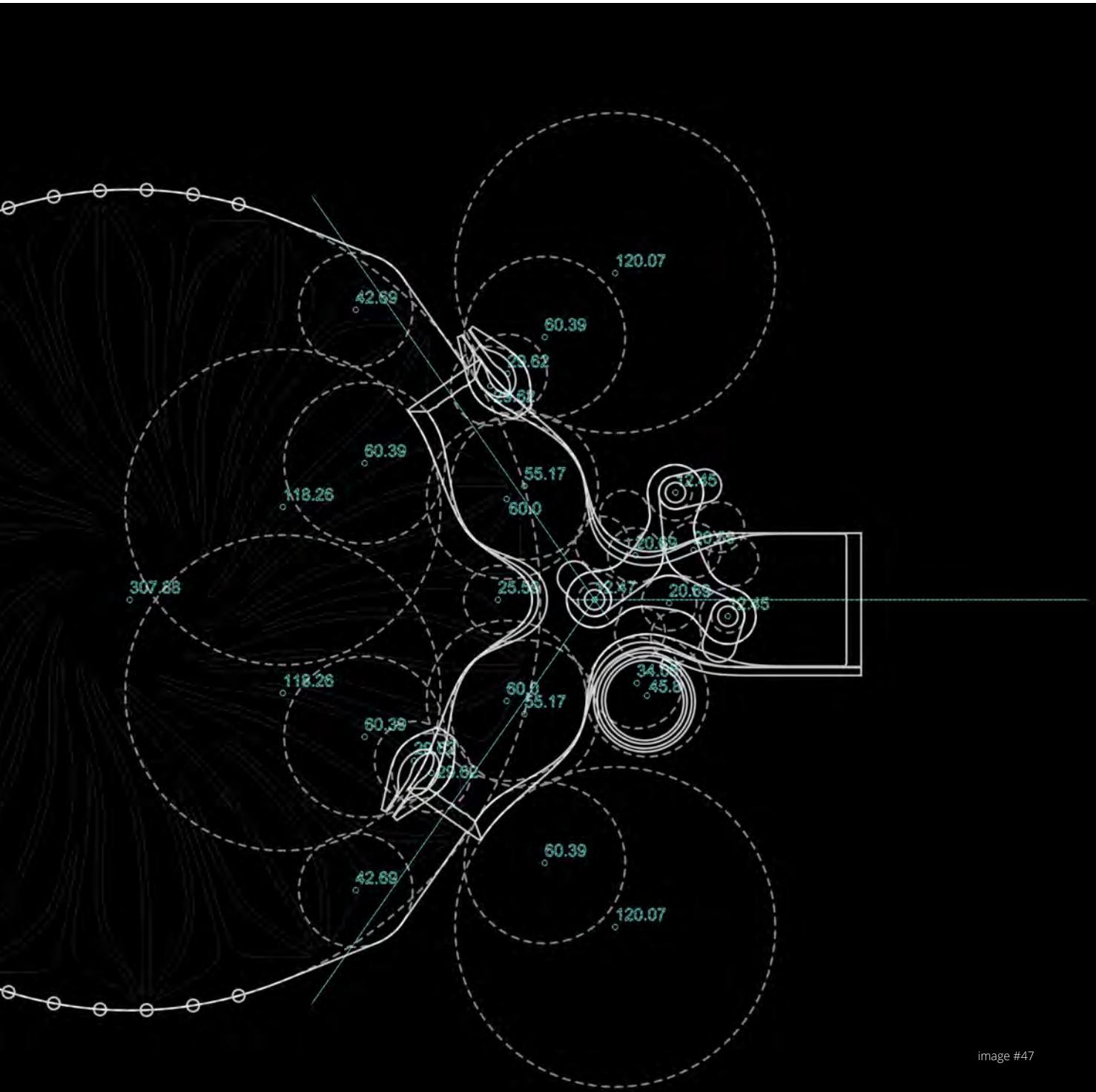


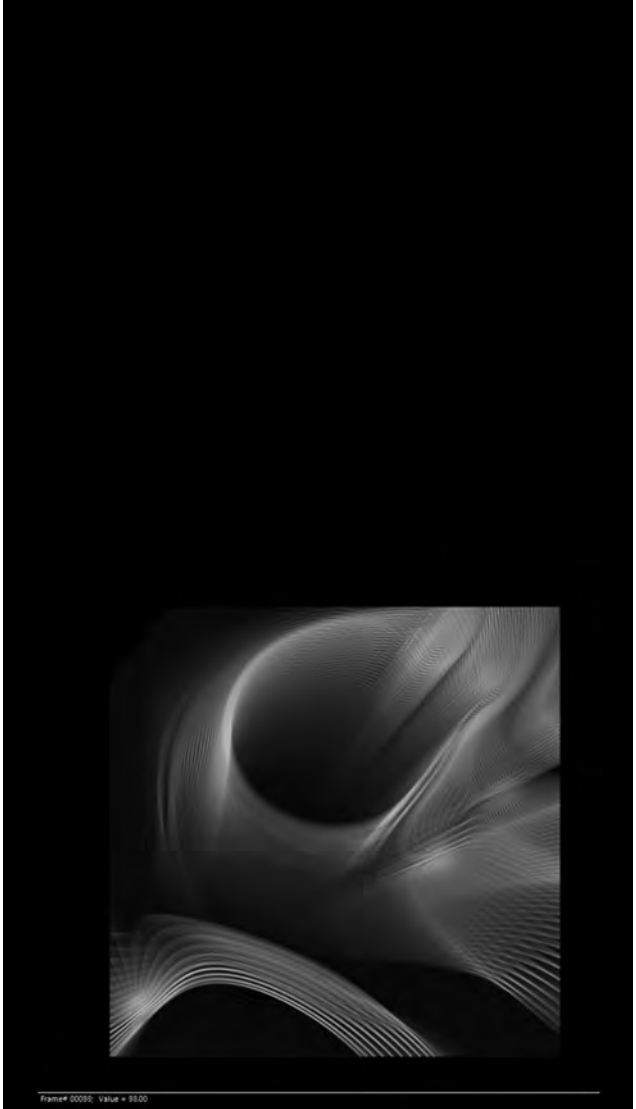
image #47

image 48

modeling motion in 2D space using grasshopper

image 49

image 50



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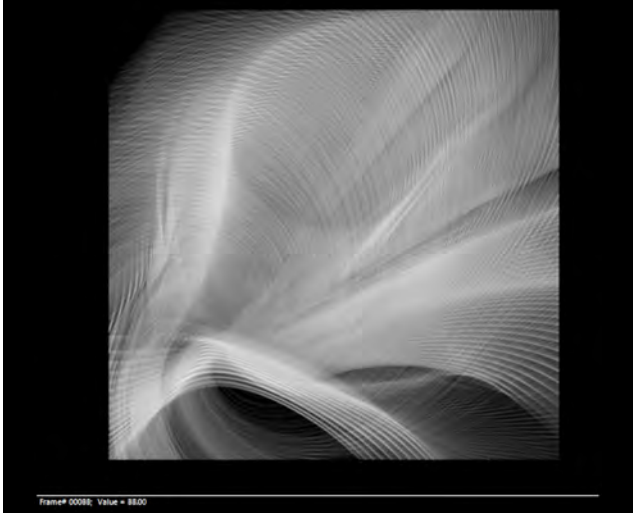
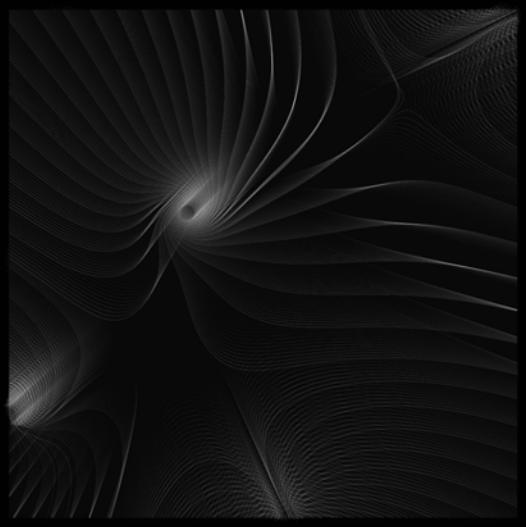


image 52

modeling motion in 2D space using grasshopper

modeling motion in 2D space using grasshopper



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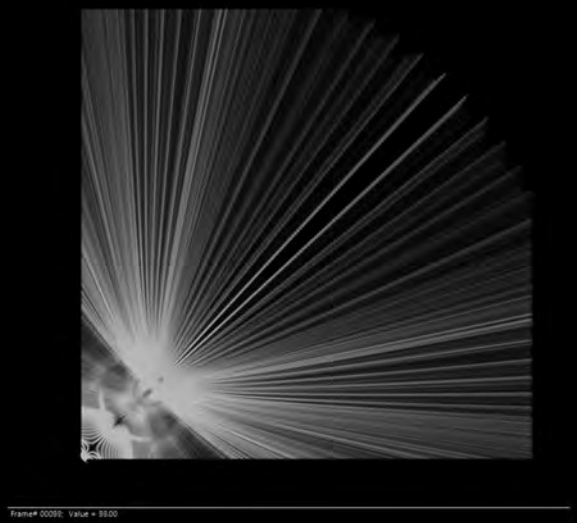

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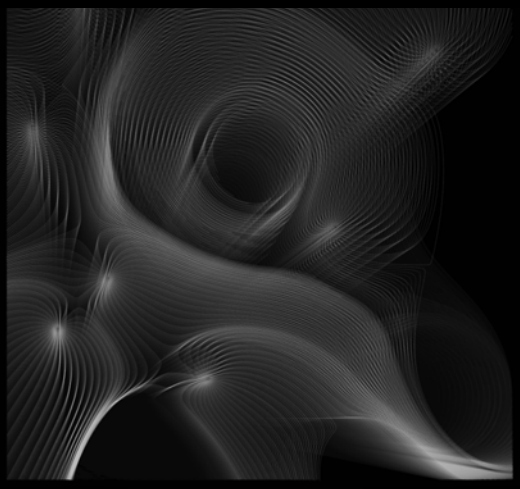


image 55

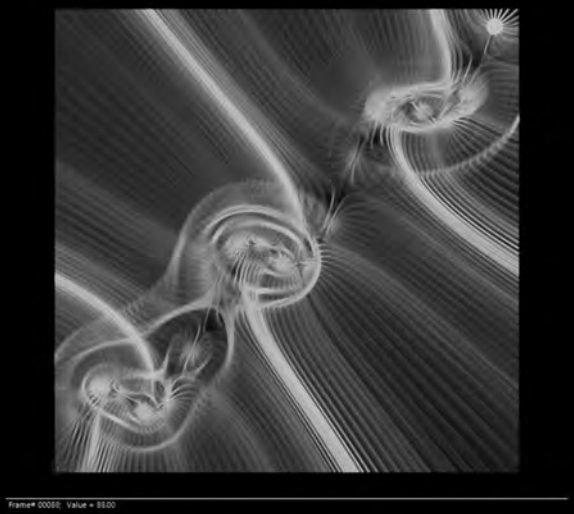
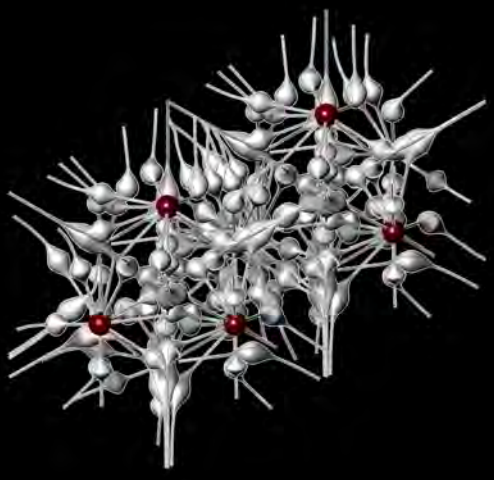


image 56

modeling motion in 2D space using grasshopper

Electromagnetic fields applied in 3d space to simulate motion

image 57



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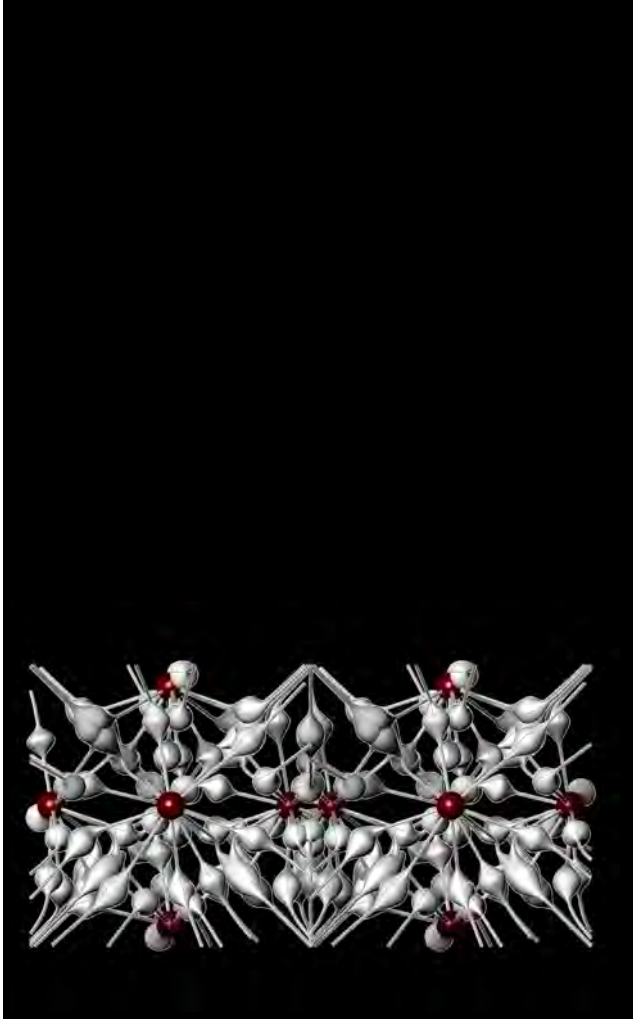

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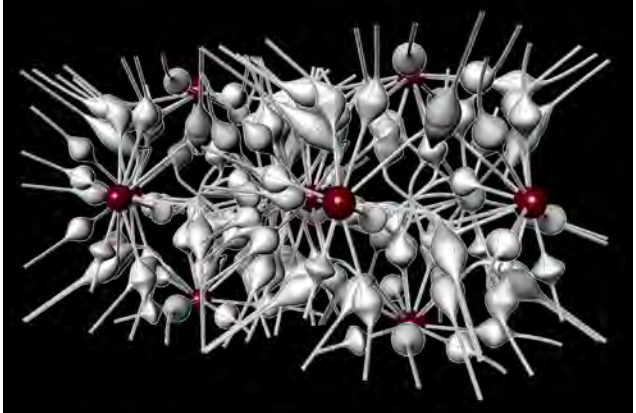
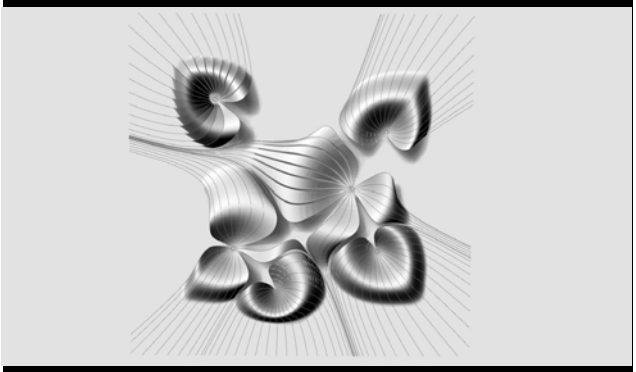
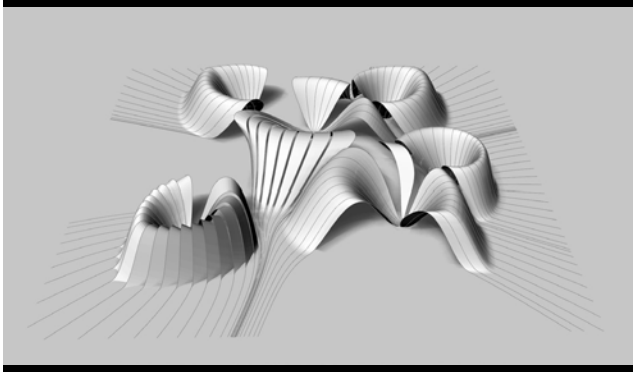


image 60

Electromagnetic fields applied in 3d space to simulate motion

Electromagnetic fields applied in 3d space to simulate motion





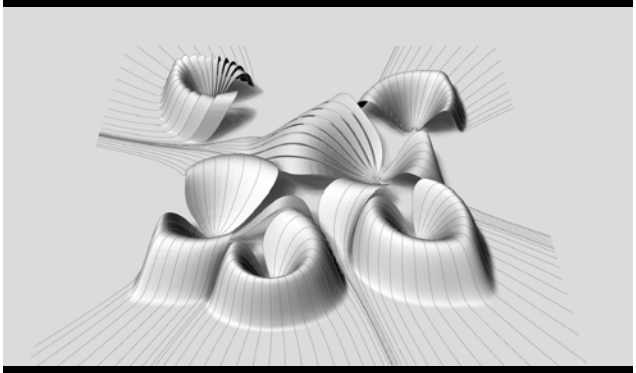
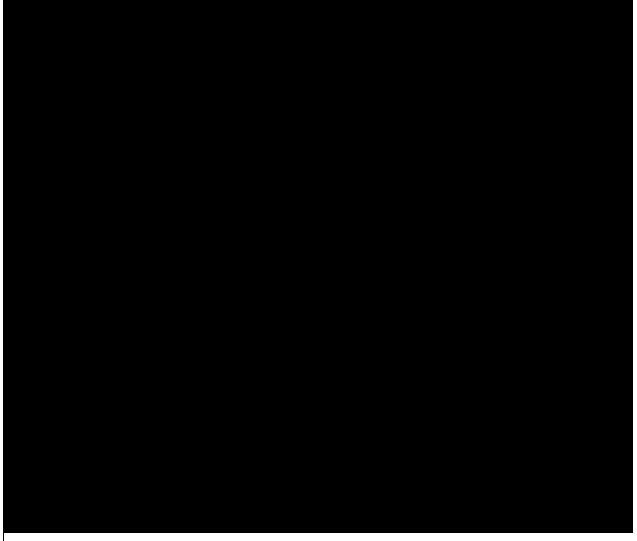
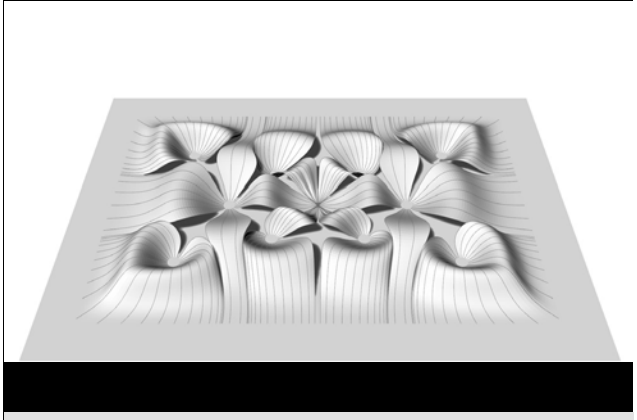
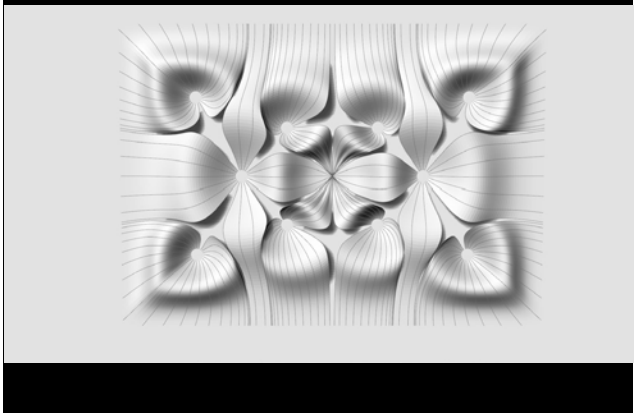


image 61,62,63







Electromagnetic fields applied in 3d space to simulate motion

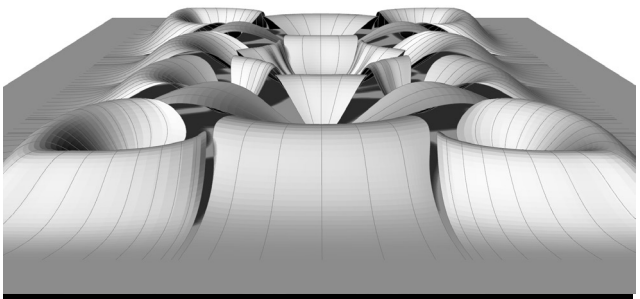
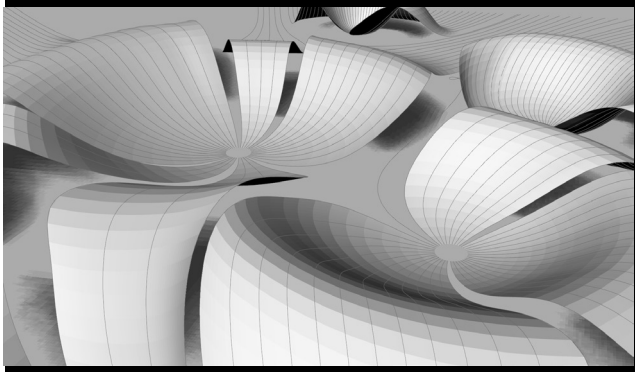
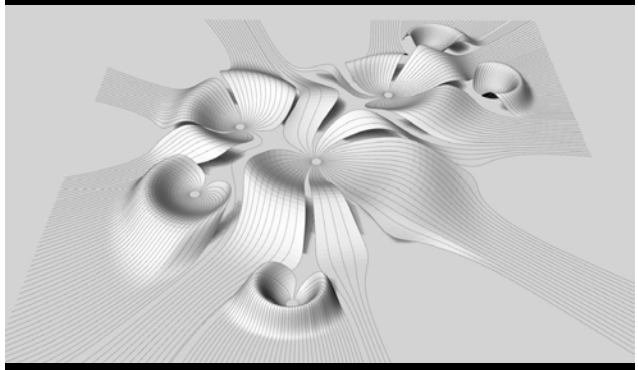


image 64,65,66

Electromagnetic fields applied in 3d space to simulate motion





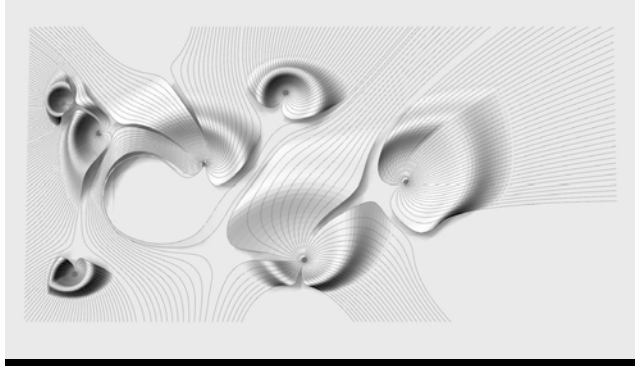
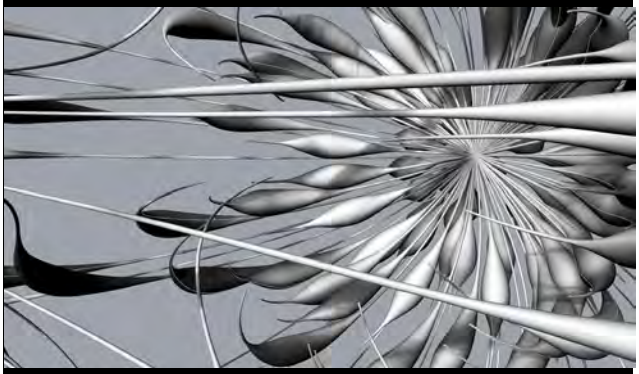
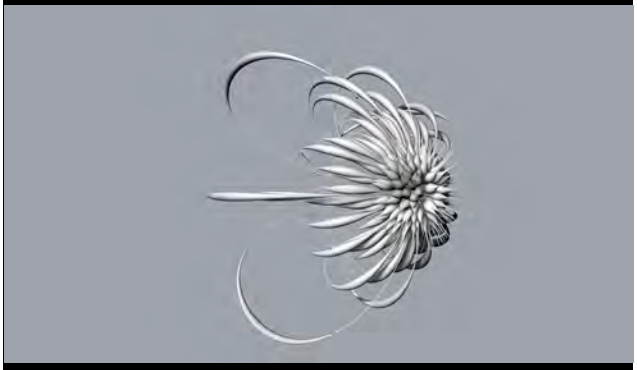
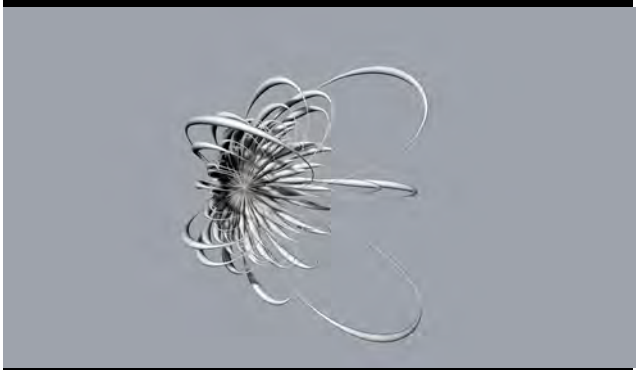


image # 67, 68, 69







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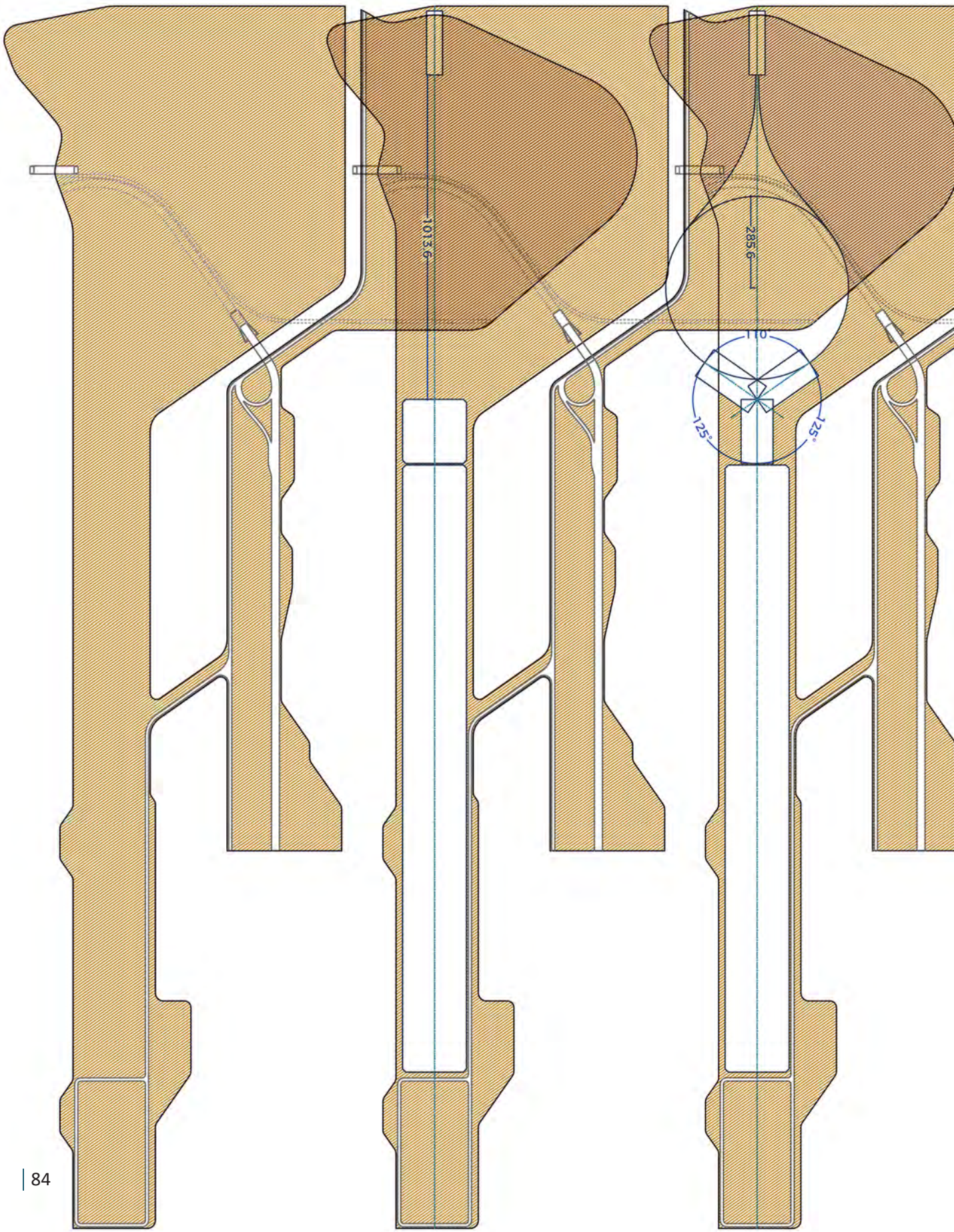
Electromagnetic fields applied in 3d space to simulate motion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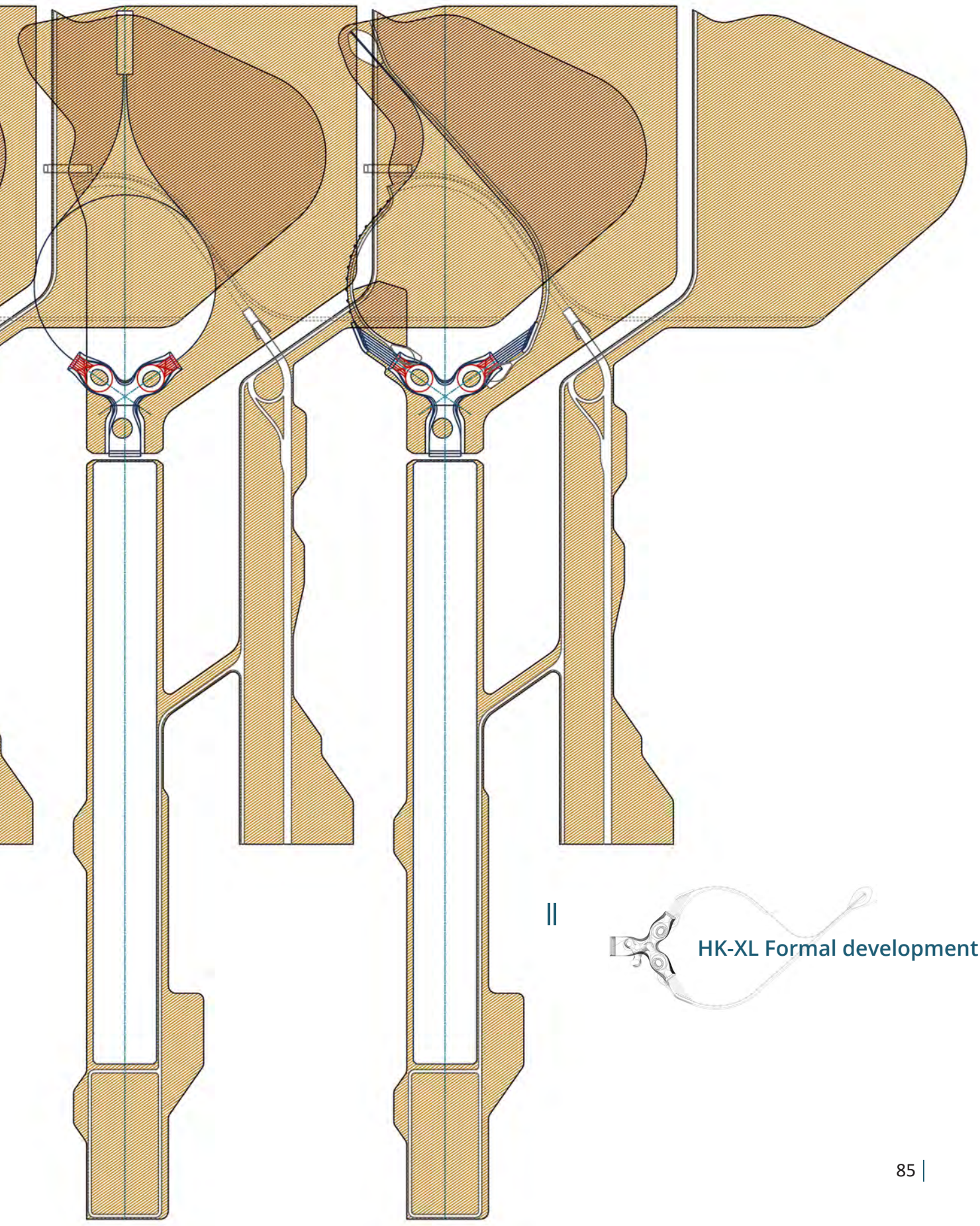
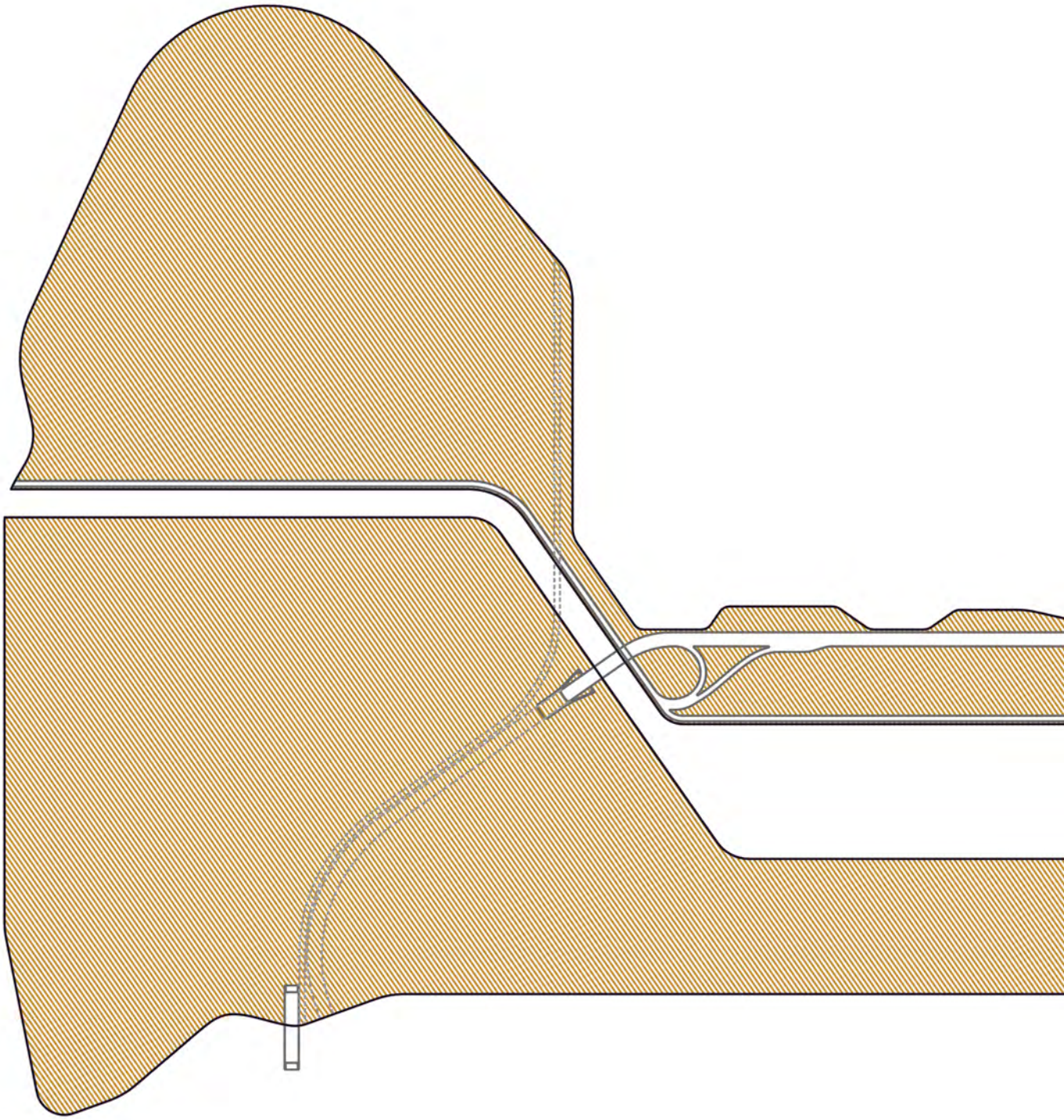
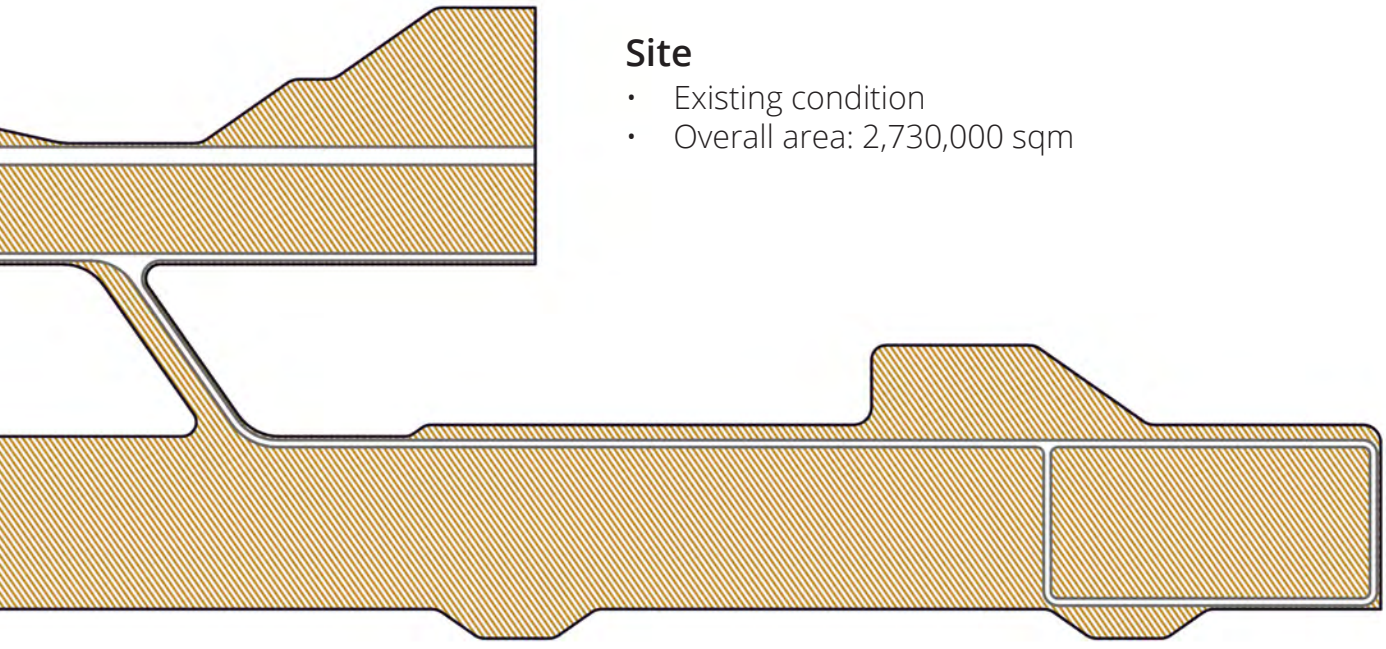
285.6
110
125°
125°



II

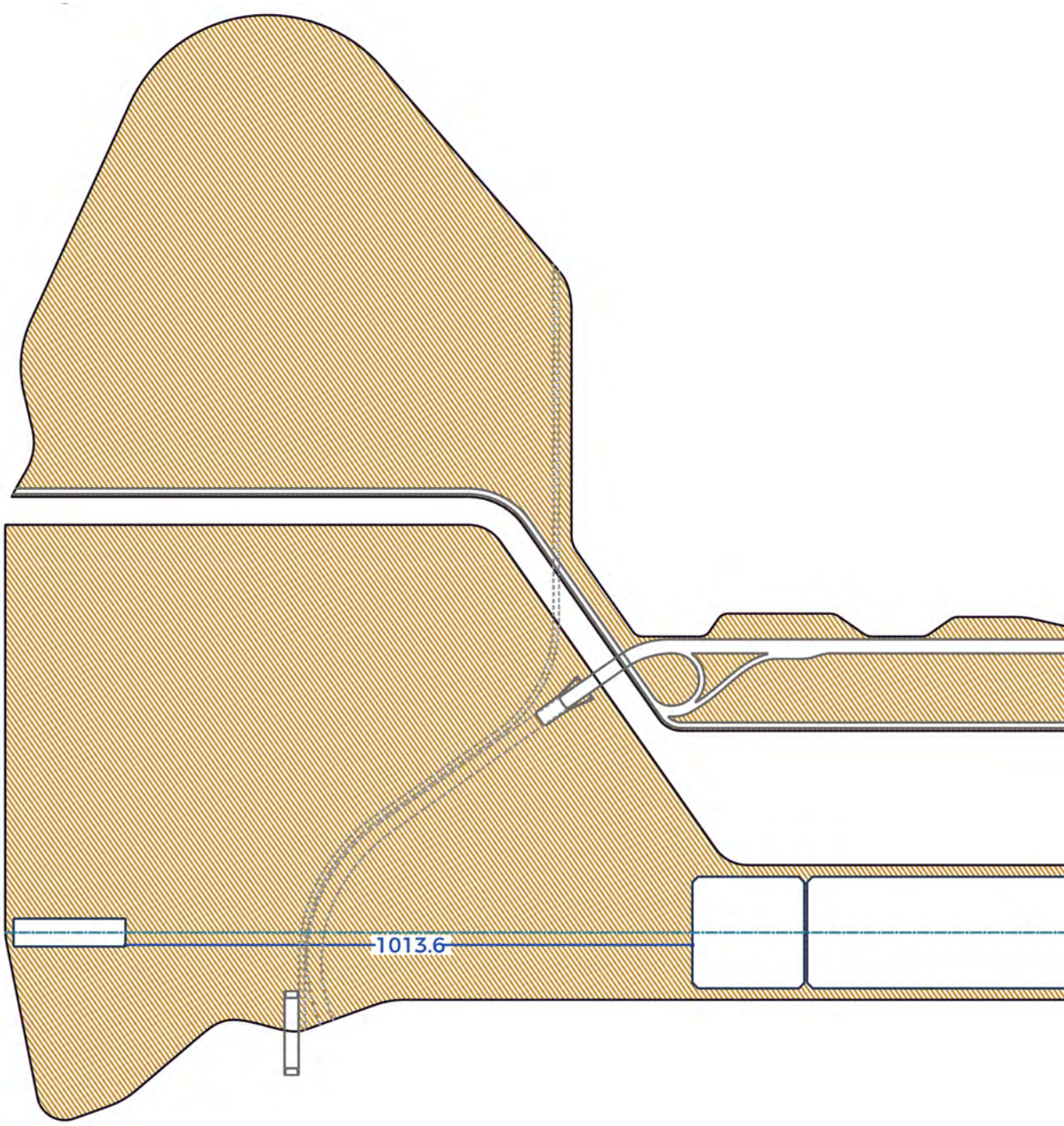
HK-XL Formal development





Site

- Existing condition
- Overall area: 2,730,000 sqm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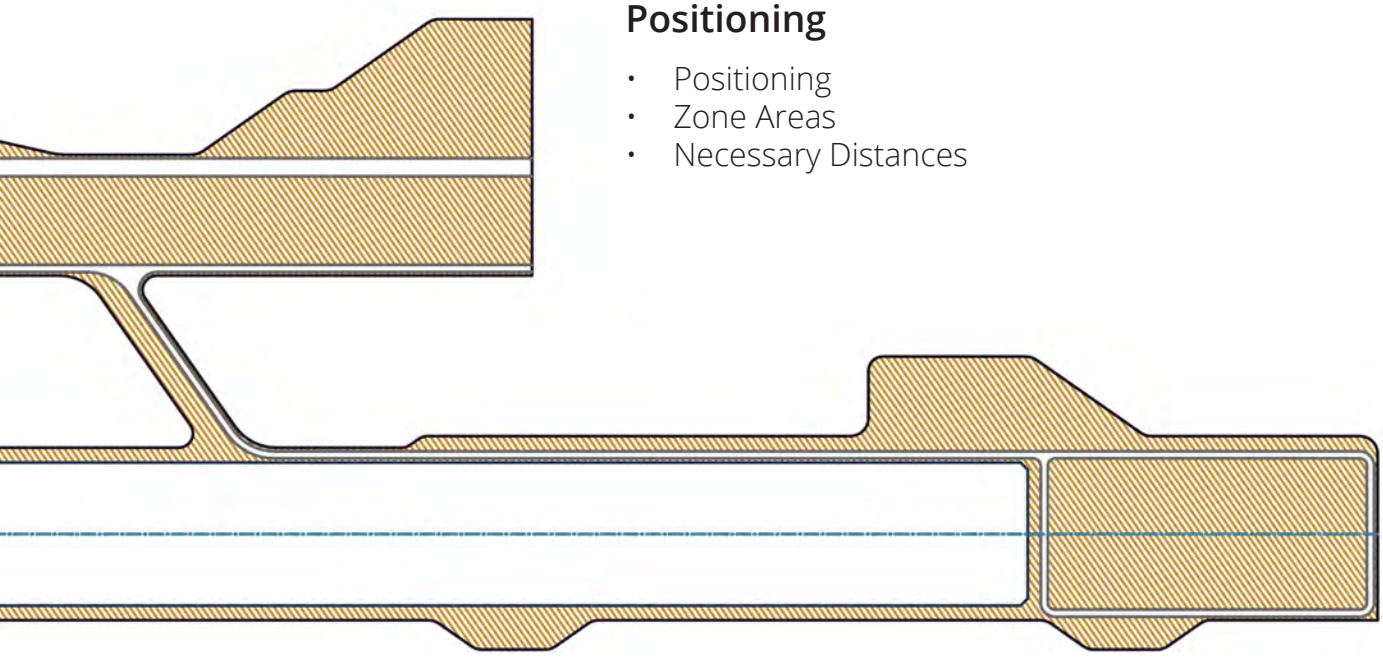
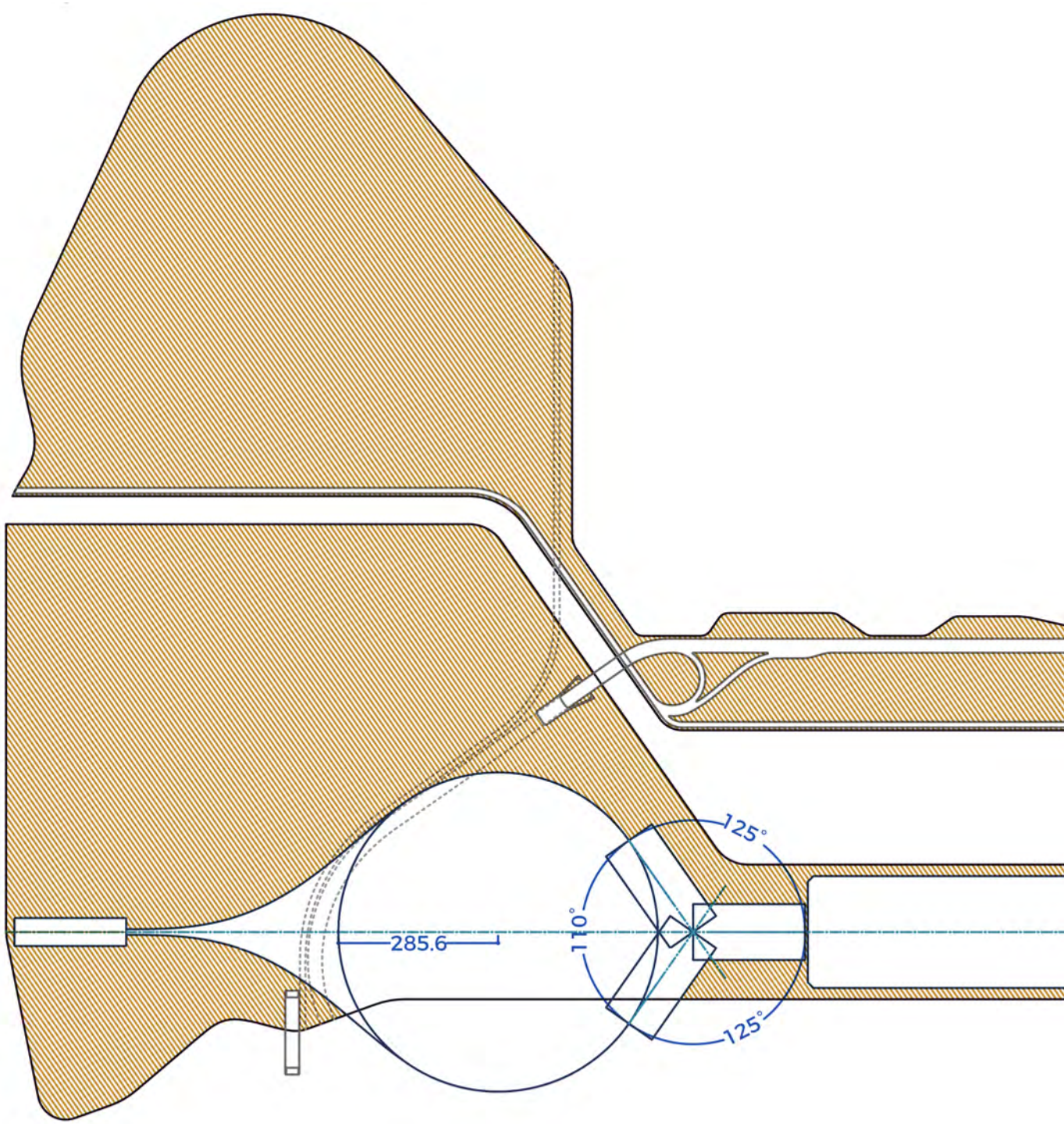
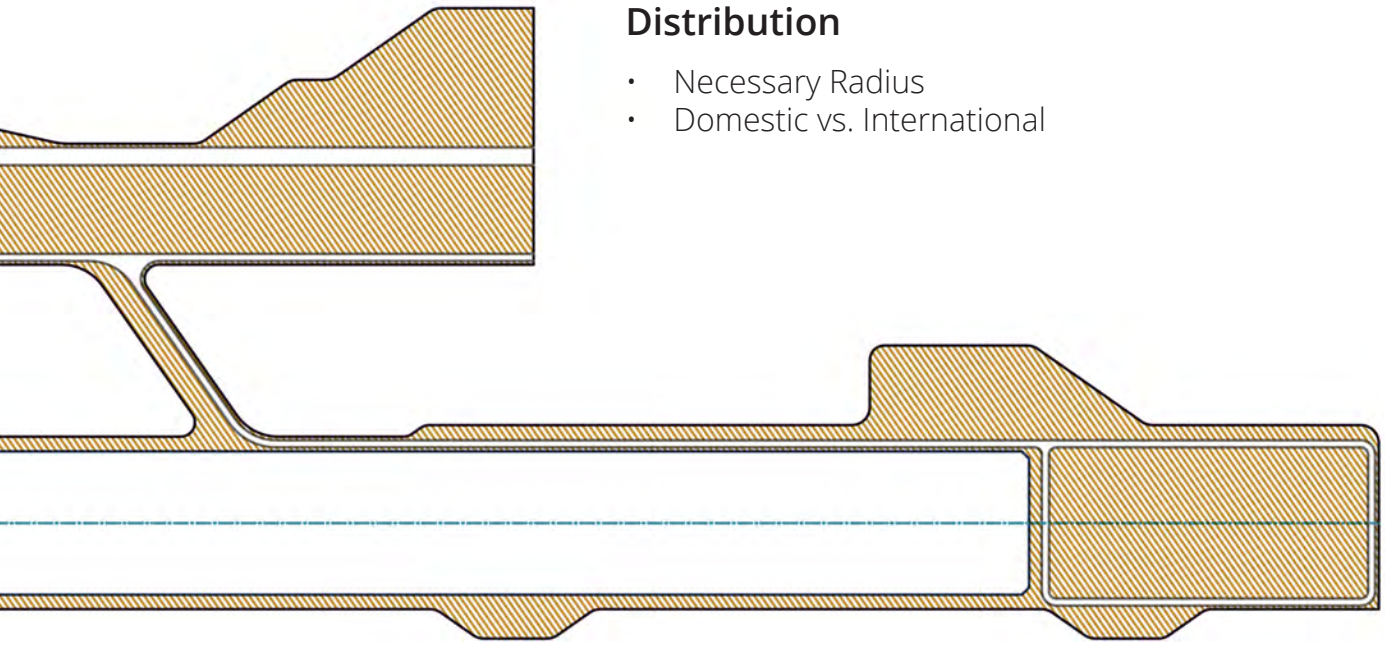


Positioning

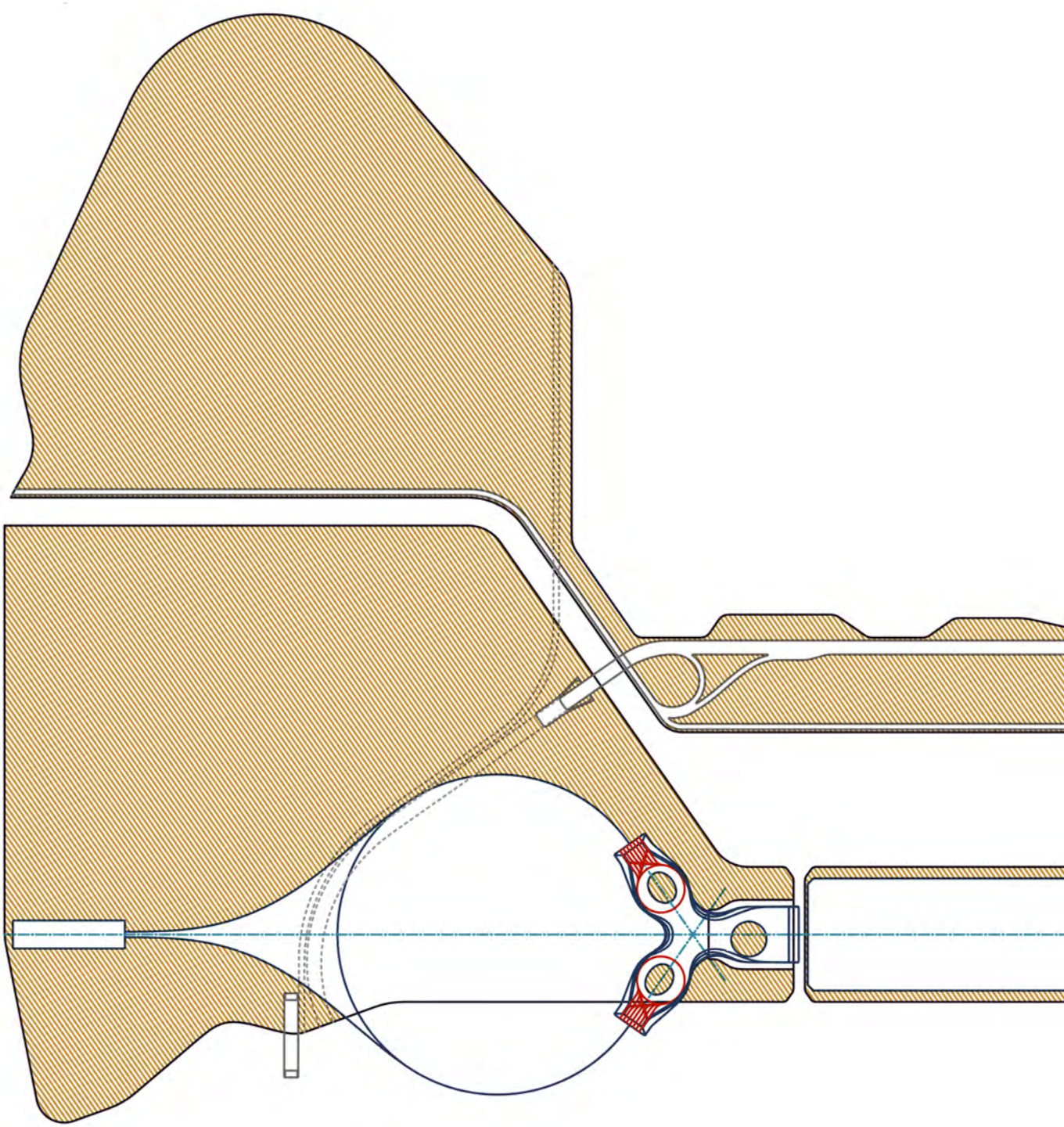
- Positioning
- Zone Areas
- Necessary Distances

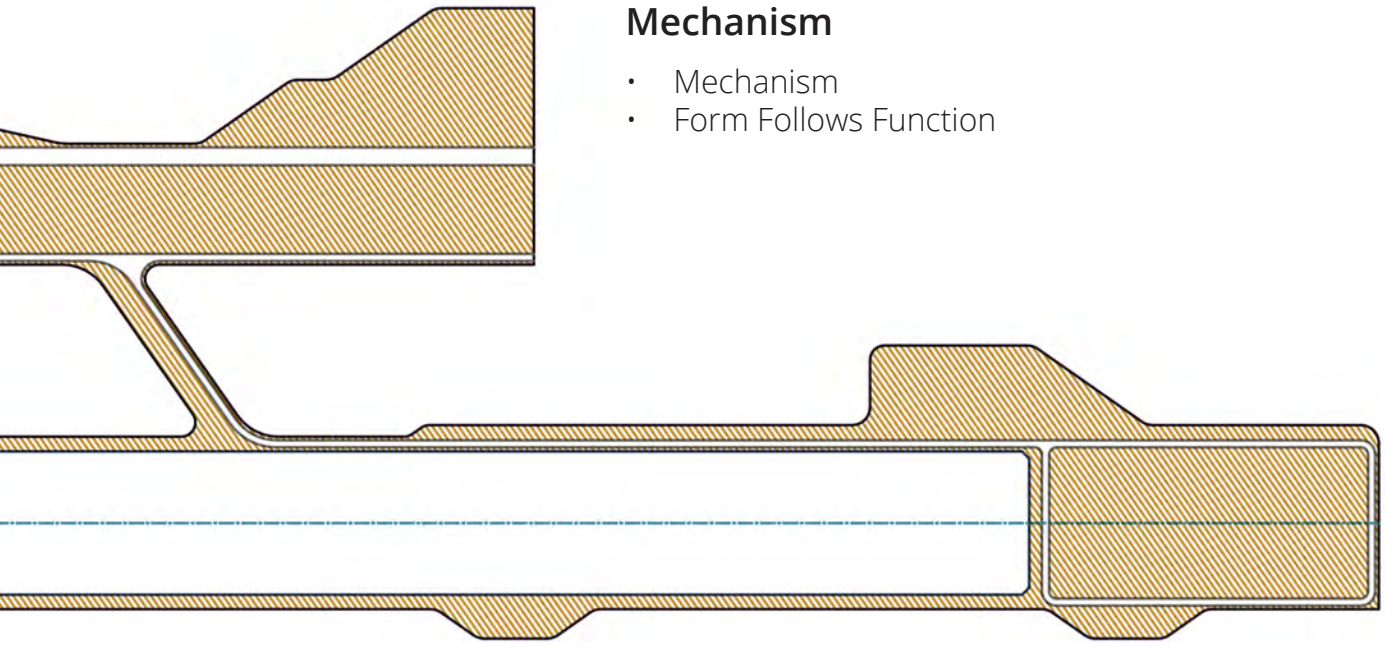

125°
110°
285.6
125°



Distribution

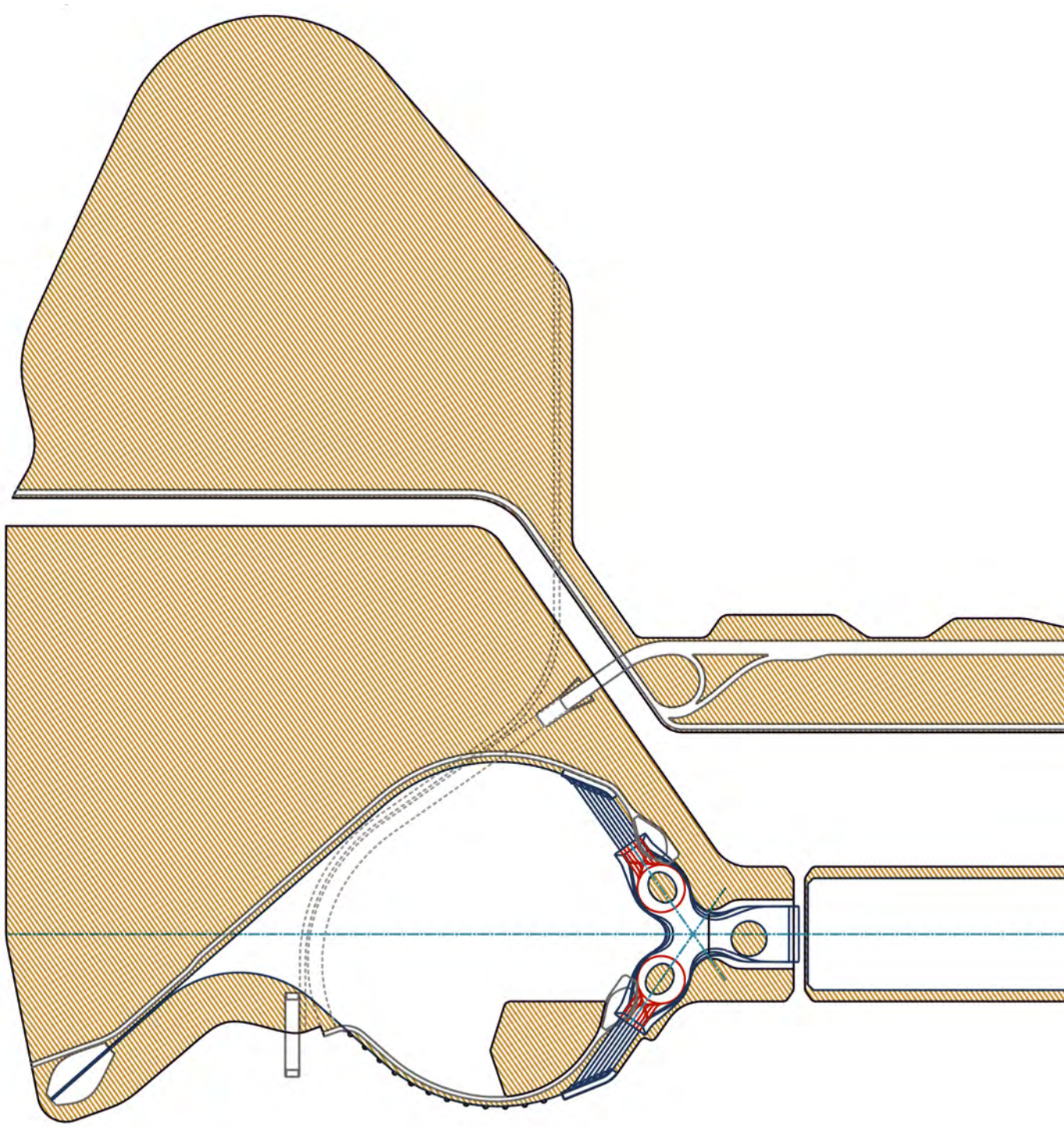
- Necessary Radius
- Domestic vs. International

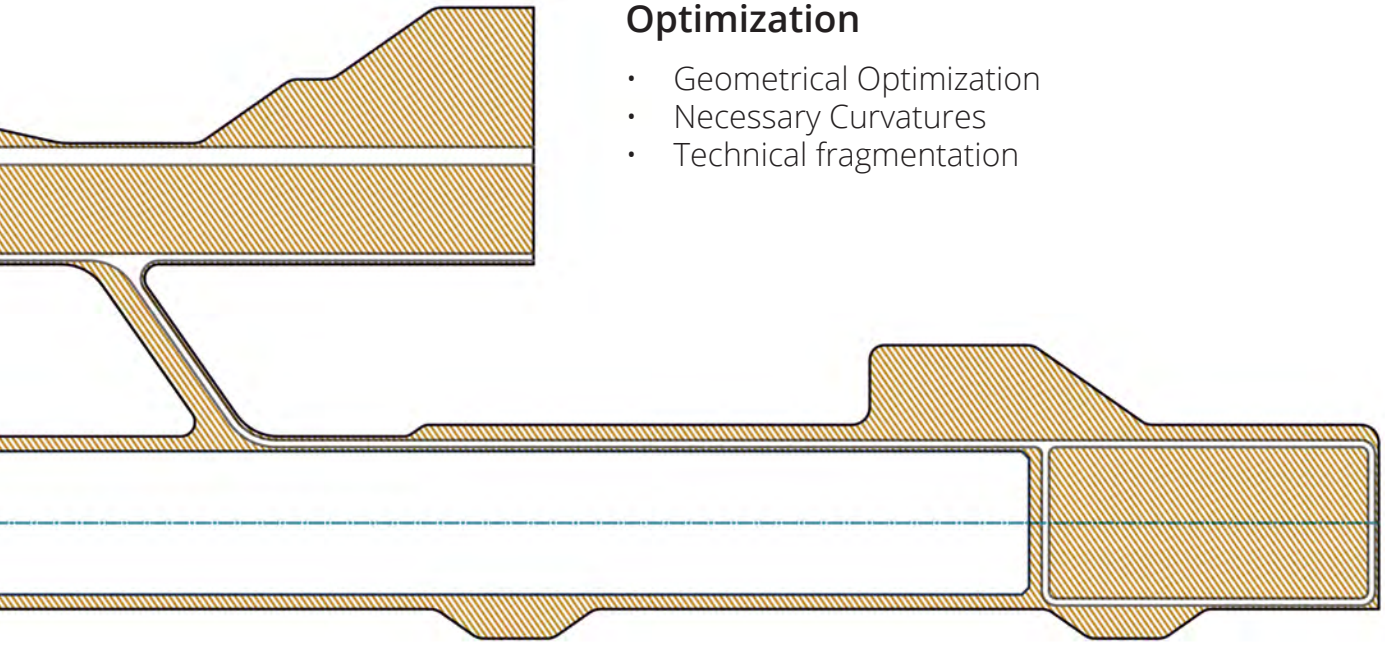




Mechanism

- Mechanism
- Form Follows Function



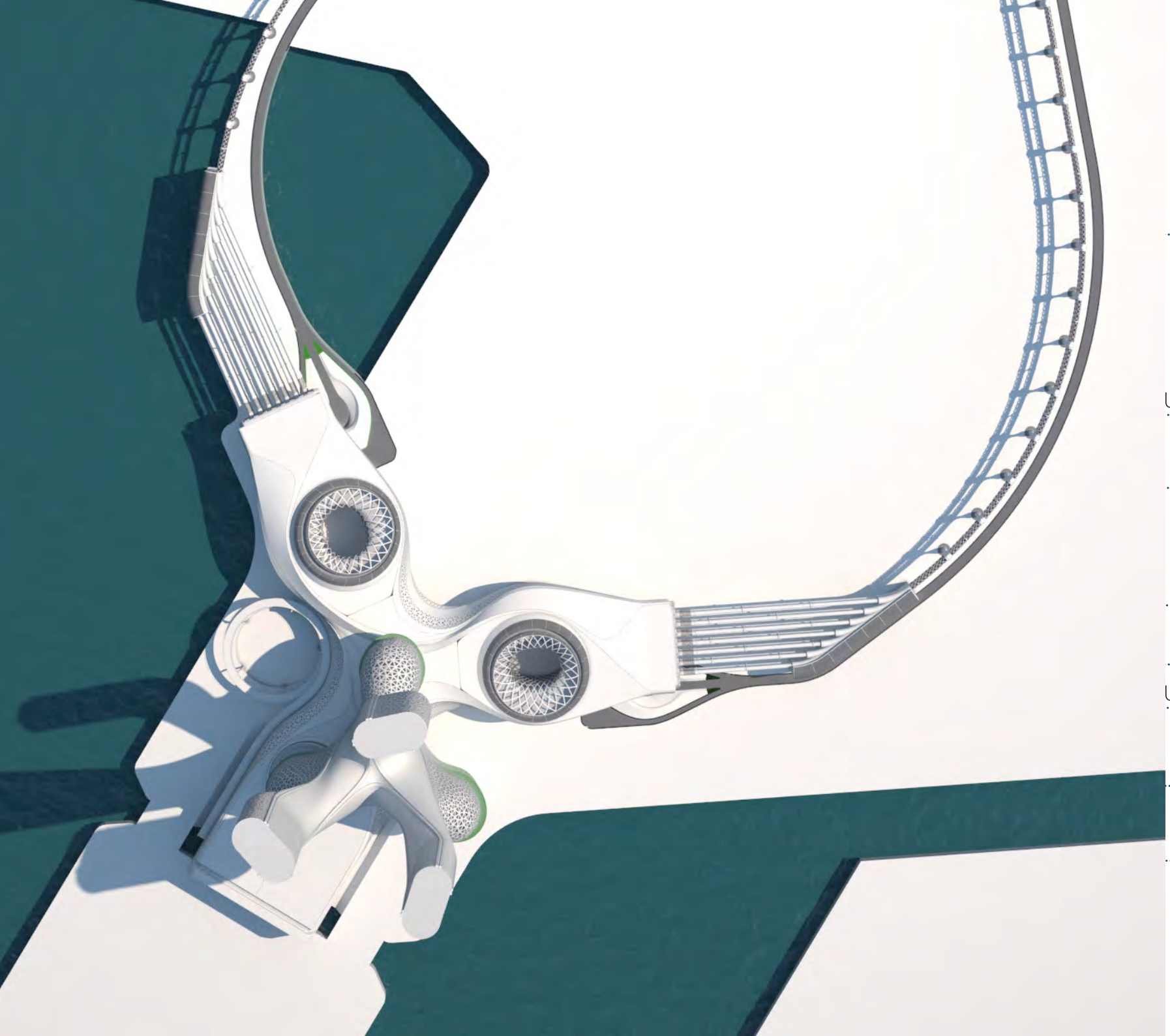


Optimization

- Geometrical Optimization
- Necessary Curvatures
- Technical fragmentation

HK-XL

Design Idea & Architectural Development



Grand plaza

Underground access portal

International Terminal

Regional Terminal

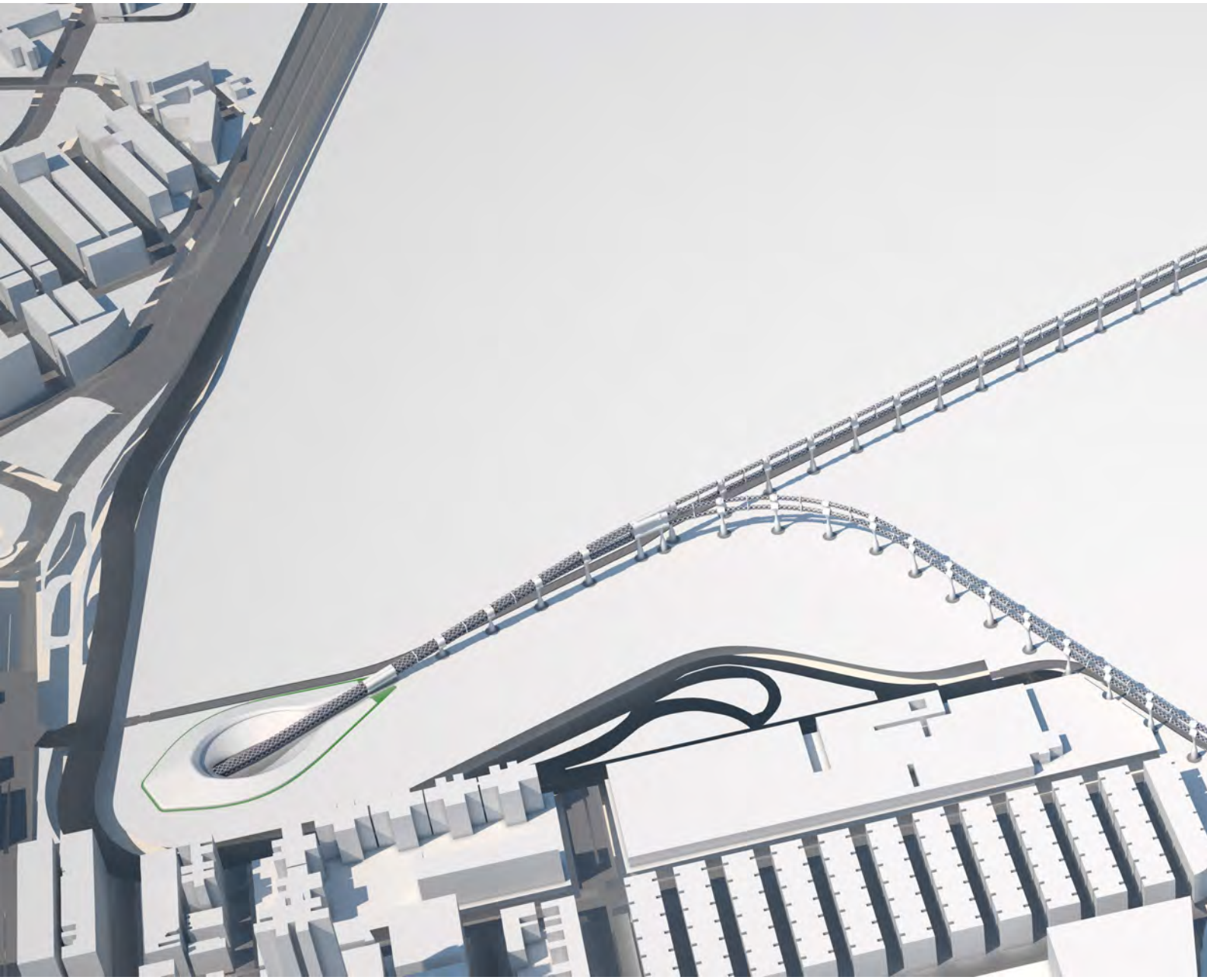
Vacuum chamber

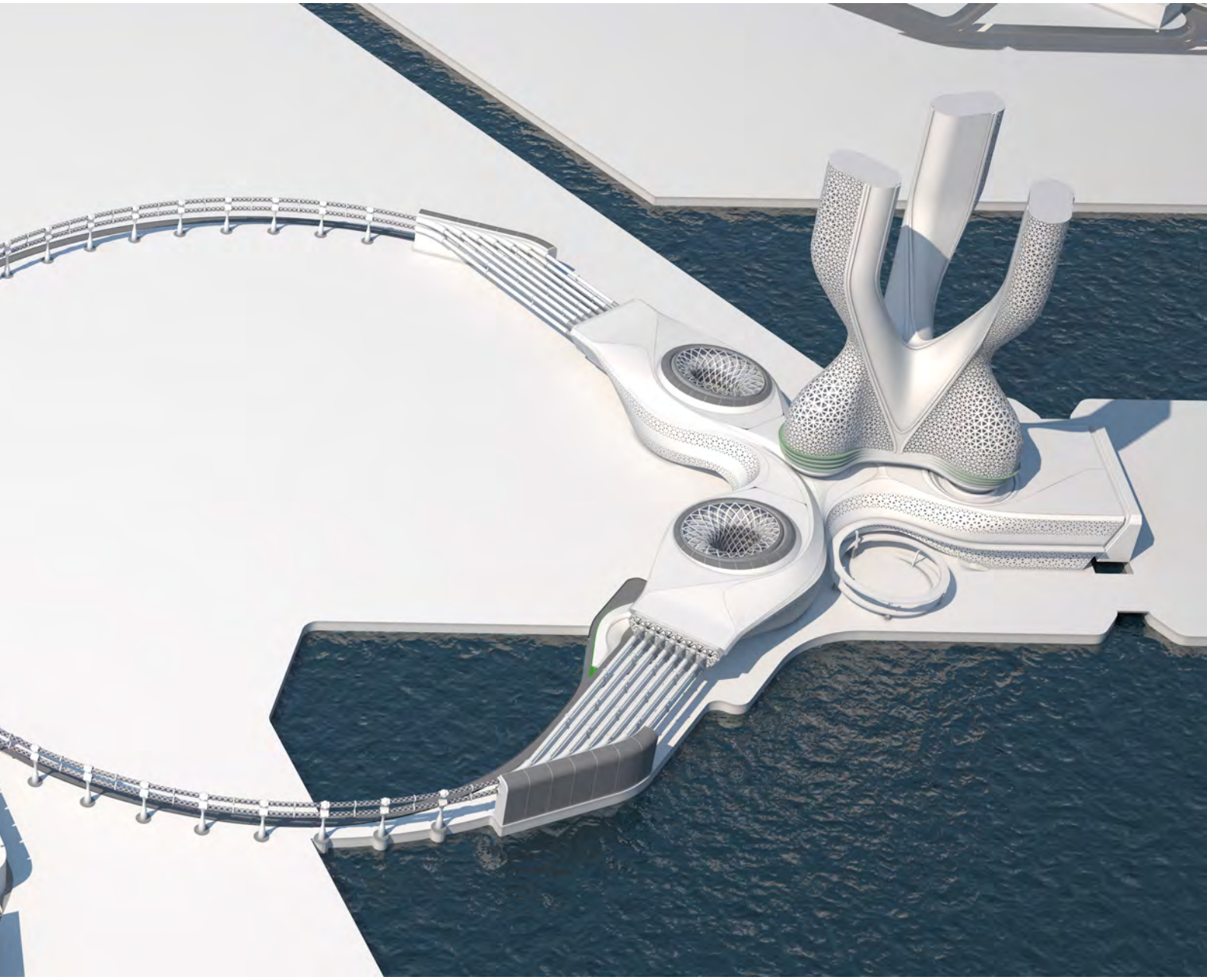
Underground access portal

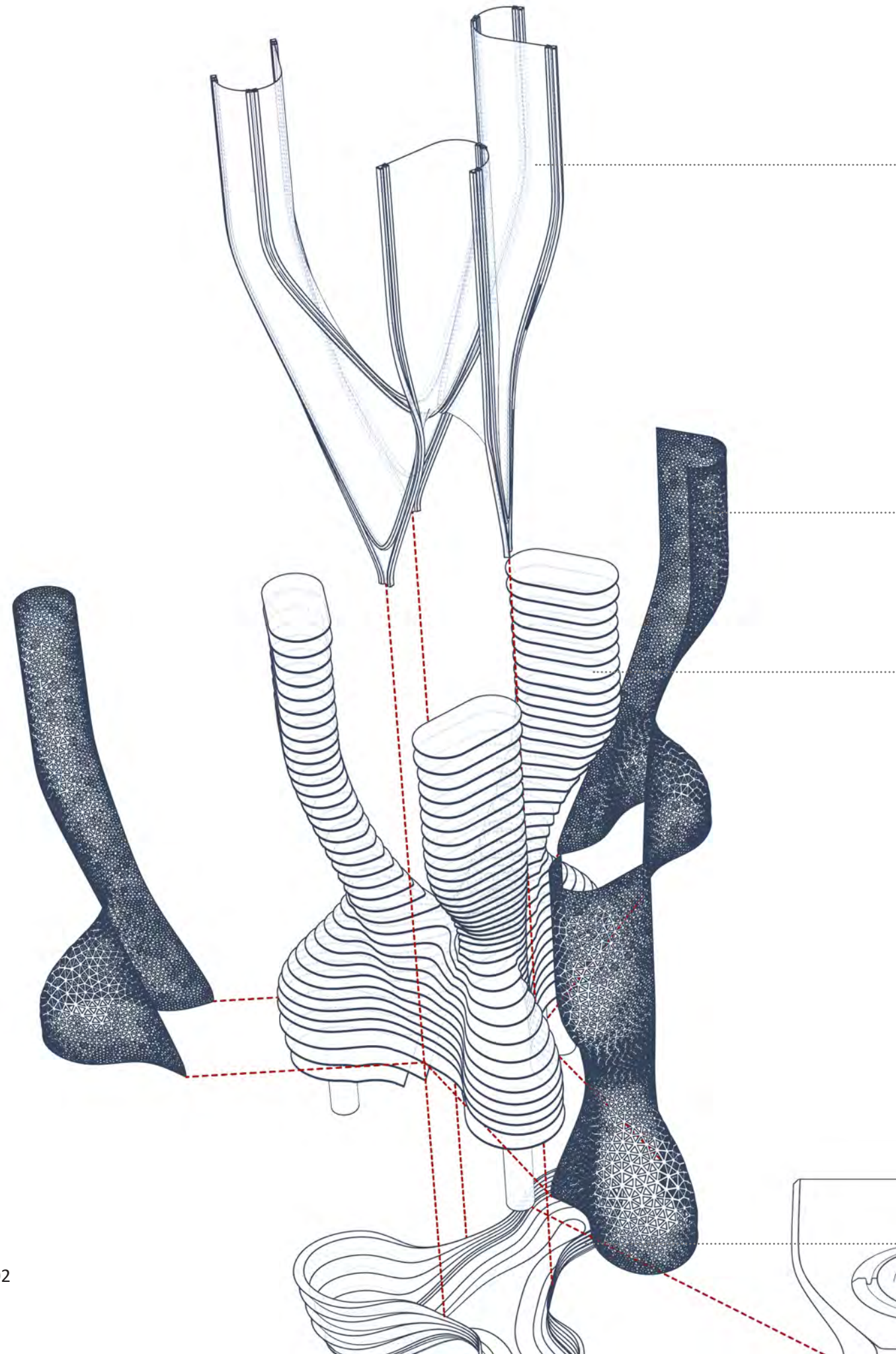
Office Tower

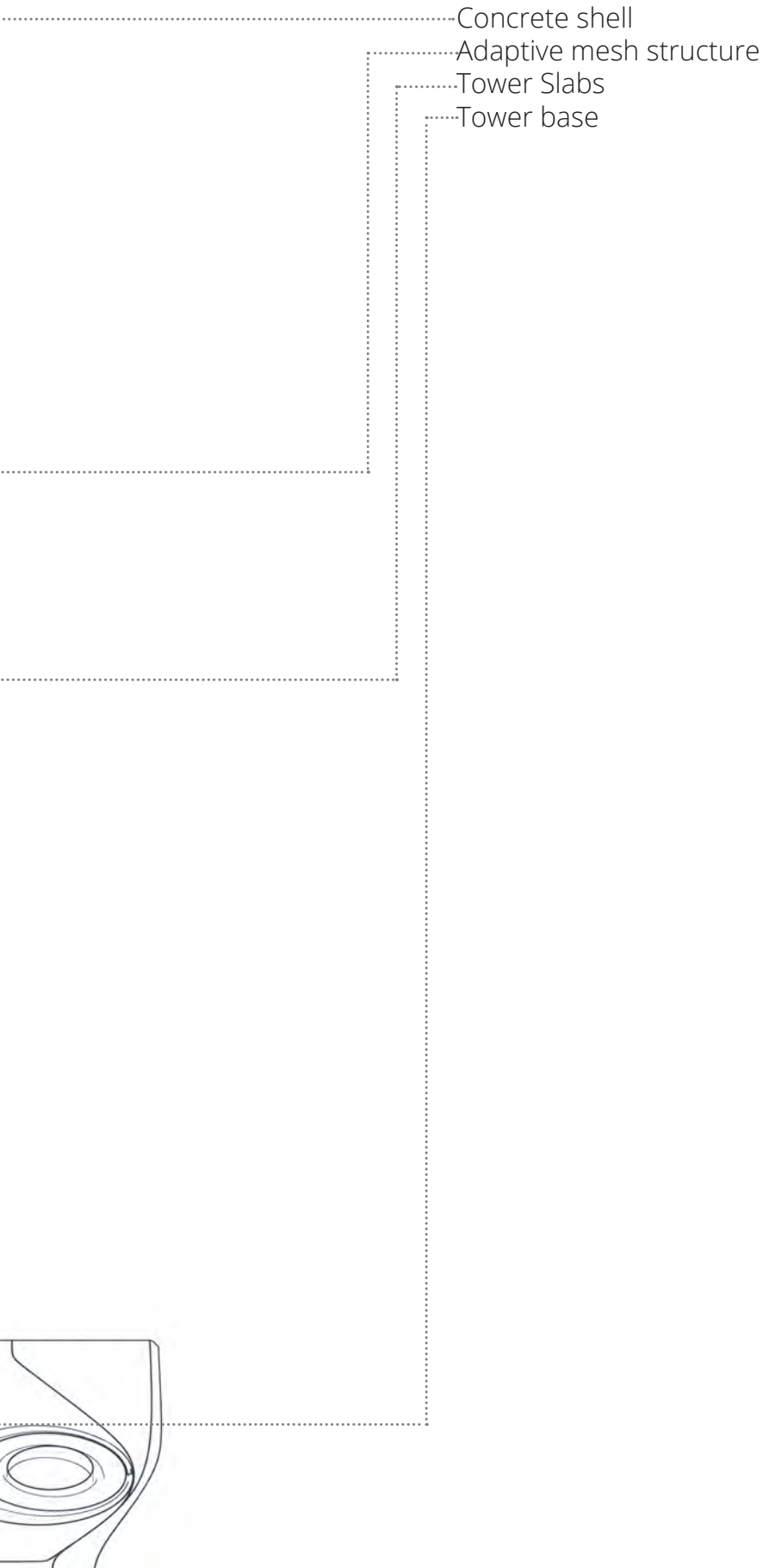
Terminal Service


Hyperloop underground access portal
Tubes branch out into regional/ international

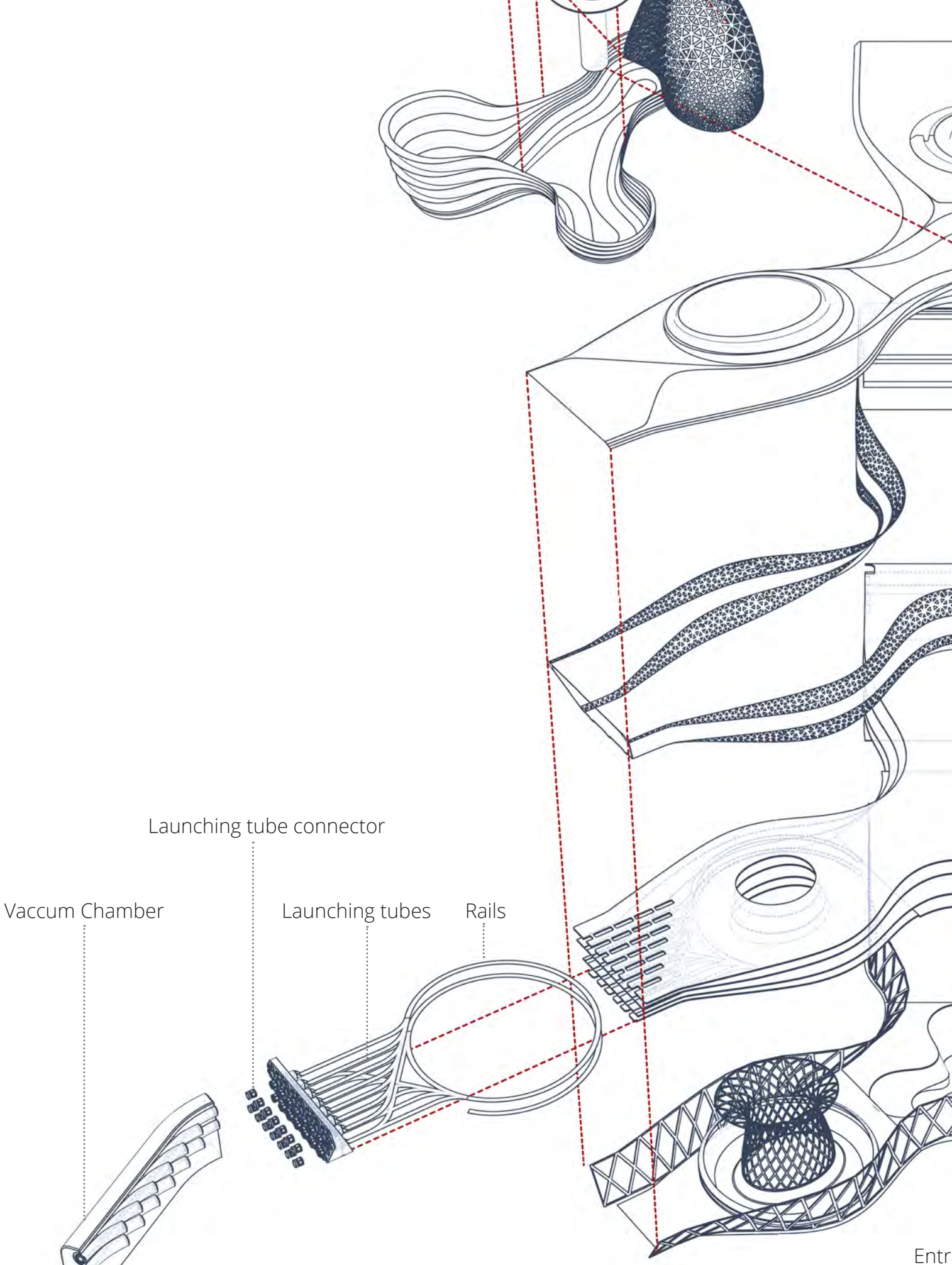




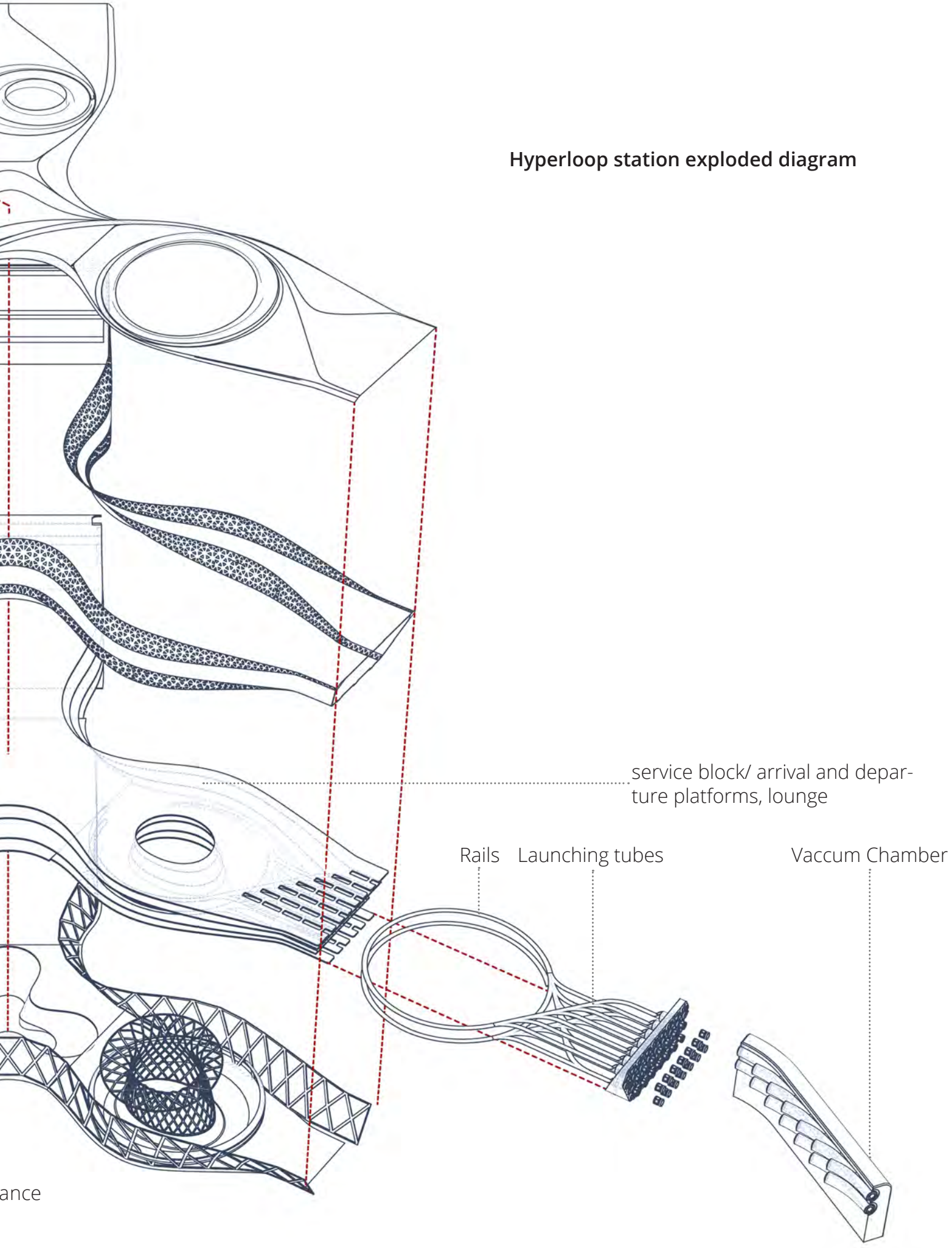


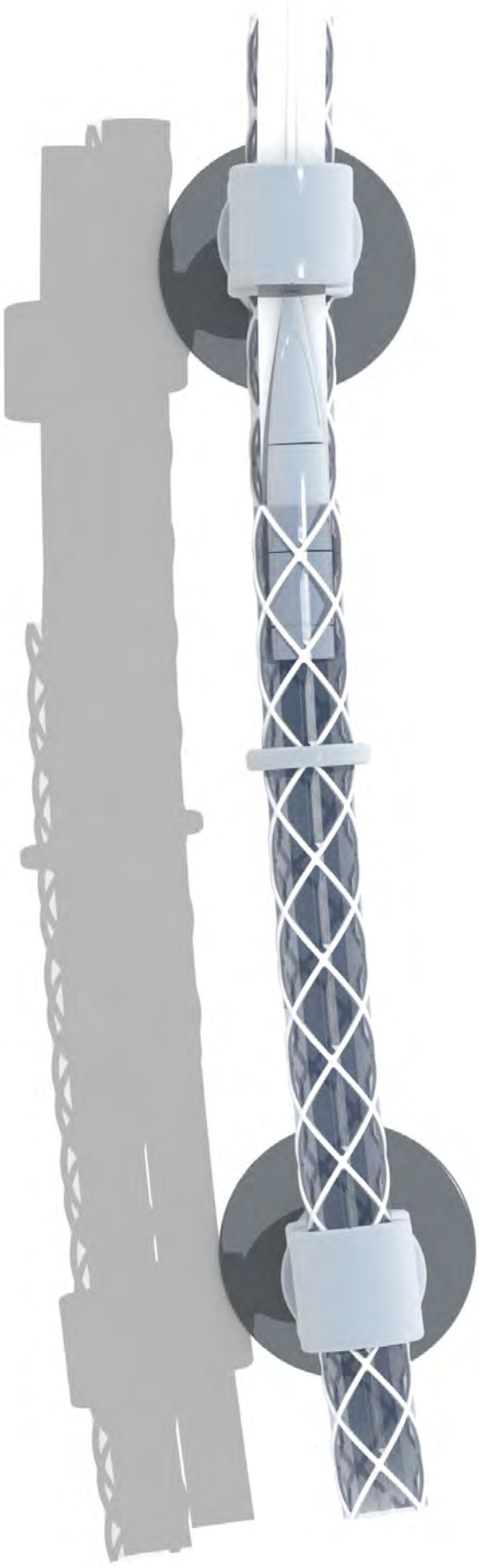


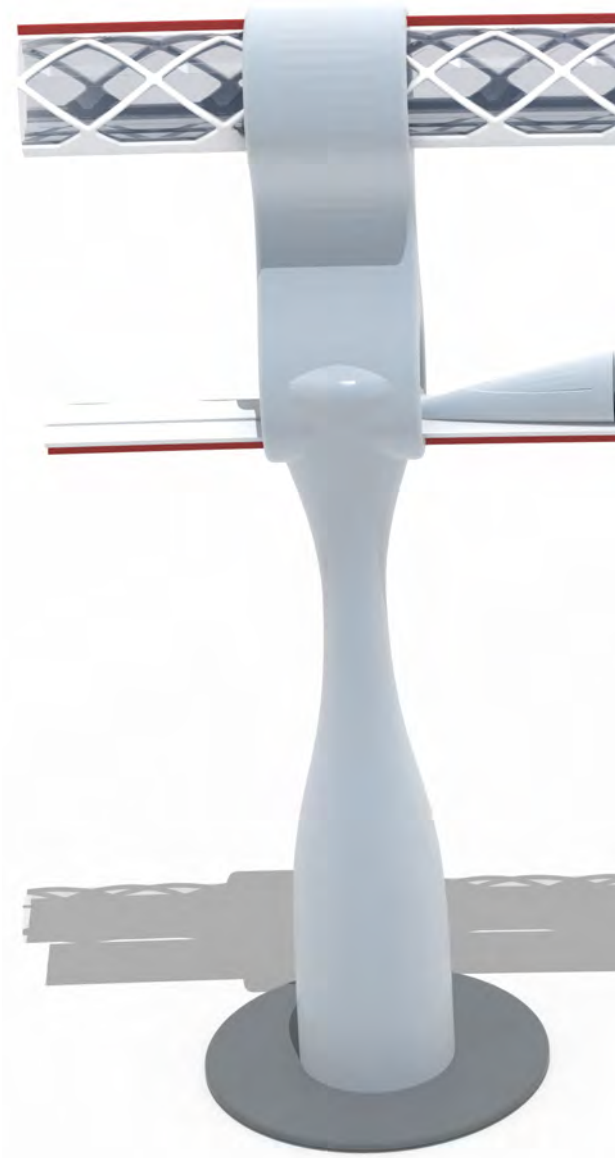
Tower exploded diagram

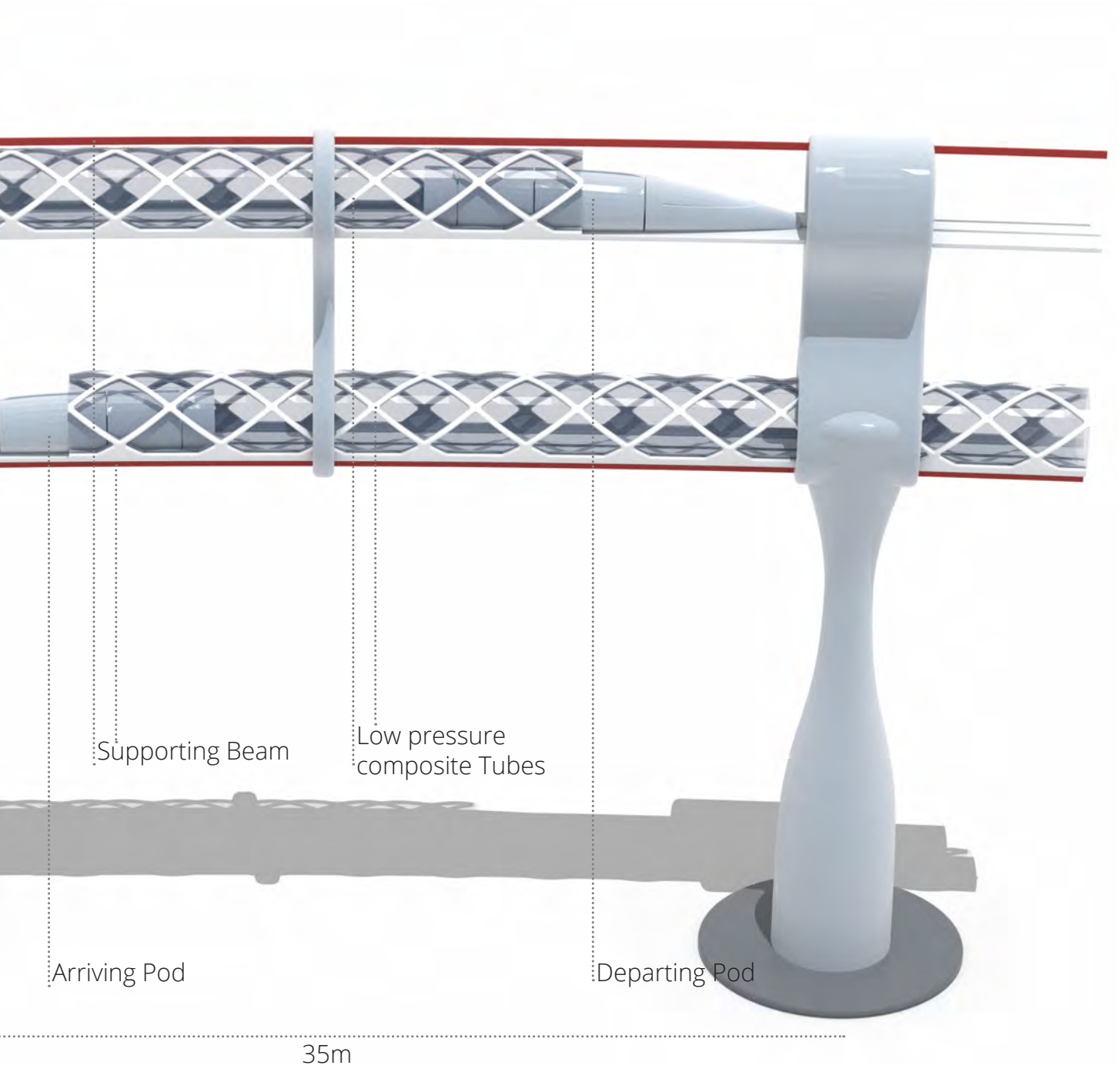

Launching tube connector
Vaccum Chamber
Launching tubes
Rails
Entr

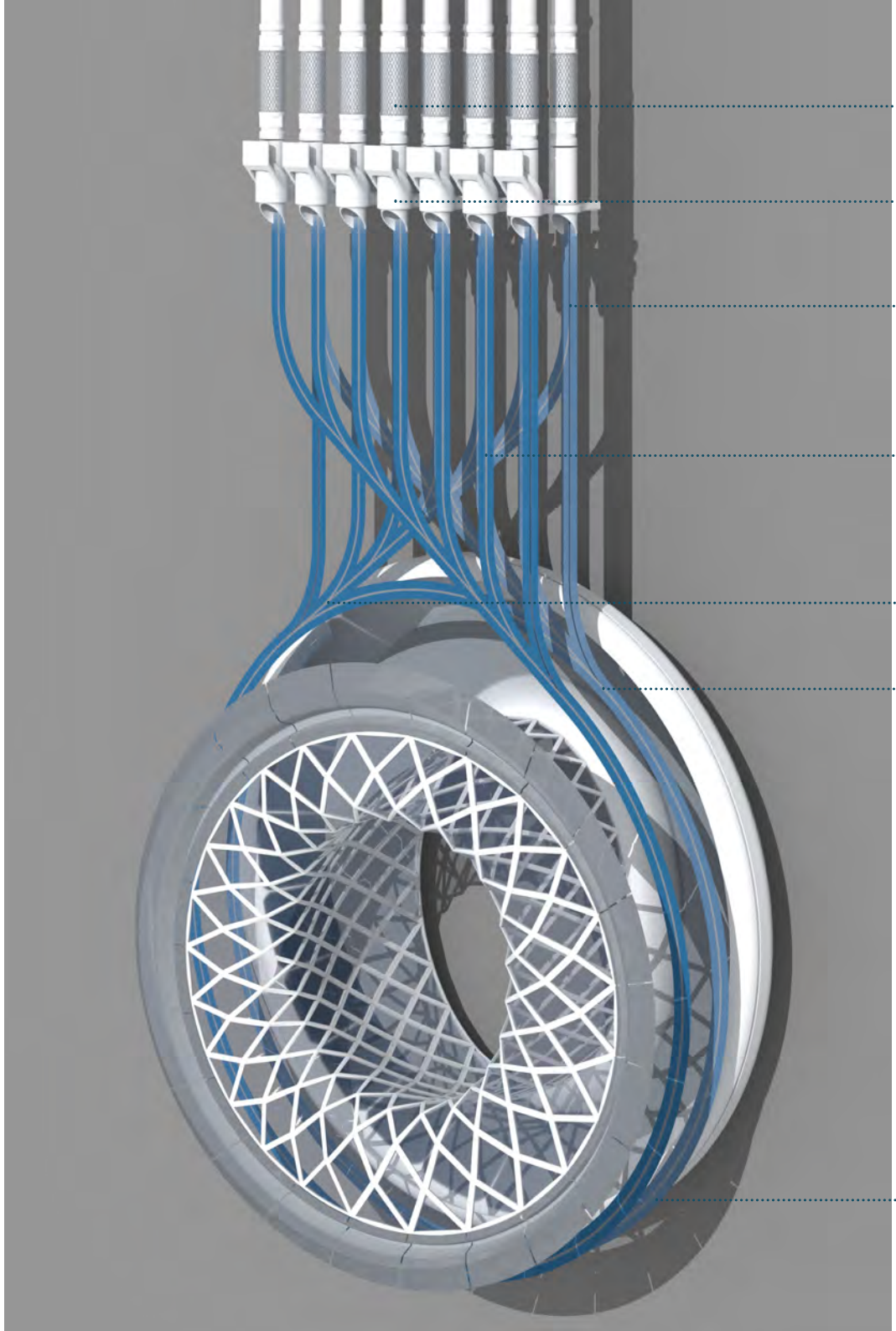
Hyperloop station exploded diagram

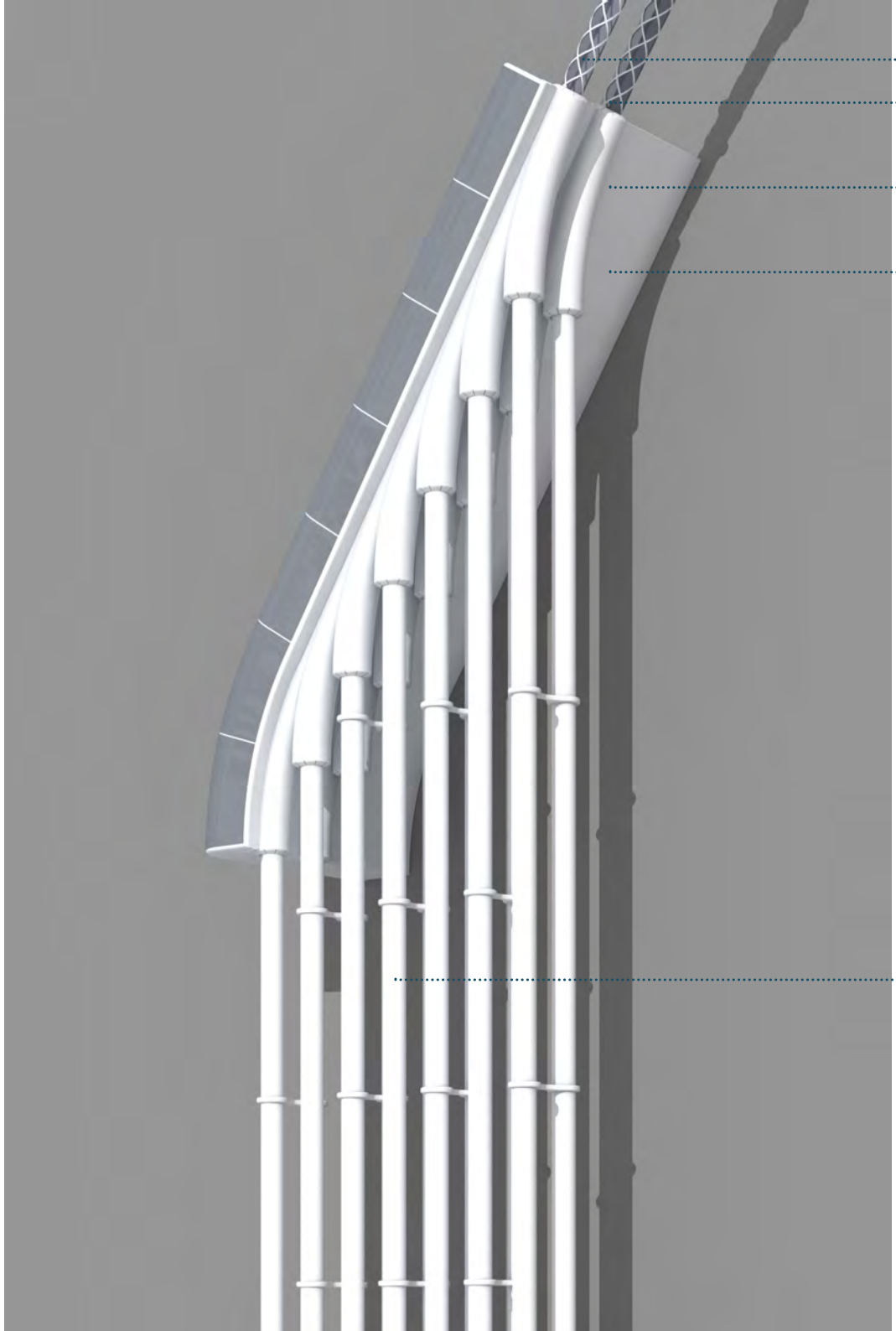




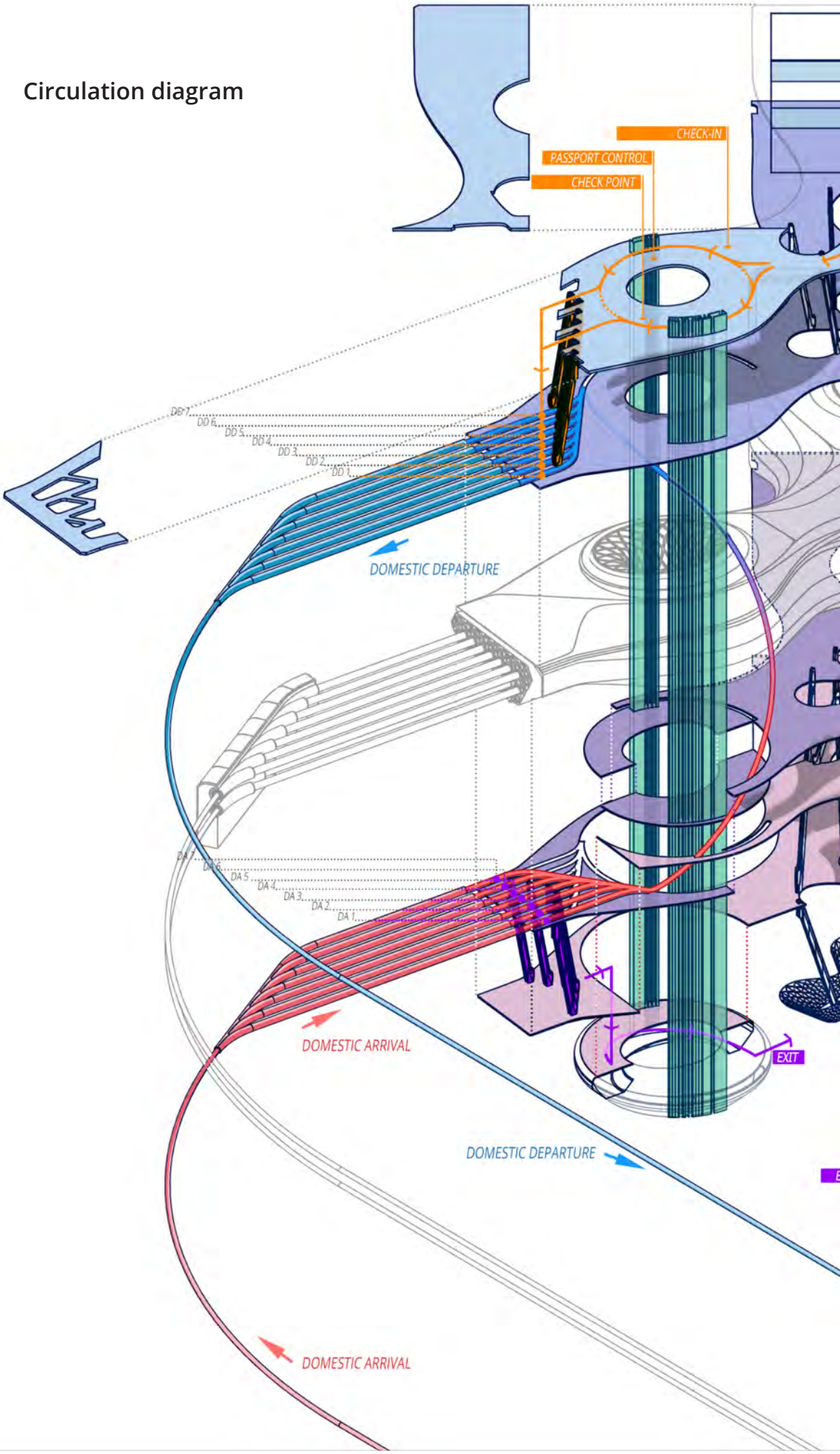


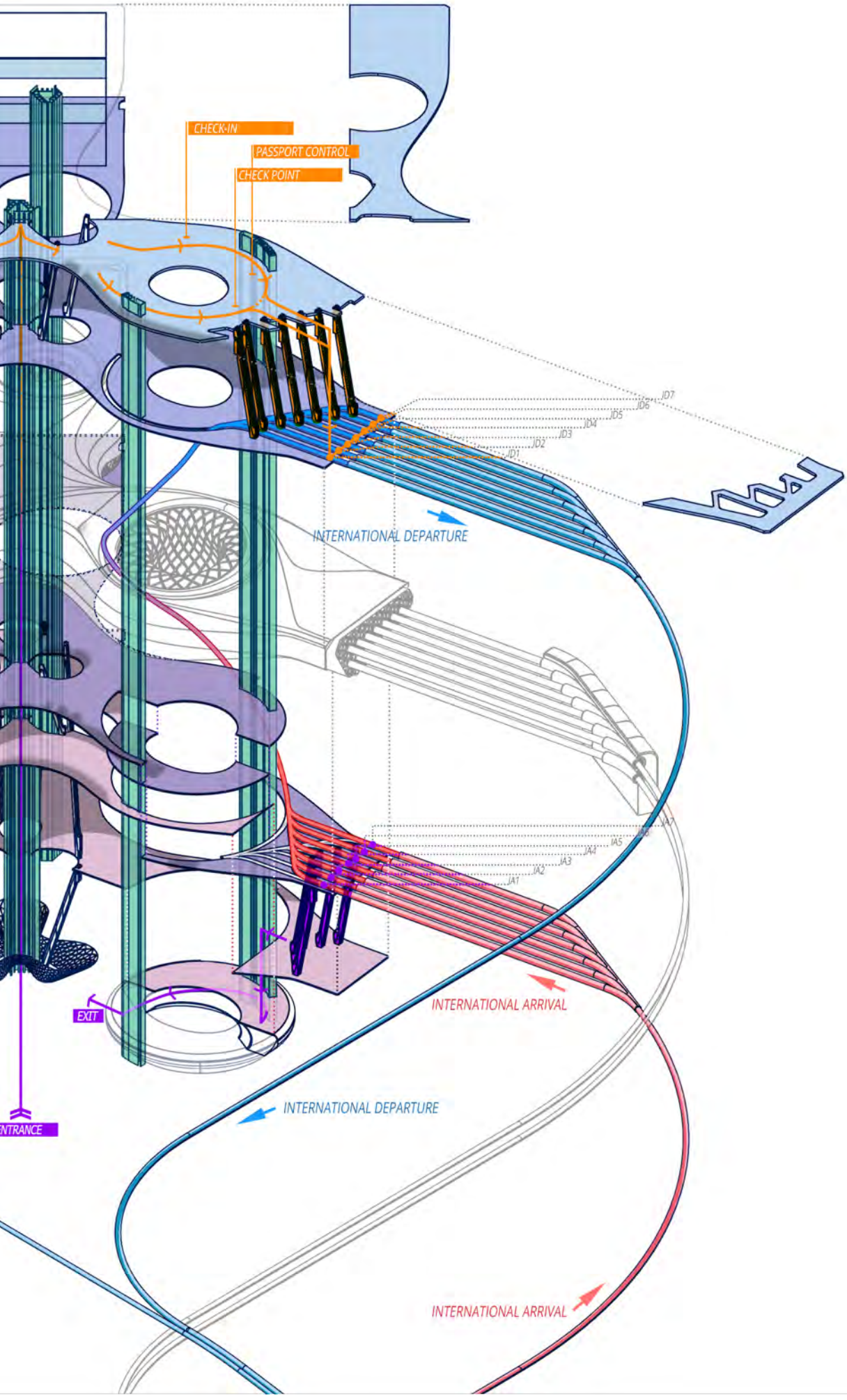

Supporting Beam
Low pressure
composite Tubes
Arriving Pod
Departing Pod
35m


Launching tube connector
Platform connectors
POD arrival zone
POD departure zone
Railshif
Railshif
Service and maintenance


Hyperloop departure tube
Hyperloop arrival Tube
Airlock switch
Vacuum chamber
Launching tubes

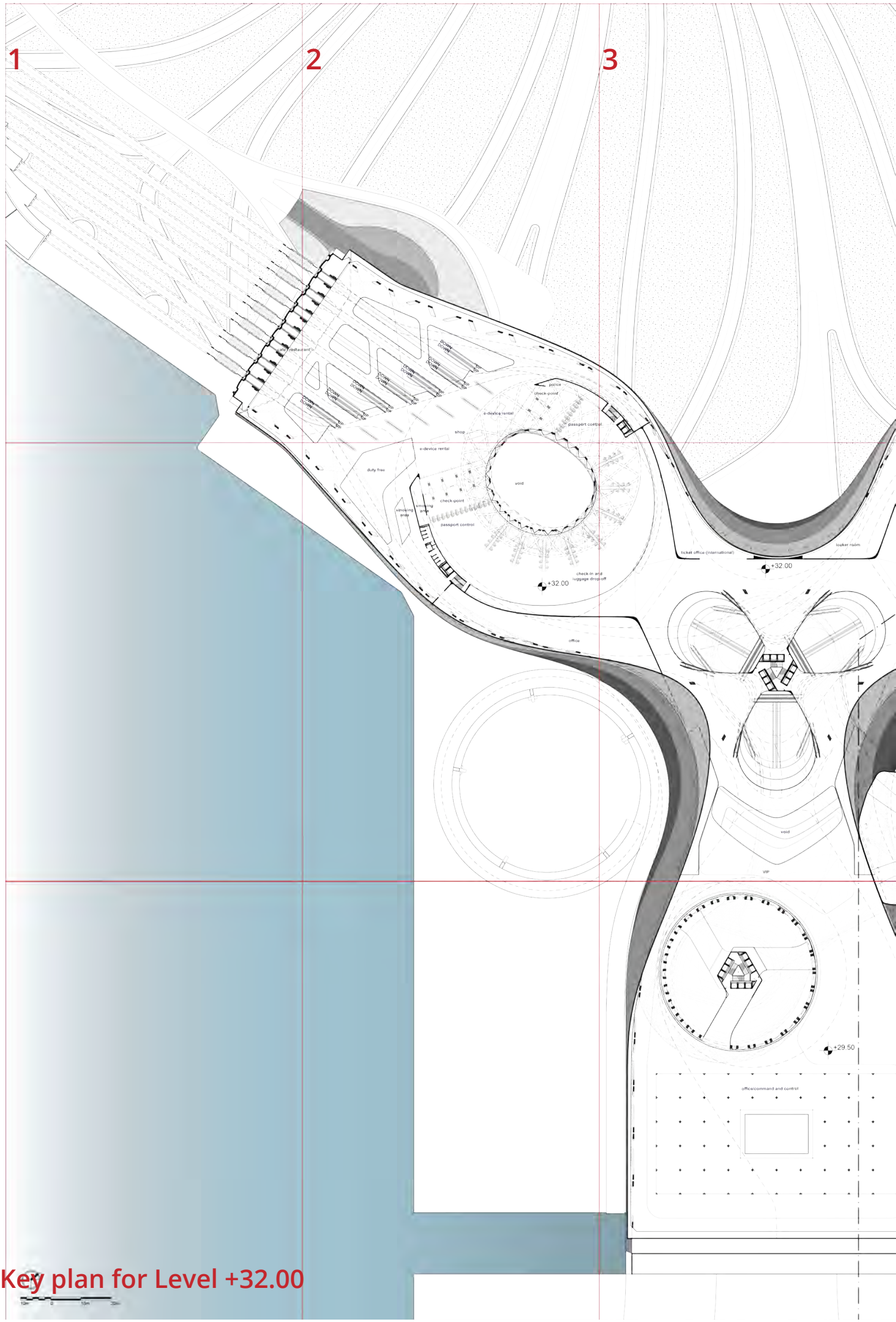
Circulation diagram



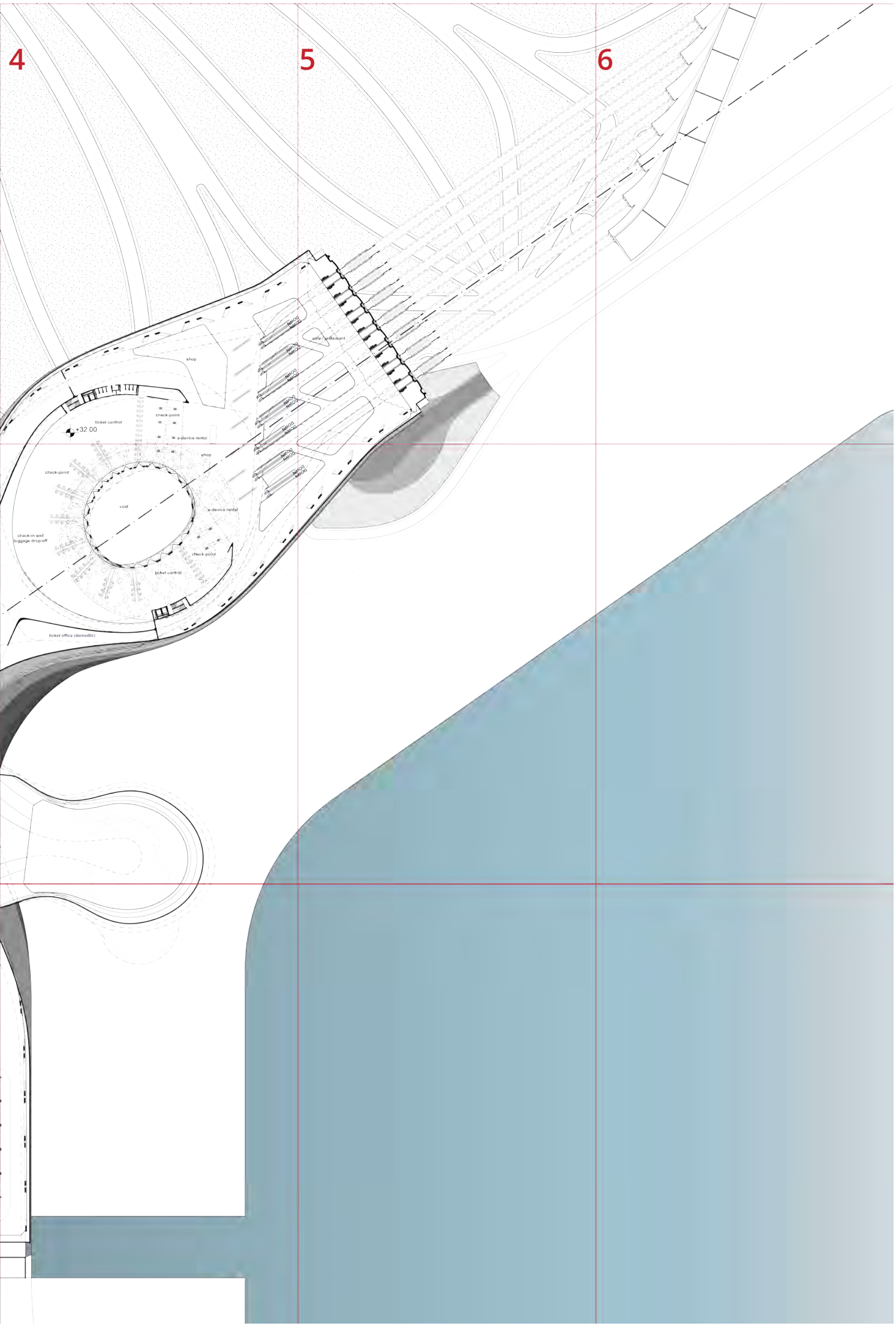

CHECK-IN
PASSPORT CONTROL
CHECK POINT
JD7
JD6
JD5
JD4
JD3
JD2
JD1
INTERNATIONAL DEPARTURE
JA7
JA6
JA5
JA4
JA3
JA2
JA1
INTERNATIONAL ARRIVAL
EXIT
INTERNATIONAL DEPARTURE
ENTRANCE
INTERNATIONAL ARRIVAL

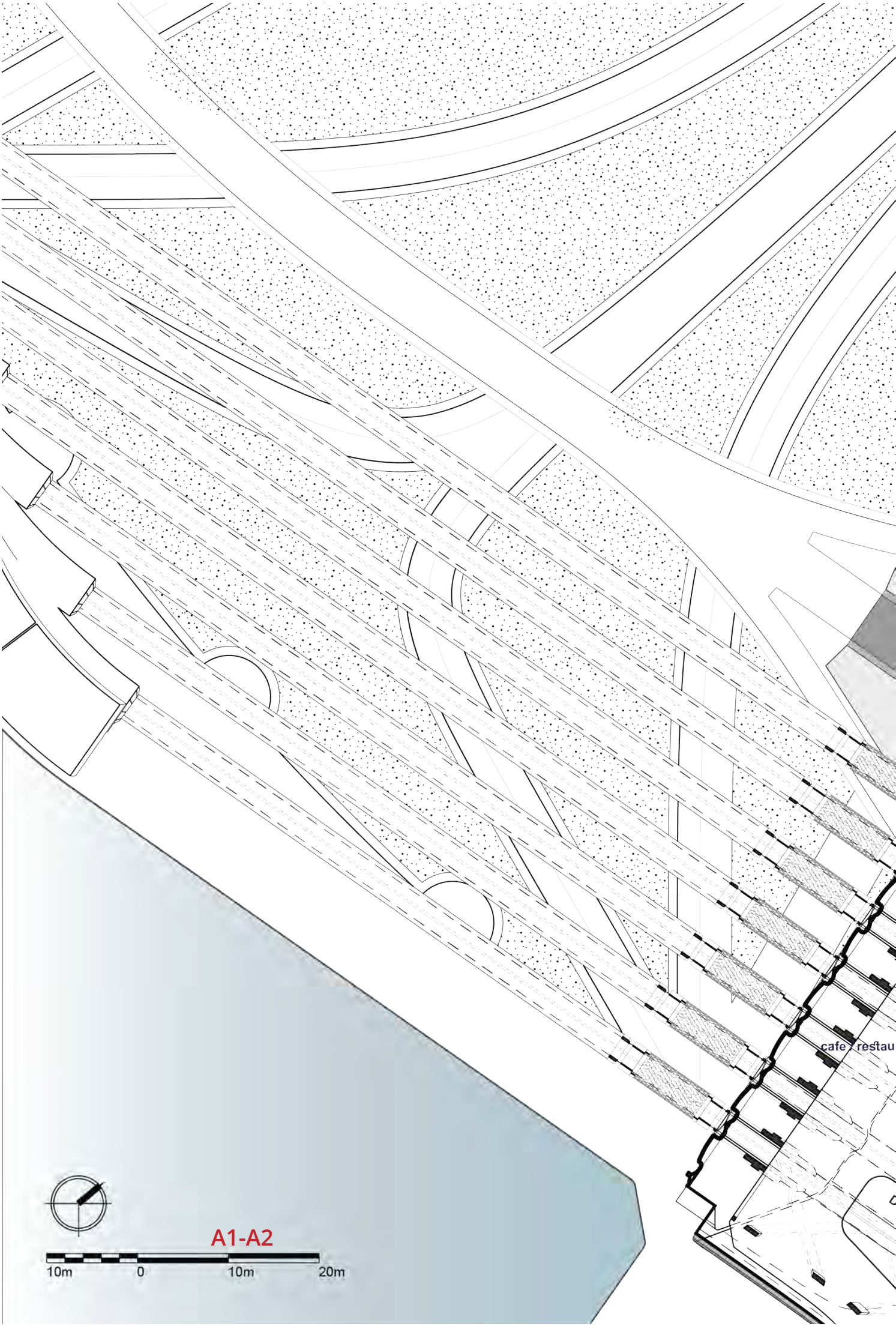
Project documents

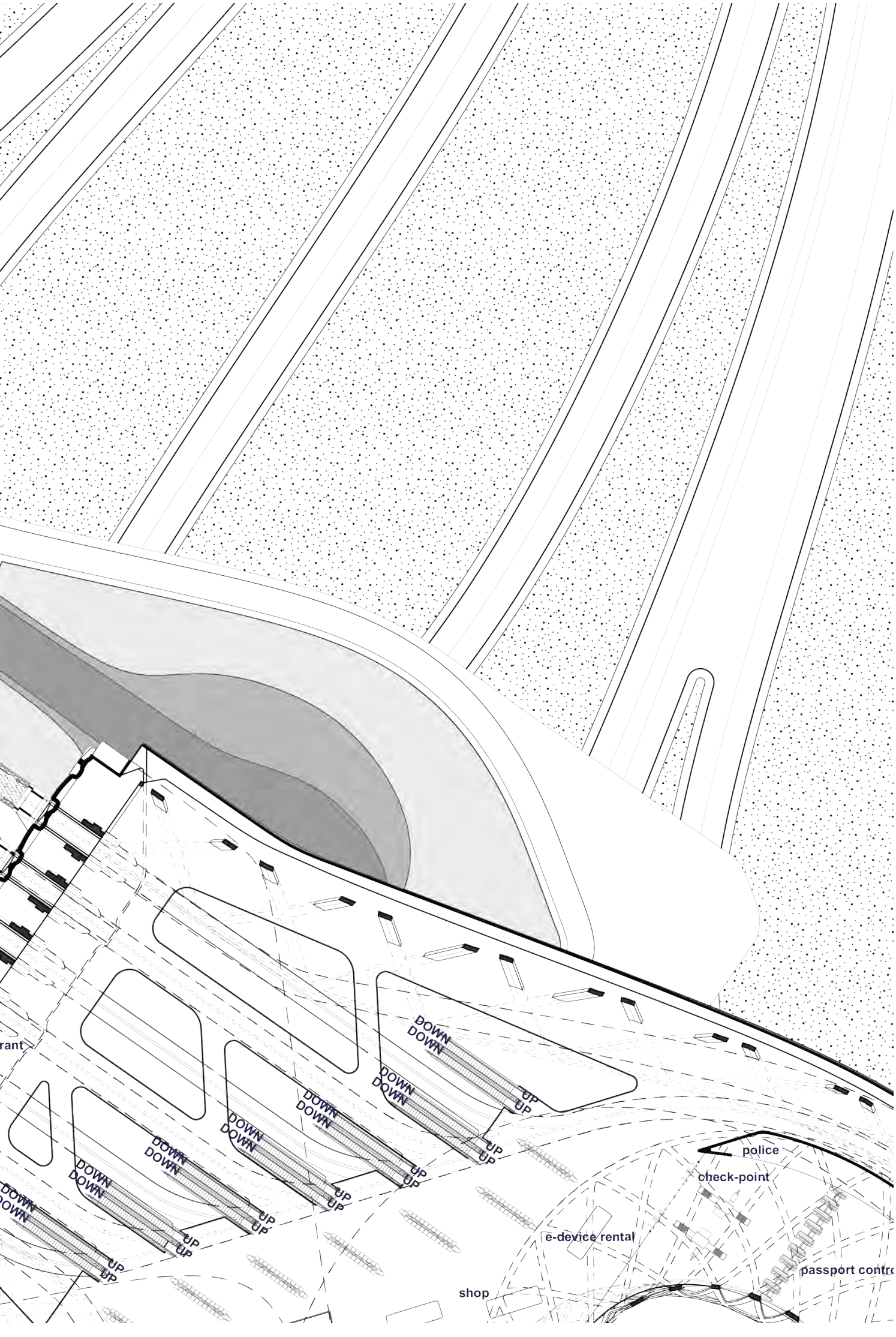
&drawings

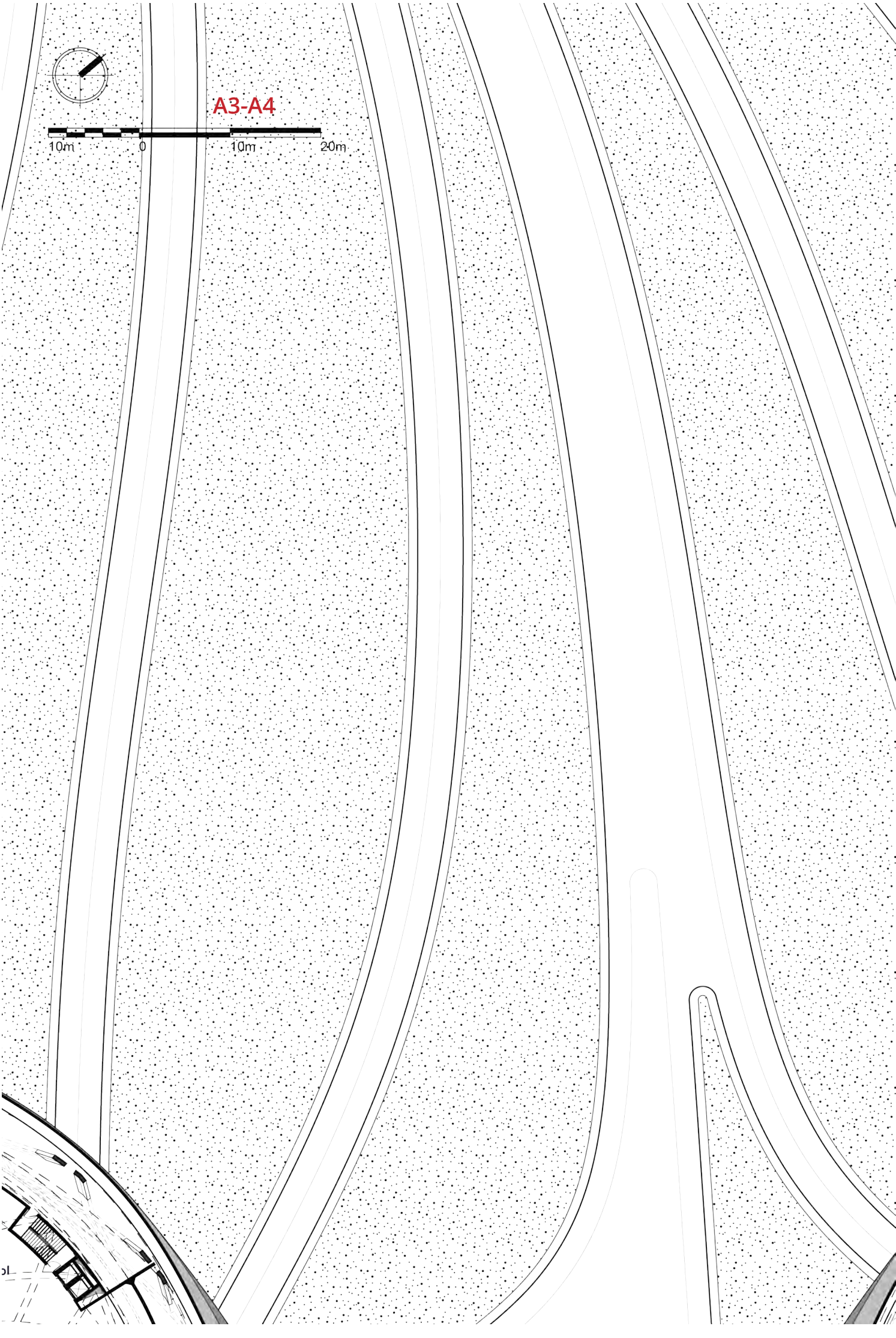


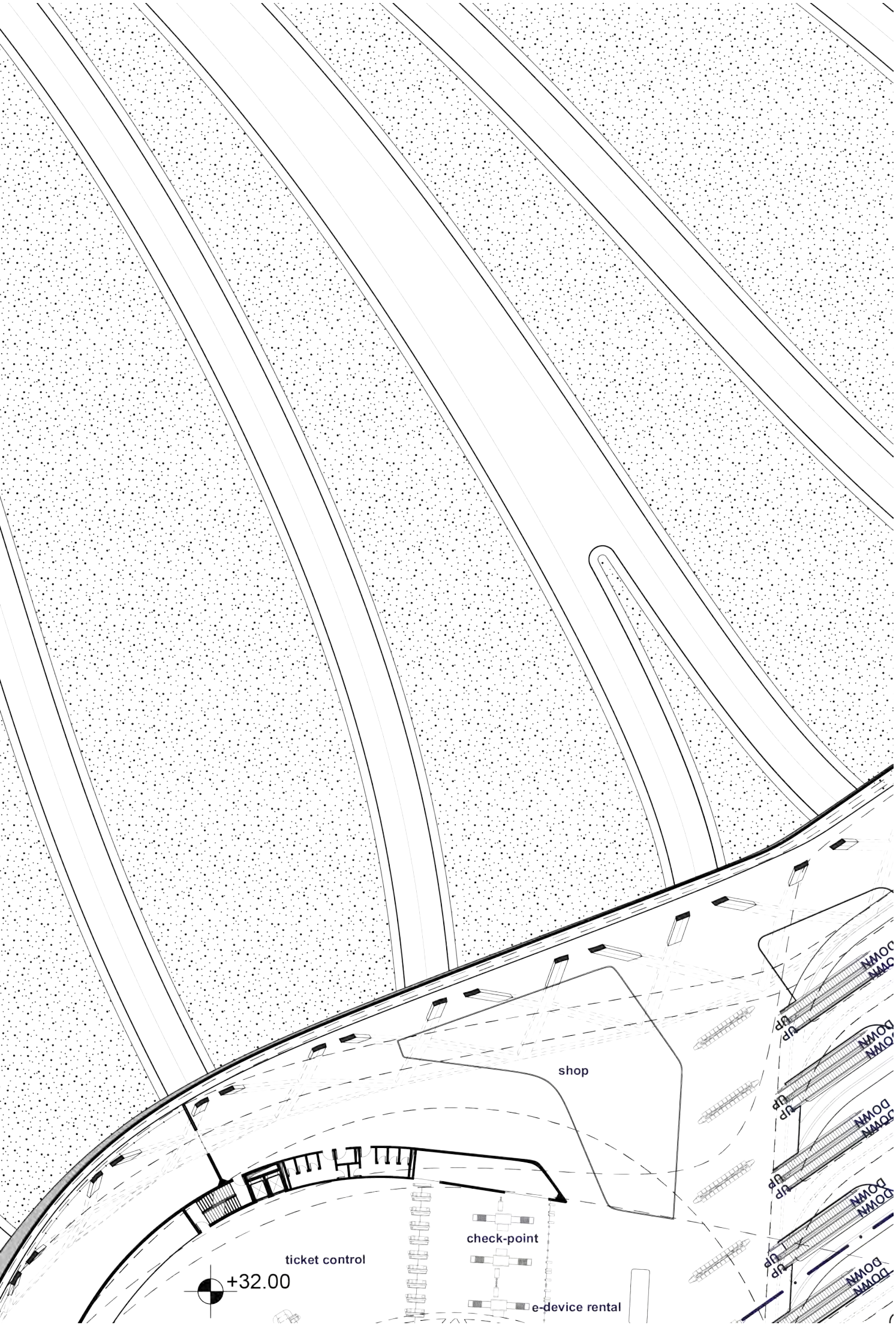
Key plan for Level +32.00

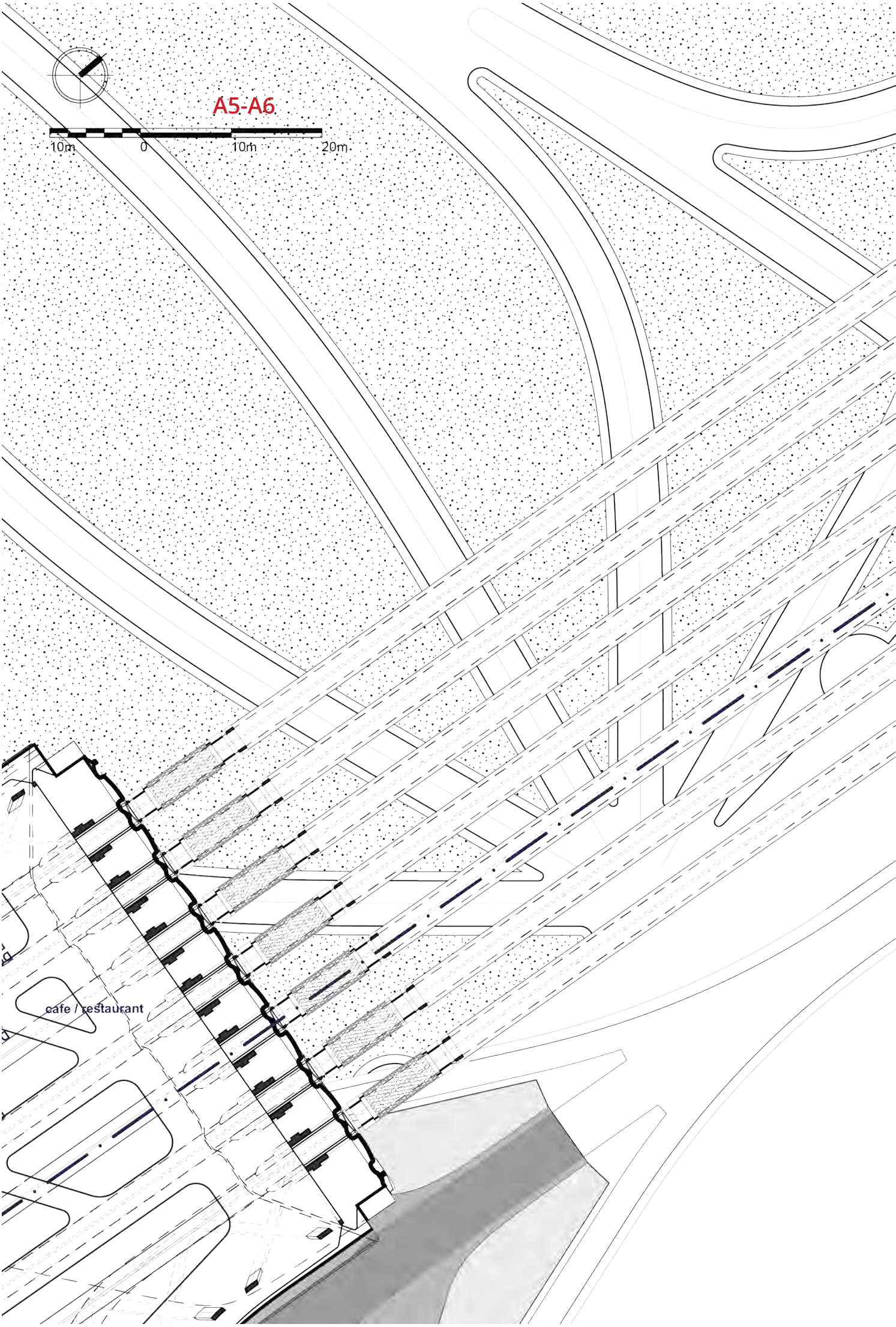

4
5
6
shop
ticket control
check-point
+32.00
e-device rental
shop
check-point
void
e-device rental
check-in and
luggage drop-off
check-point
ticket control
ticket office (domestic)
safe / restaurant

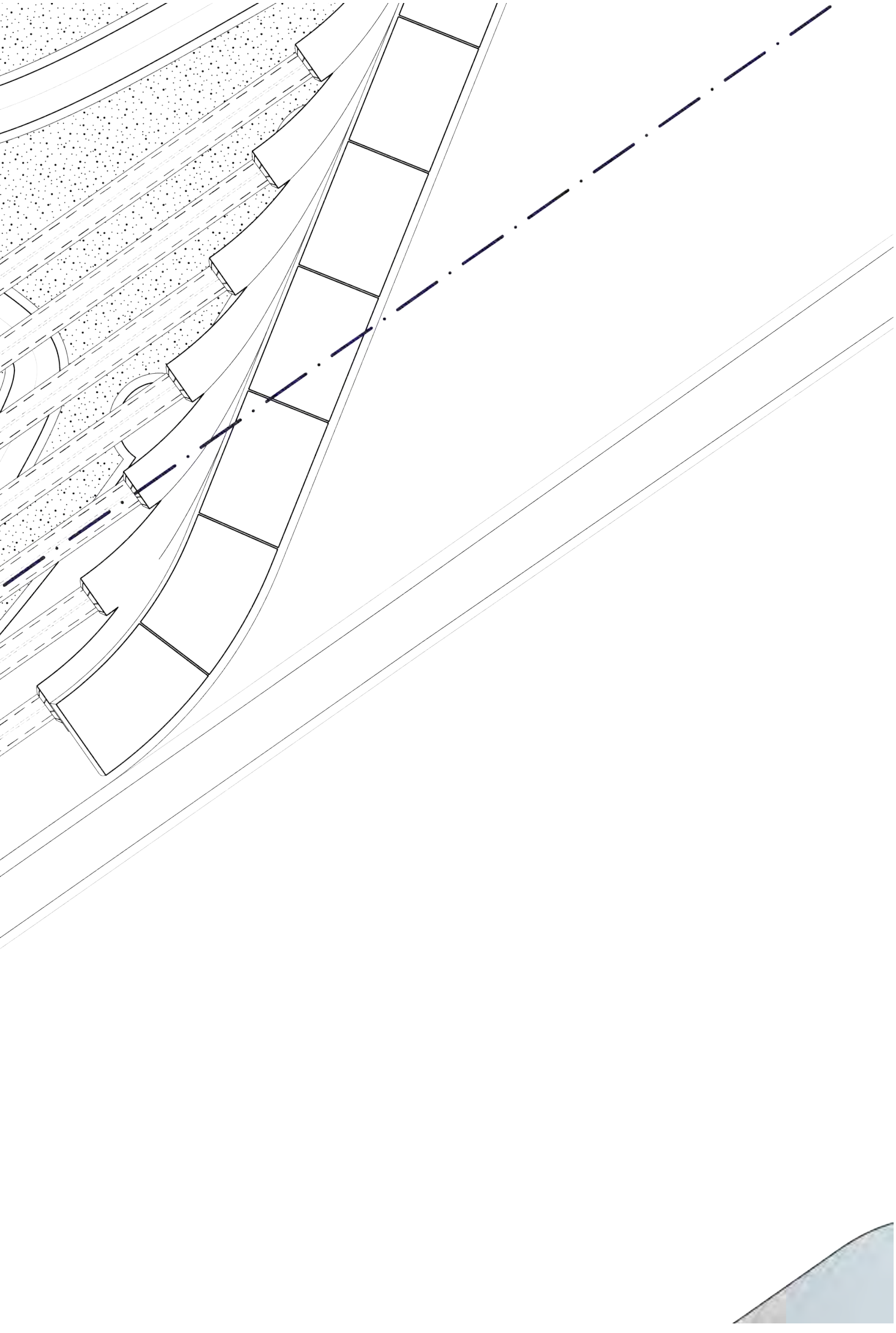

cafe / restau
A1-A2
10m
0
10m
20m


rant
DOWN
DOWN
UP
UP
police
check-point
e-device rental
passport contro
shop

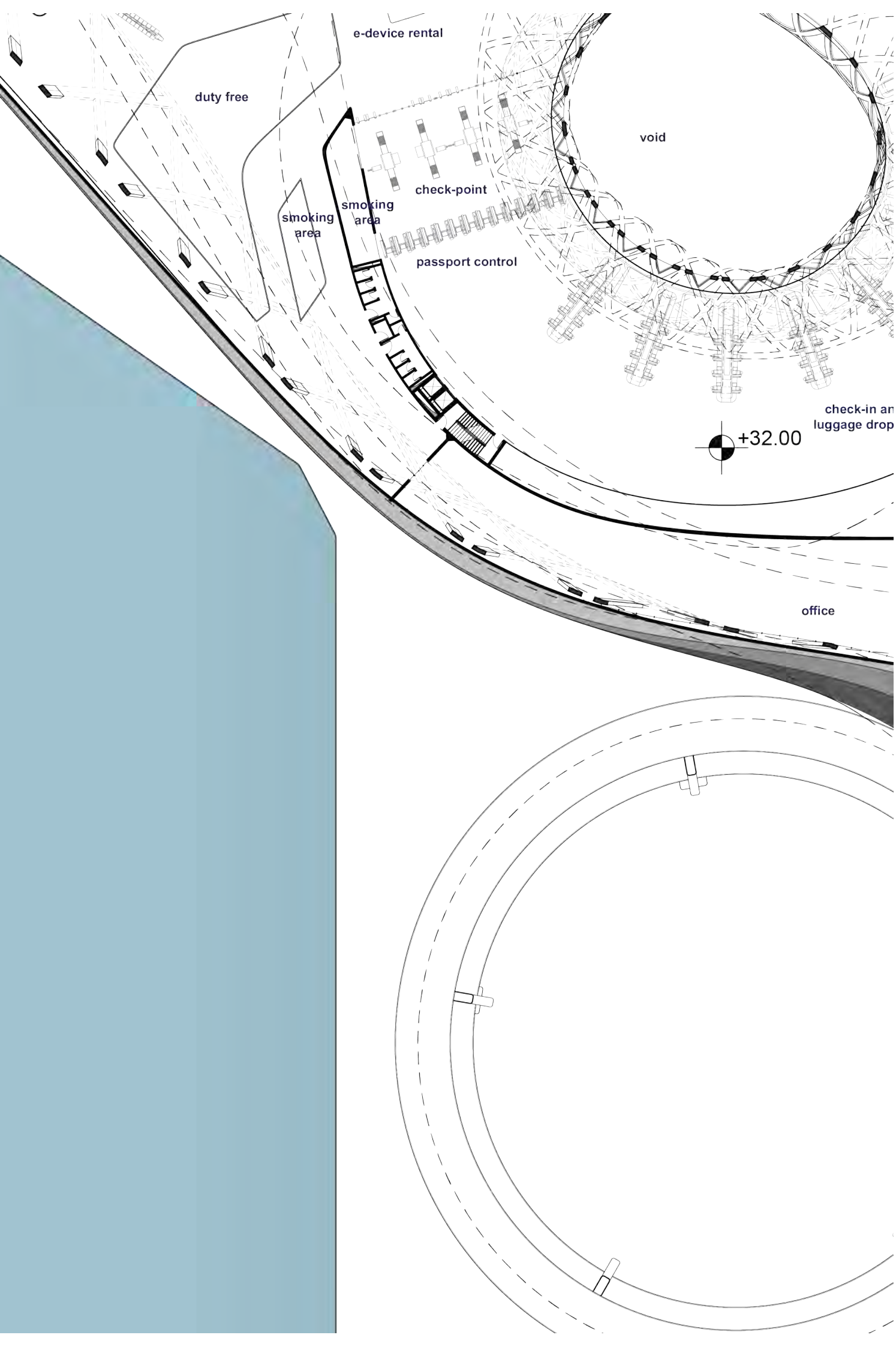

A3-A4
10m
0
10m
20m

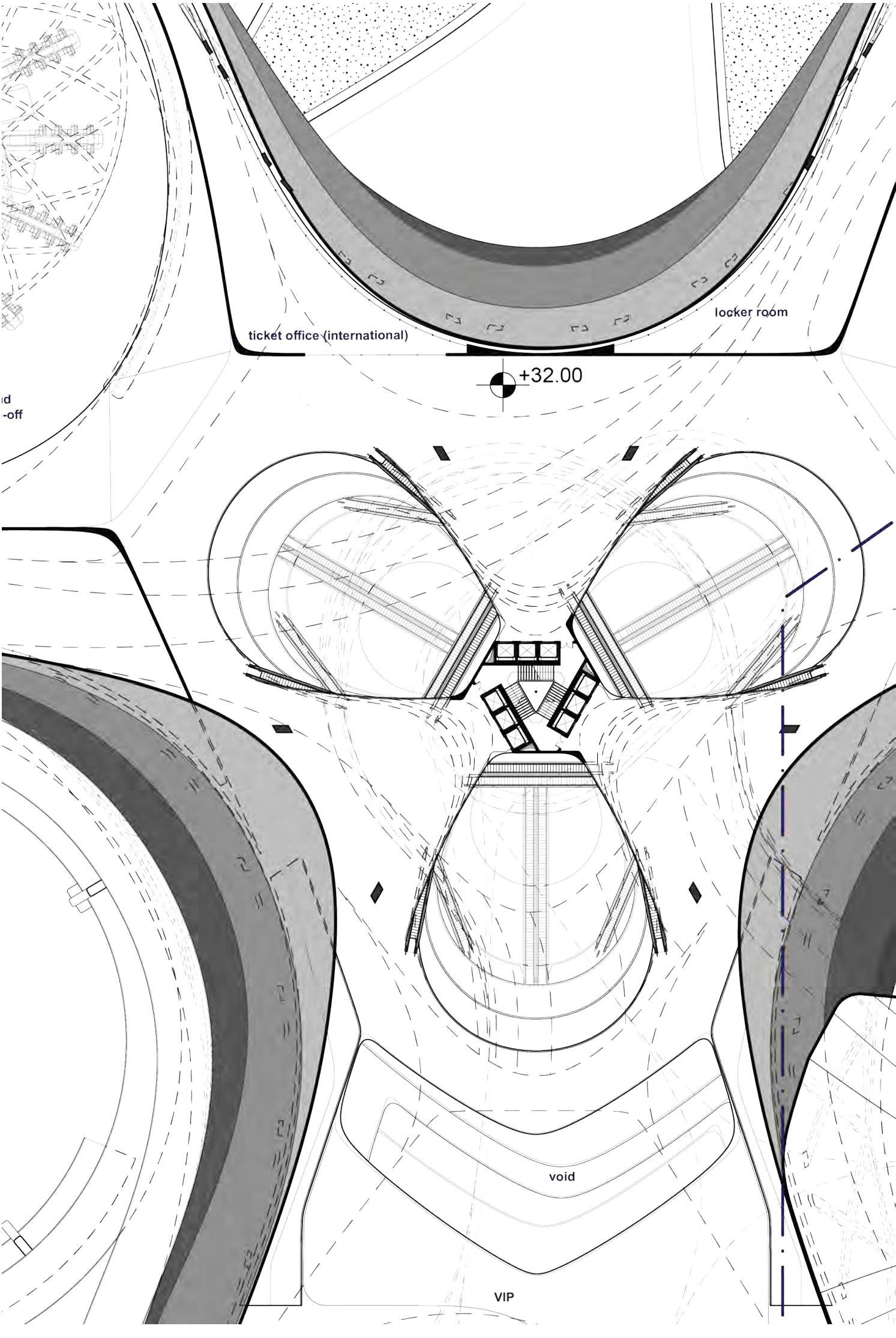

shop
check-point
ticket control
+32.00
e-device rental
UP
DOWN

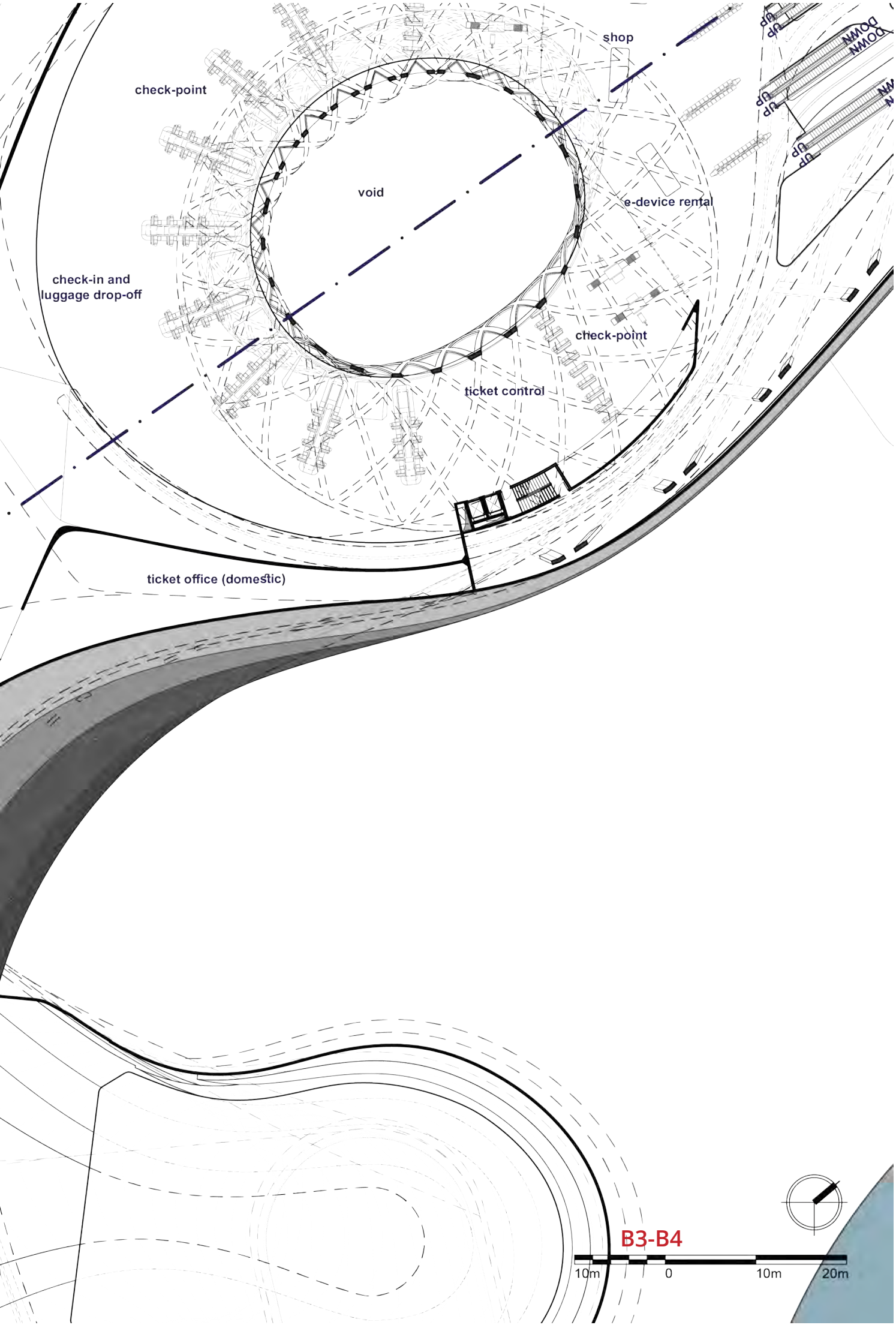

A5-A6
10m
0
10m
20m
cafe / restaurant

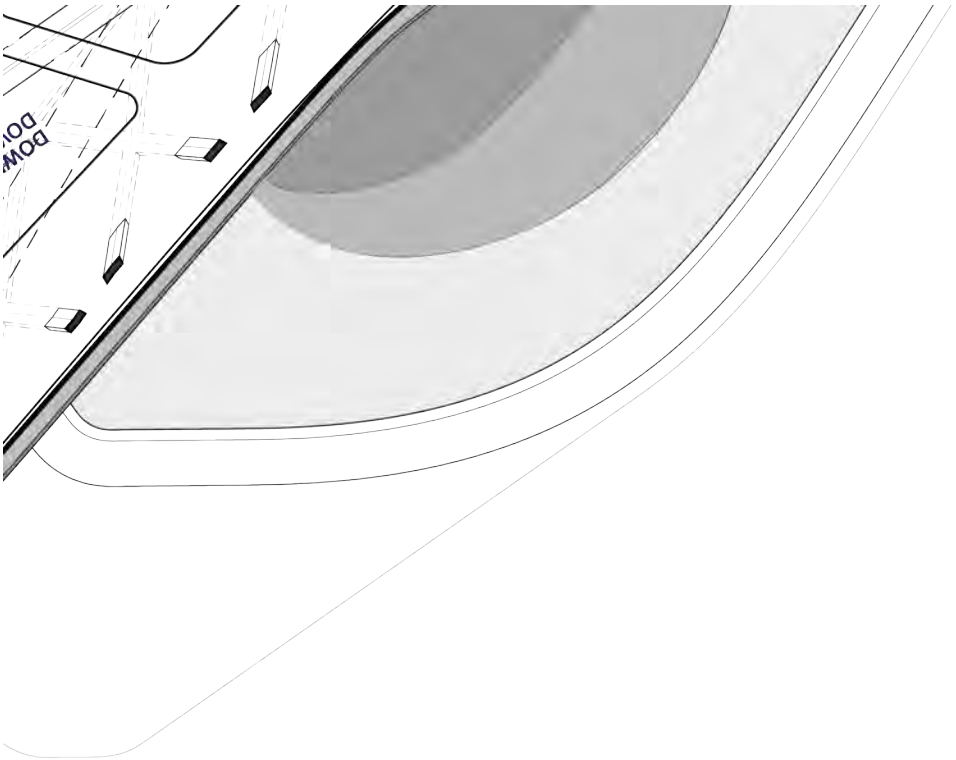


B1-B2


e-device rental
duty free
void
check-point
smoking area
smoking area
passport control
check-in an
luggage drop
+32.00
office


locker room
ticket office (international)
+32.00
void
VIP

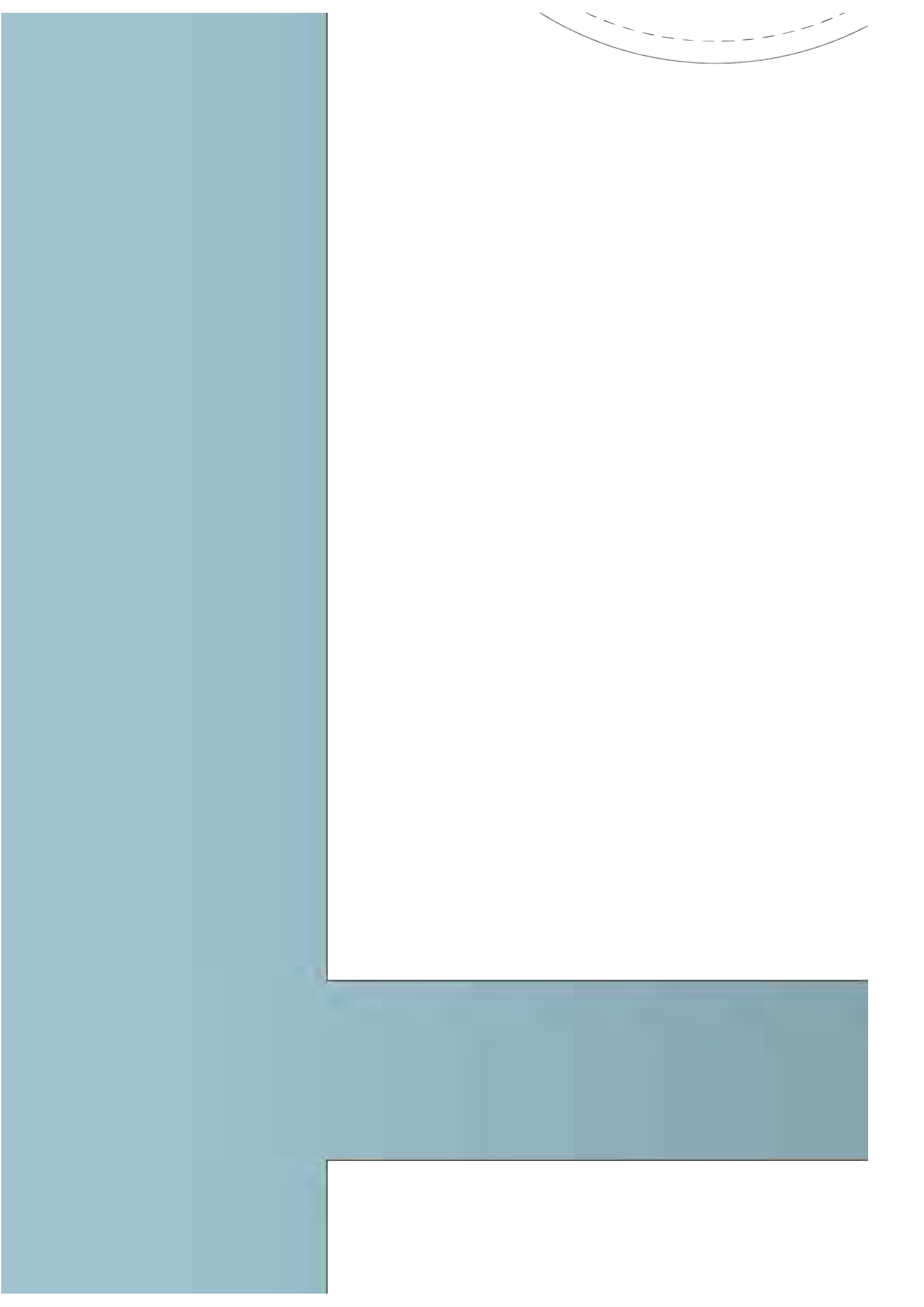

shop
check-point
void
e-device rental
check-in and
luggage drop-off
check-point
ticket control
ticket office (domestic)
B3-B4
10m
0
10m
20m

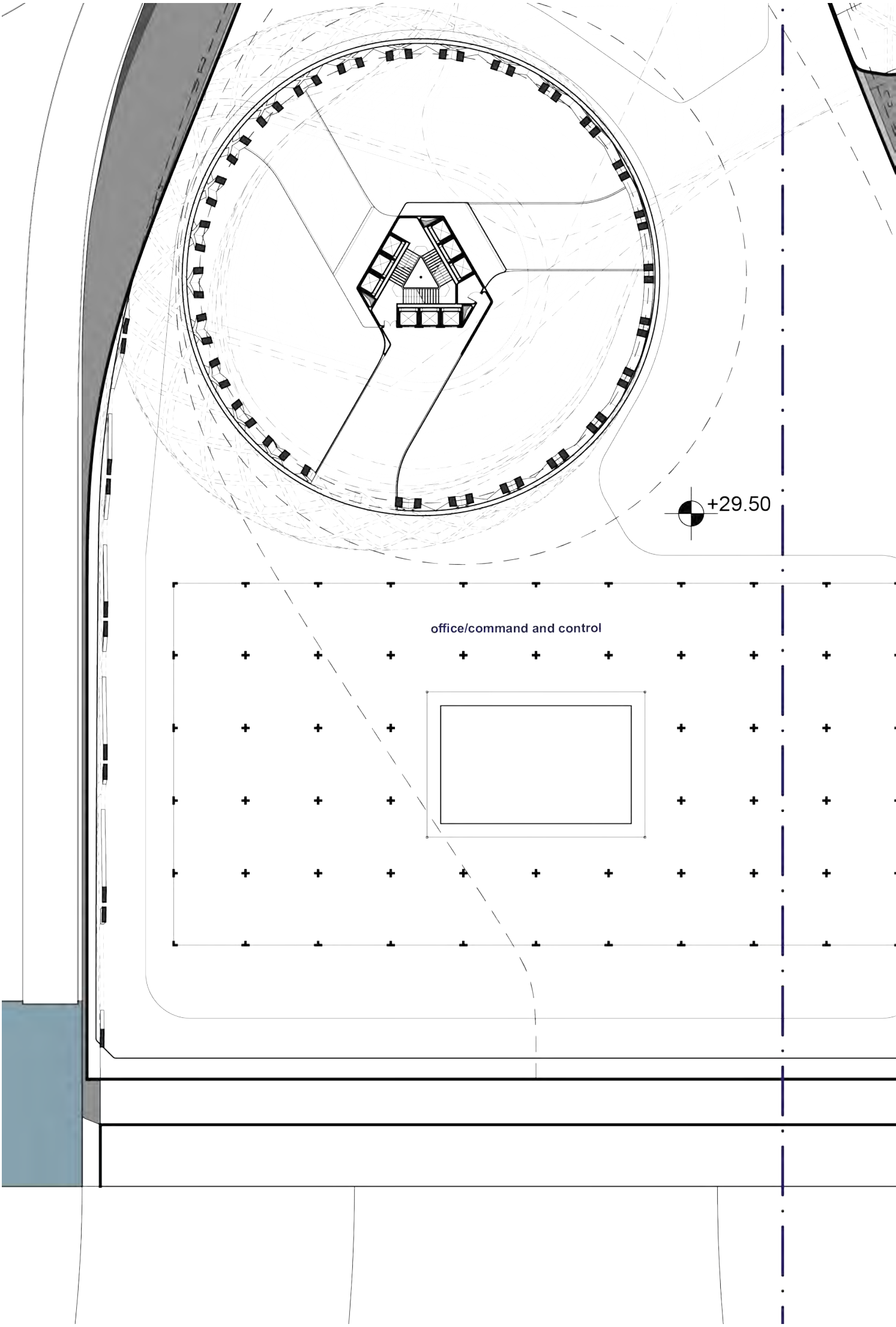


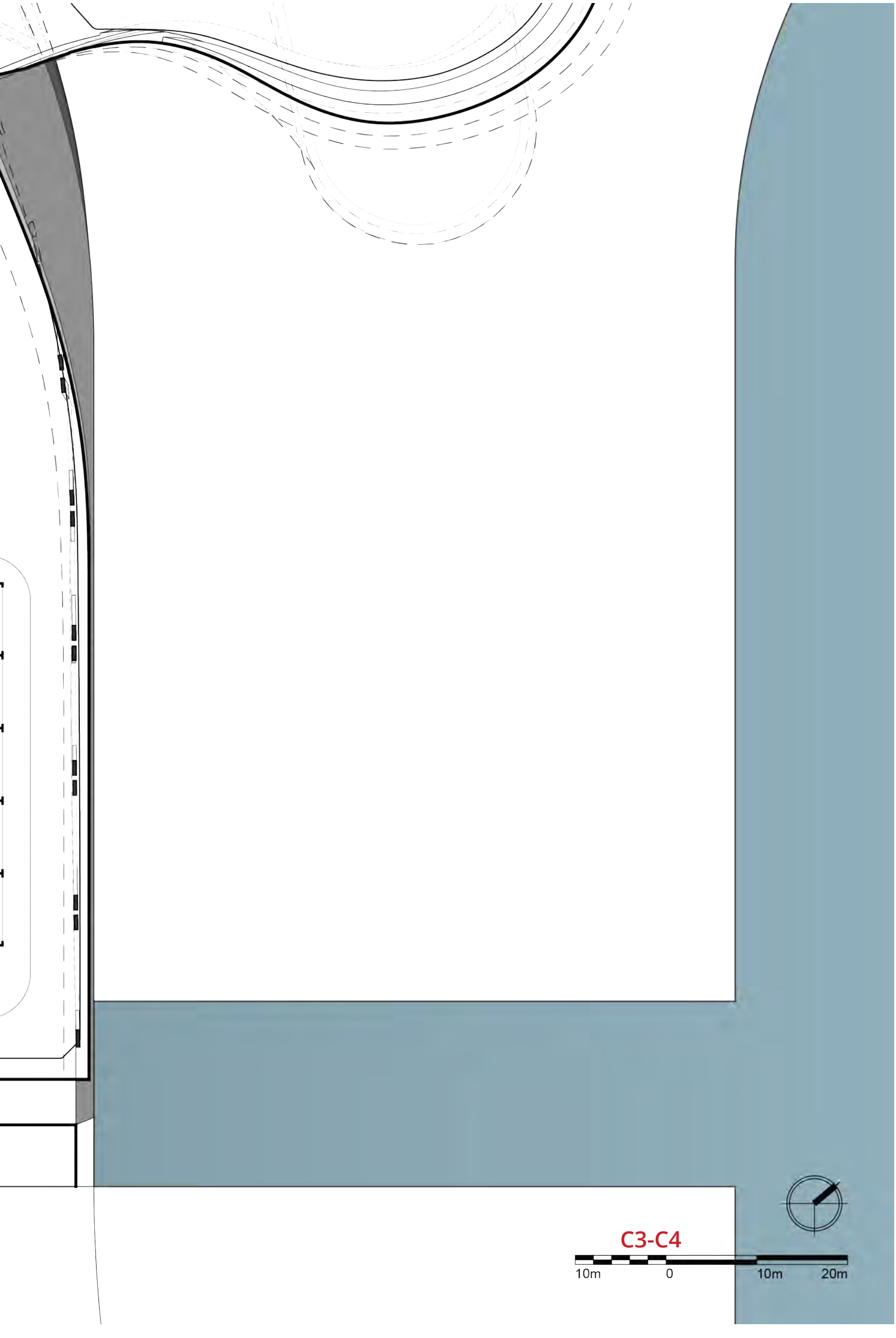
B5-B6

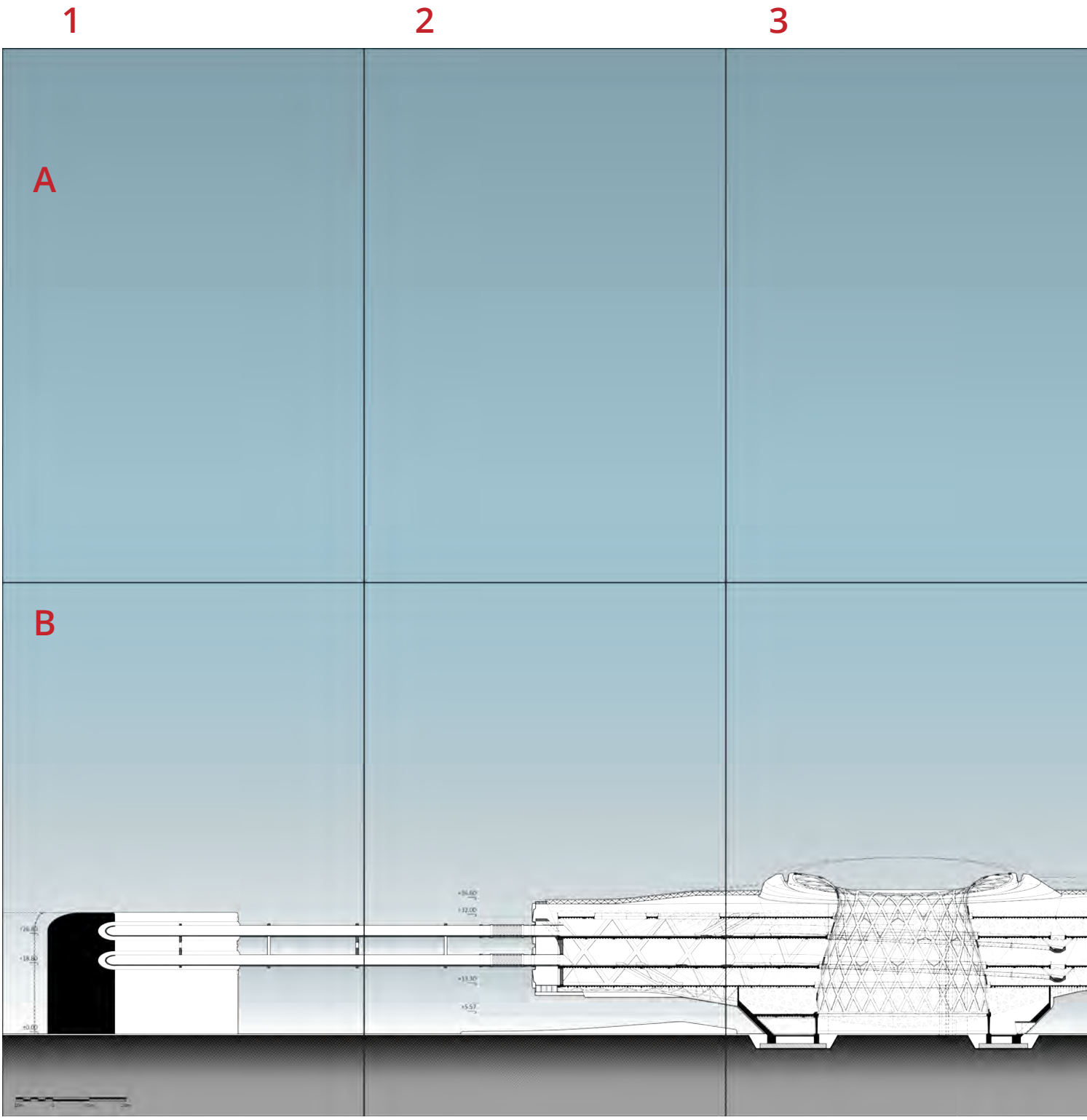
10m 0 10m 20m

C1-C2



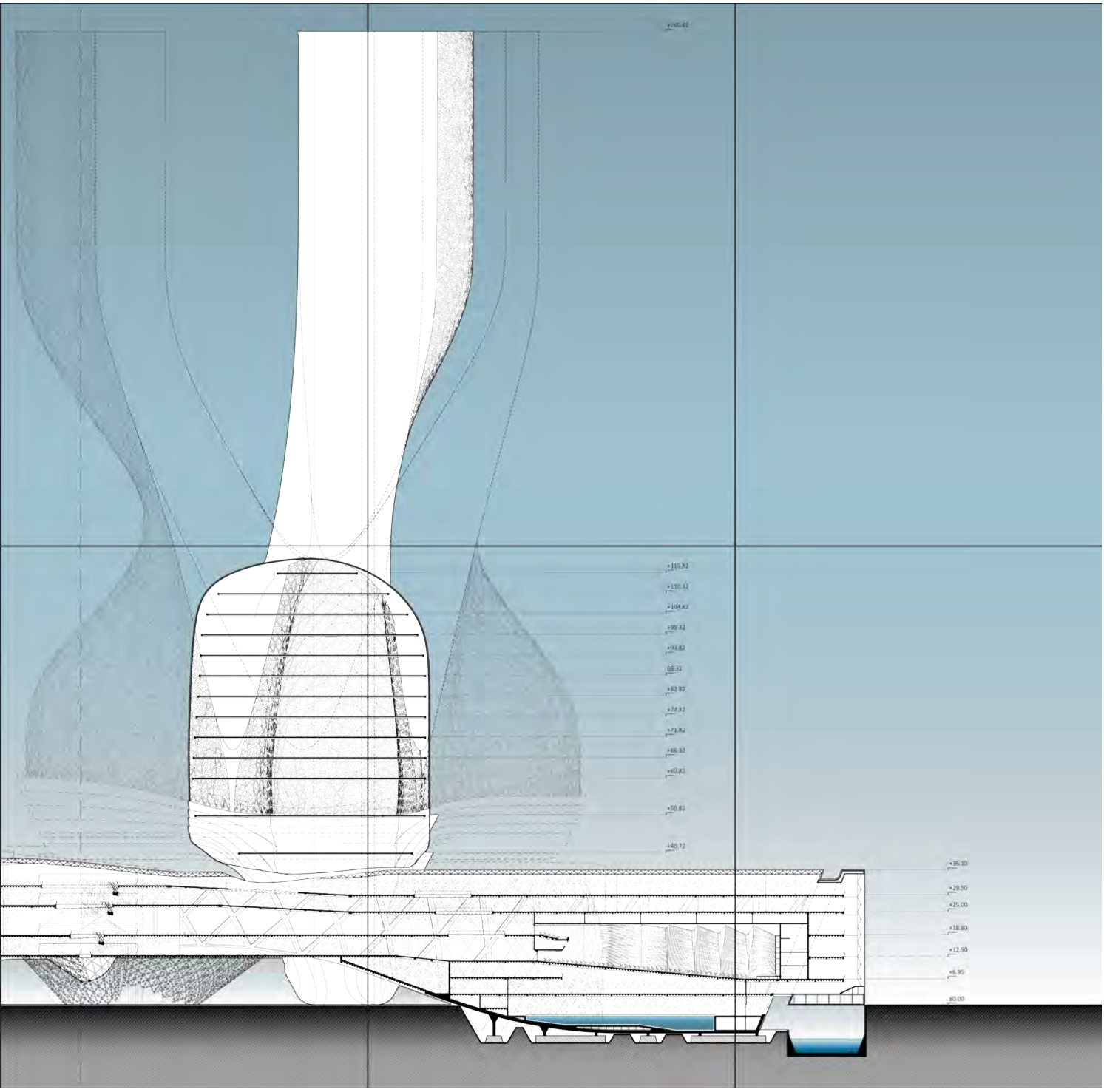

+29.50
office/command and control

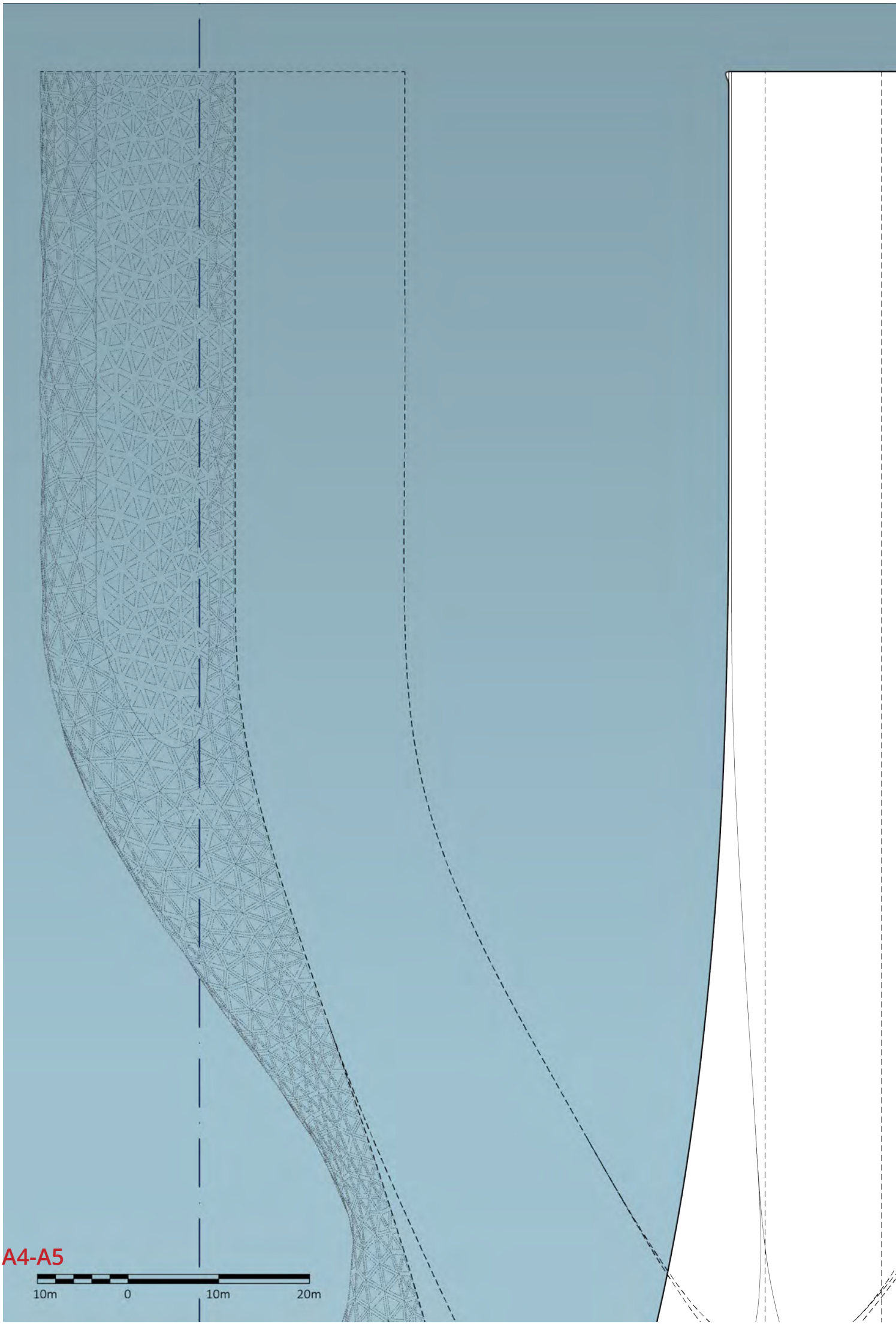

C3-C4
10m
0
10m
20m

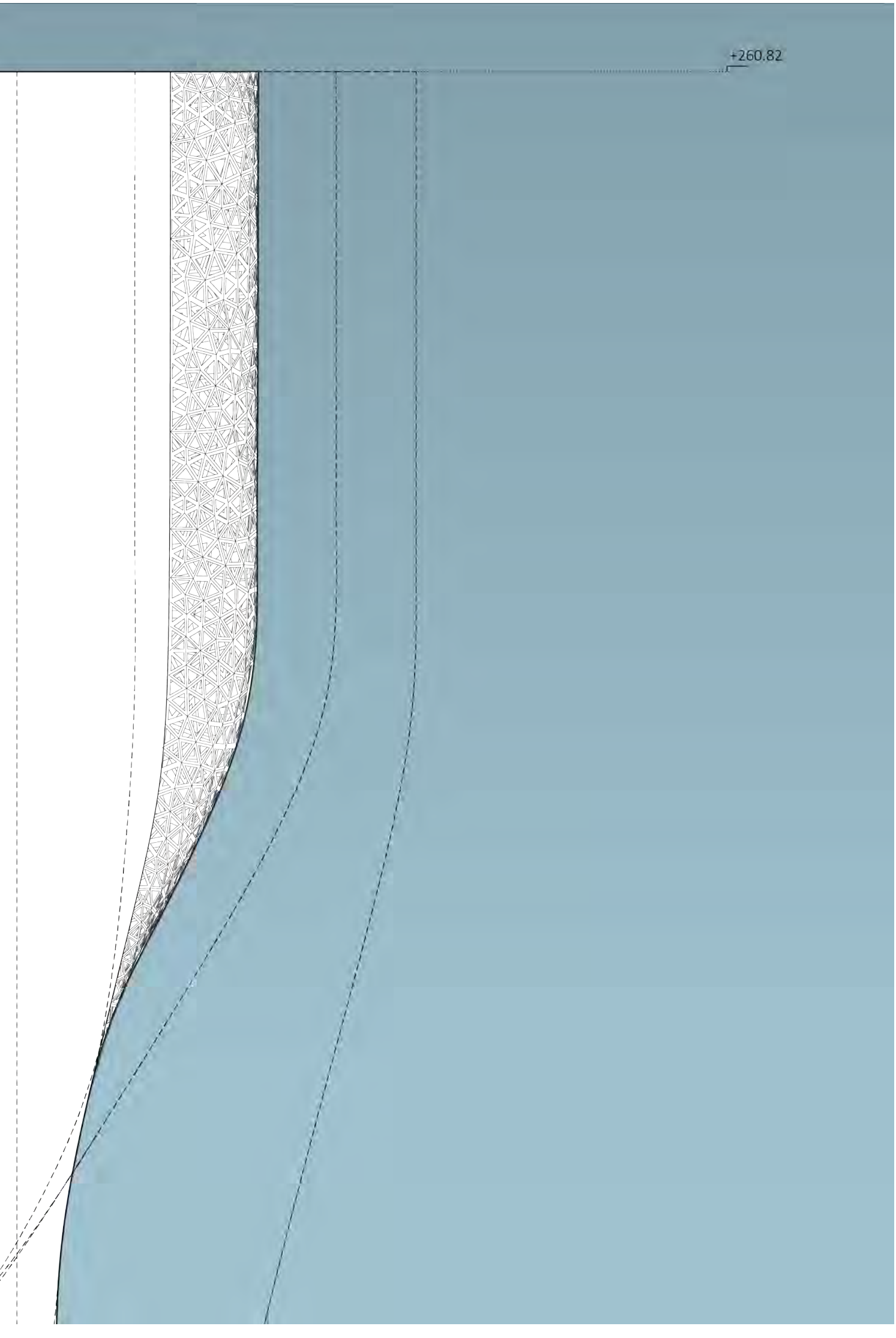


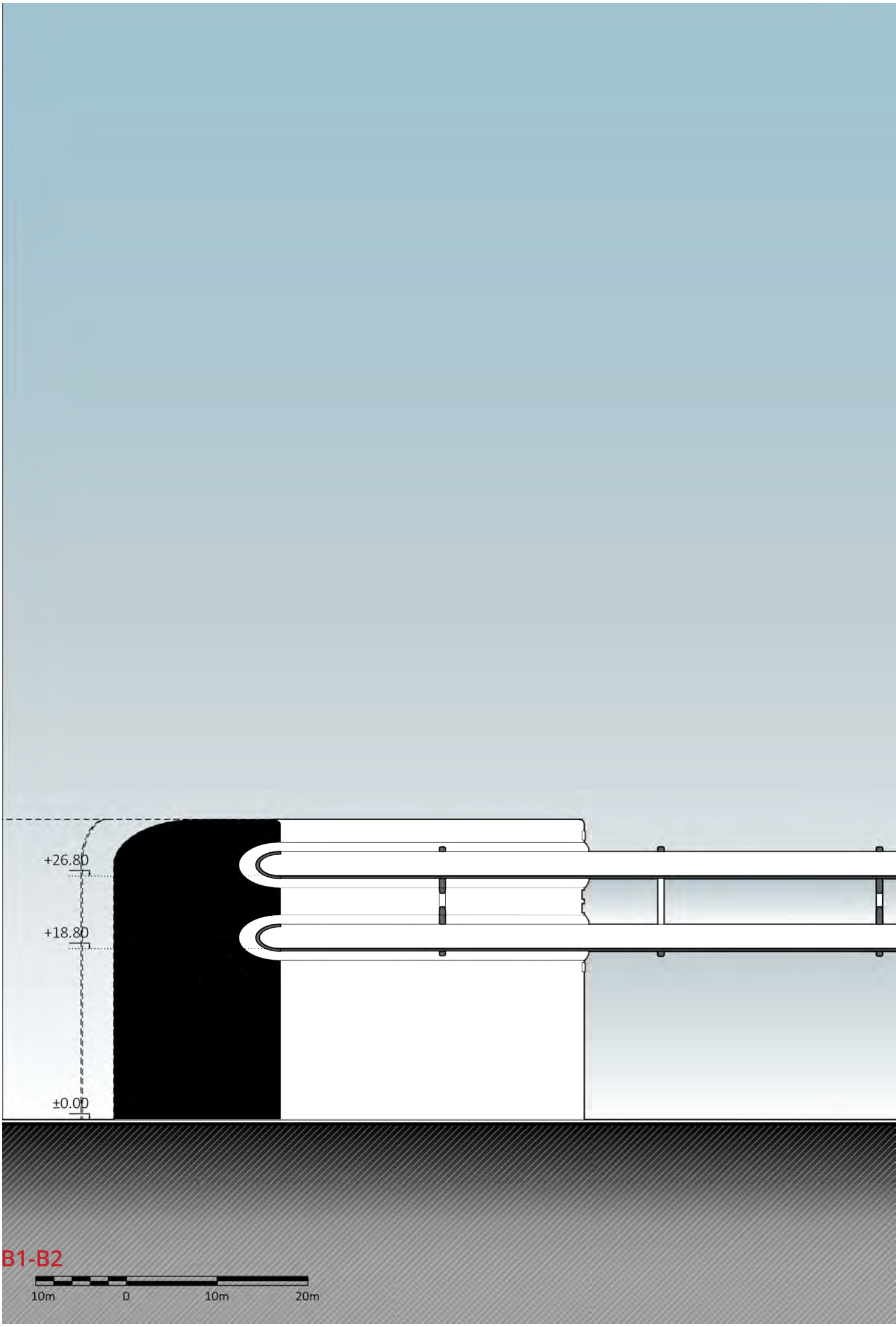
Key plan for Section

4 5 6

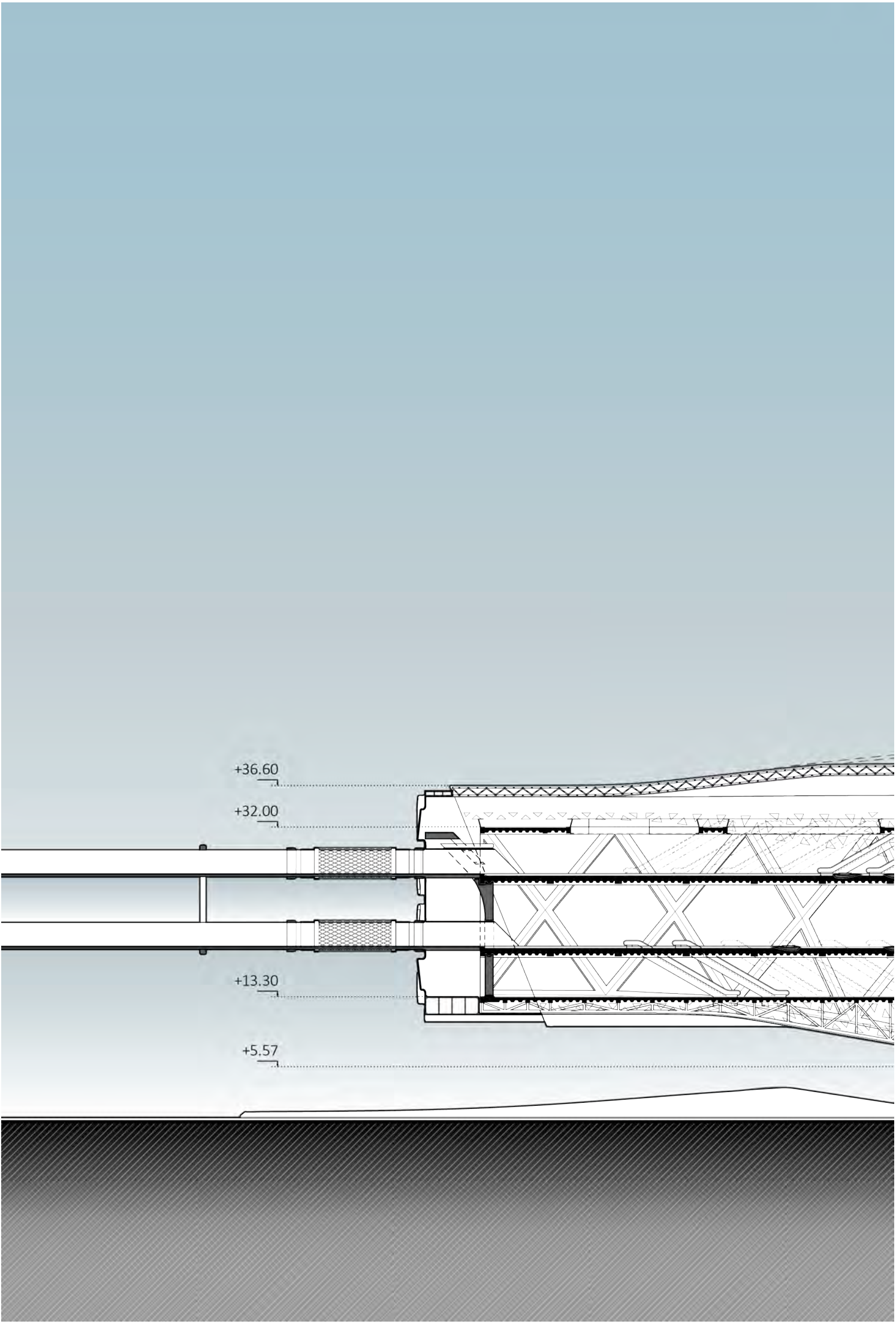


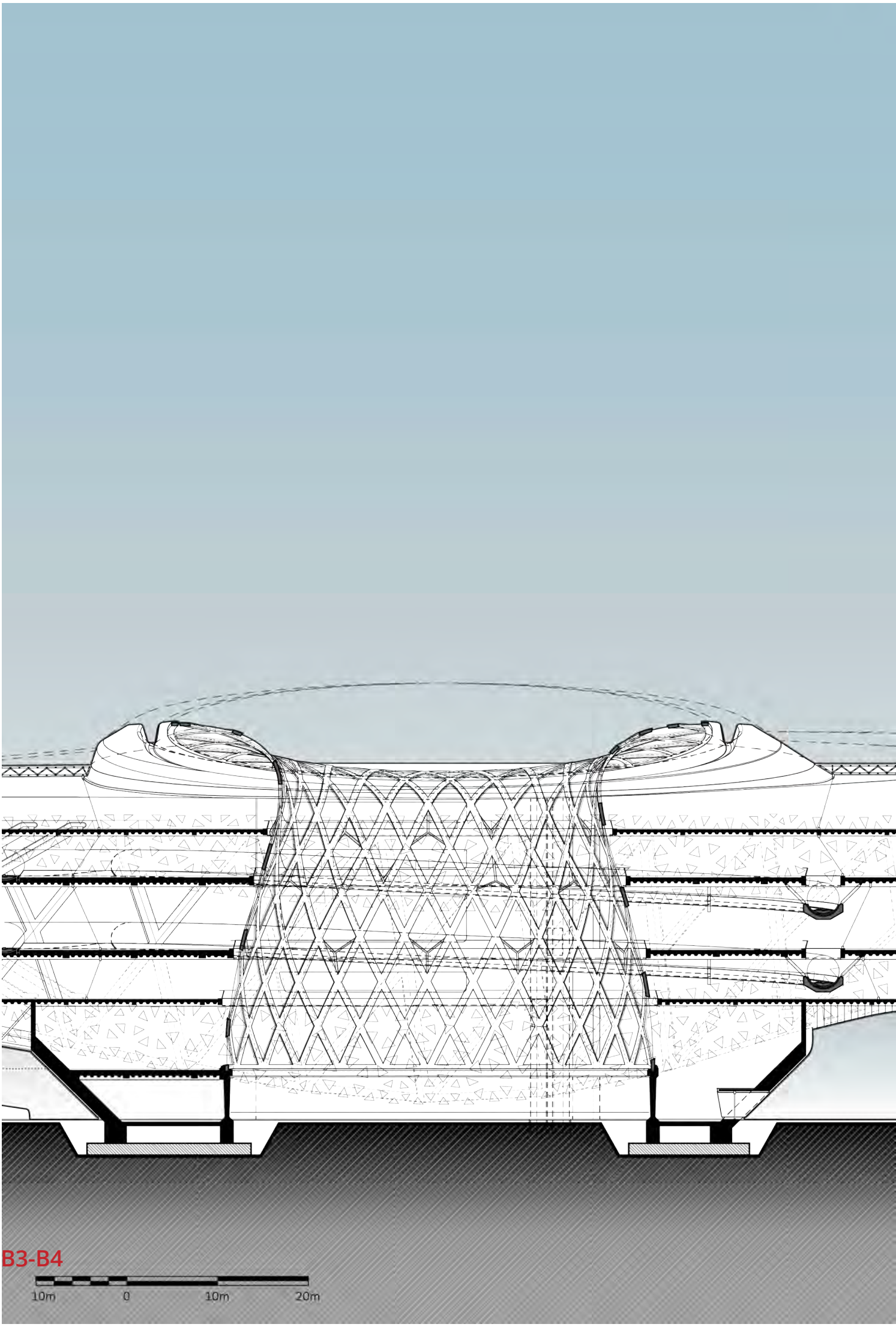

A4-A5
10m
0
10m
20m

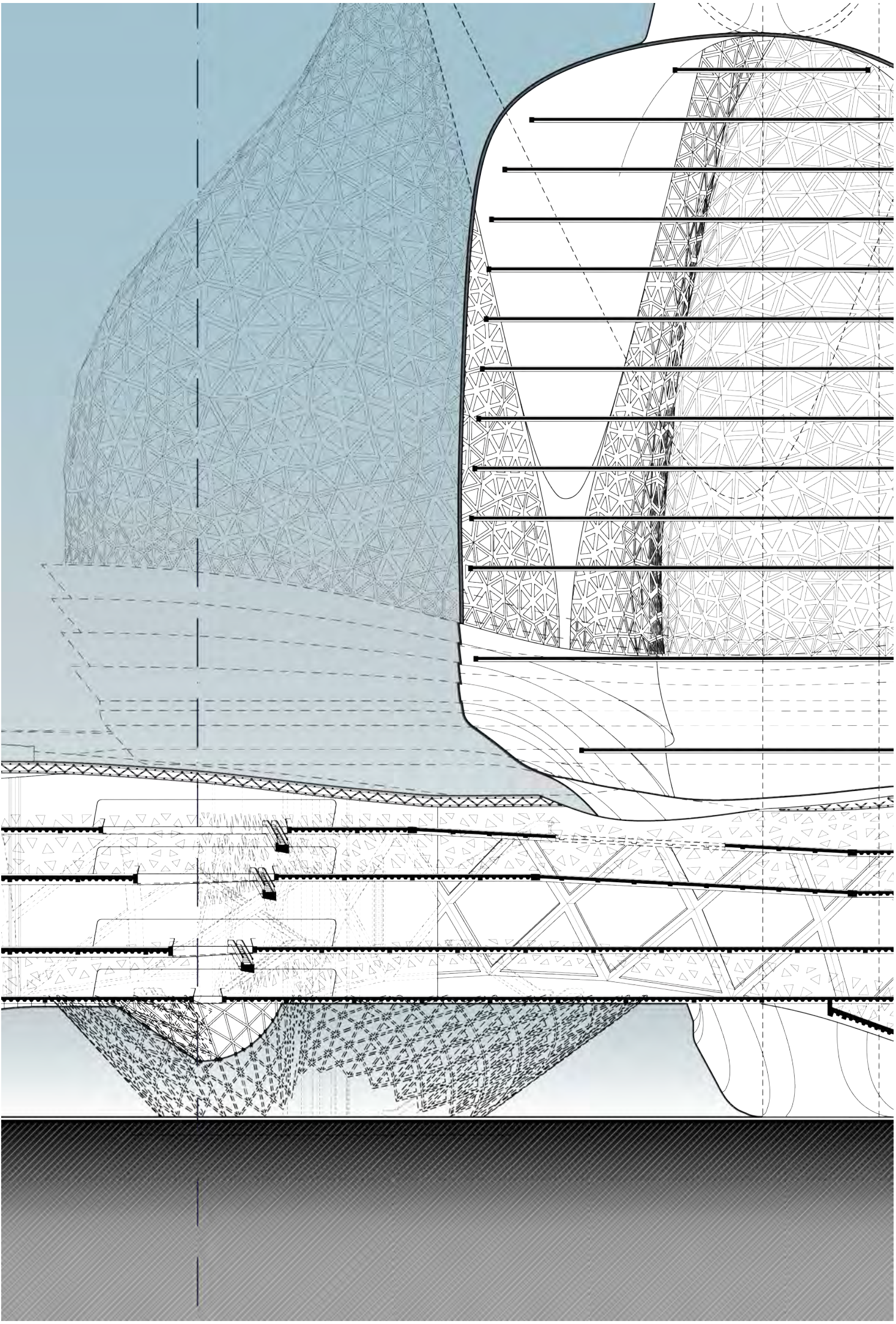

+260.82

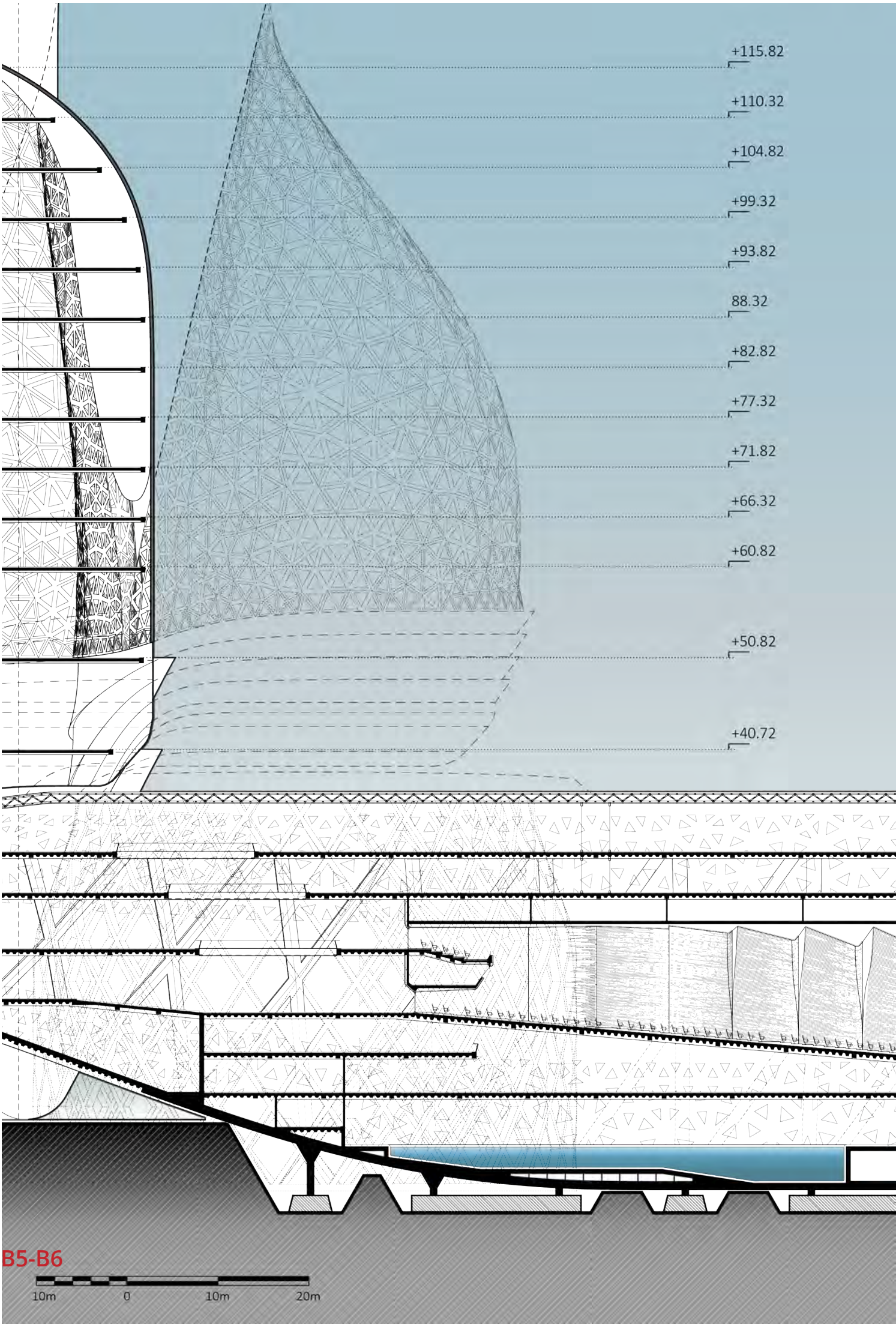


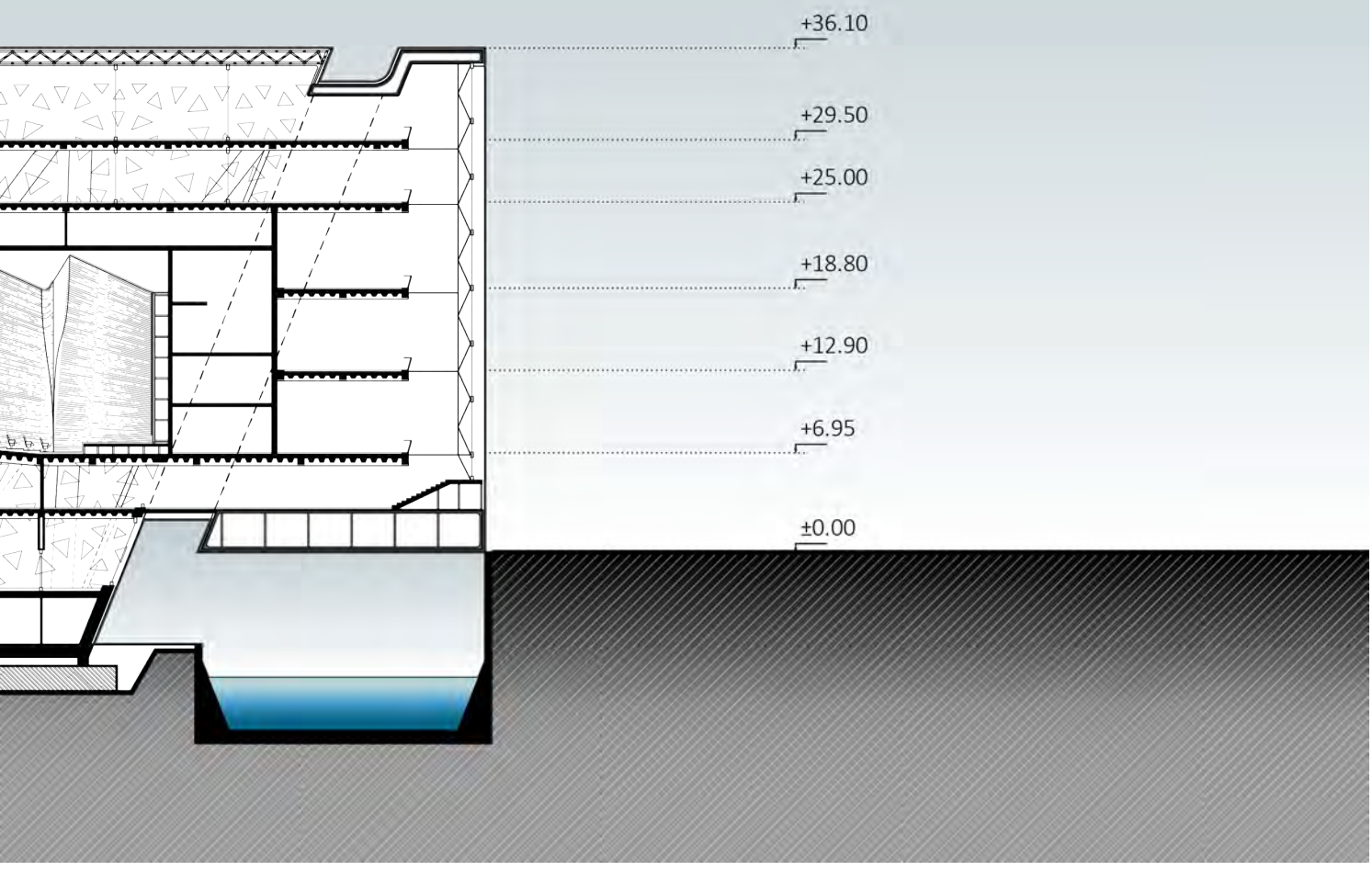
B1-B2


+36.60
+32.00
+13.30
+5.57

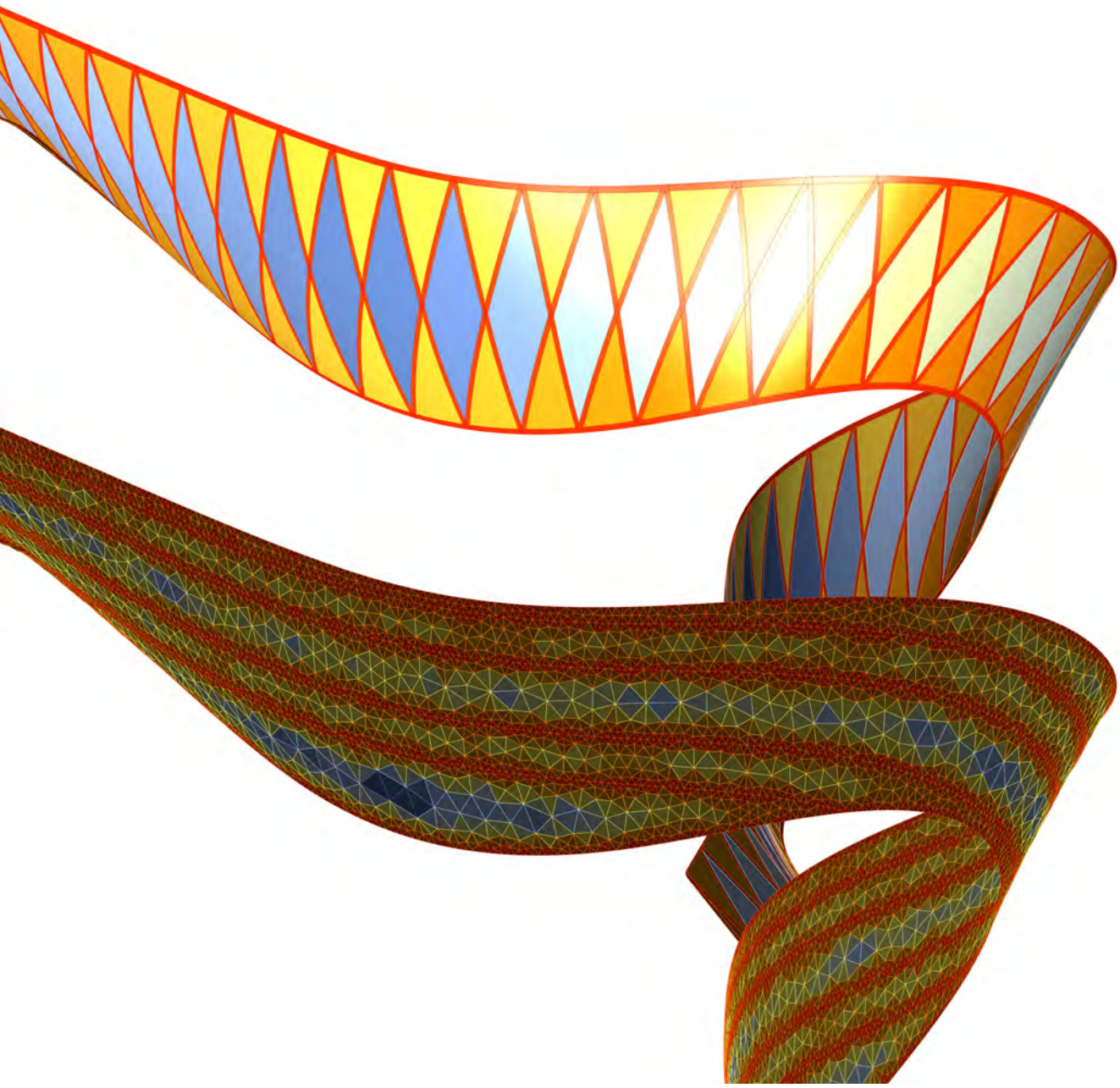

B3-B4
10m
0
10m
20m




+115.82
+110.32
+104.82
+99.32
+93.82
88.32
+82.82
+77.32
+71.82
+66.32
+60.82
+50.82
+40.72
B5-B6
10m
0
10m
20m

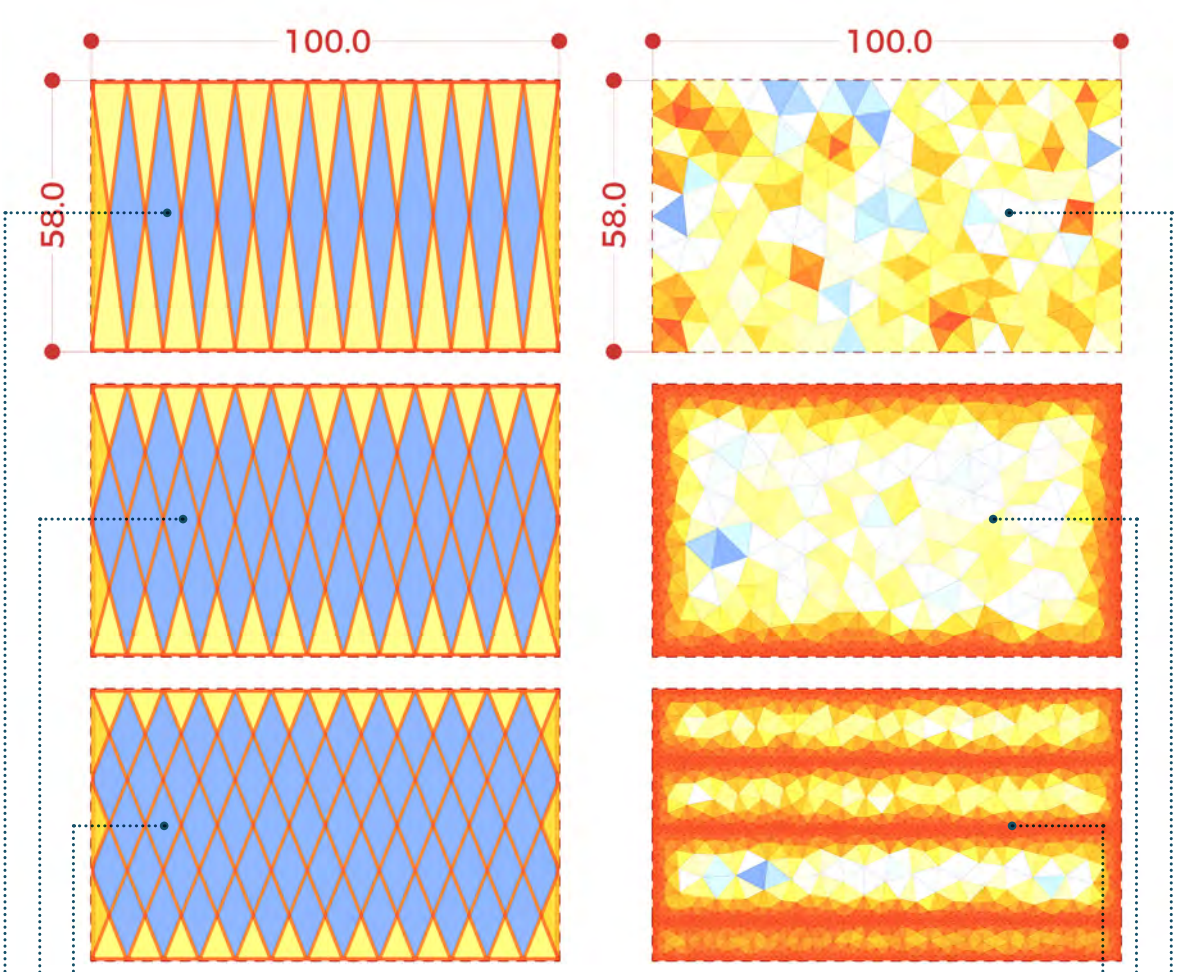

+36.10
+29.50
+25.00
+18.80
+12.90
+6.95
±0.00

Structural System



Structural Load Distribution

comparison in load distribution between an example of conventional diagrid structure and an example of adaptive mesh structure



- Total number of mesh frames
- 88
- Mesh frame Area
- 25.27_ 60.51m²
- Total mesh area
- 4407.11 m²

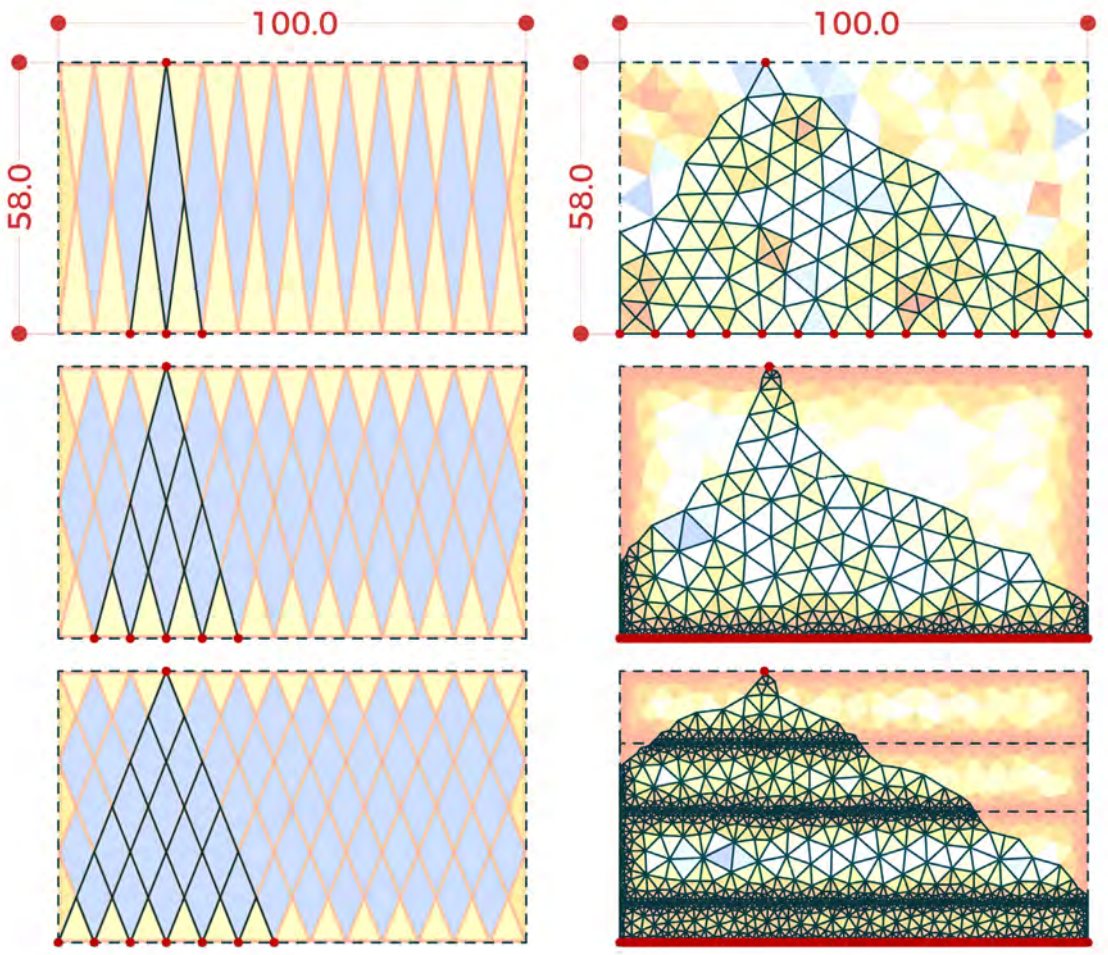
- Total number of mesh frames
- 6281
- Mesh frame Area
- 0.07_ 7.41 m²
- Total mesh area
- 5800 m²

- Total number of mesh frames
- 67
- Mesh frame Area
- 28.18_ 91.53 m²
- Total mesh area
- 4555.58 m²

- Total number of mesh frames
- 2813
- Mesh frame Area
- 4.14_ 9.08 m²
- Total mesh area
- 5800 m²

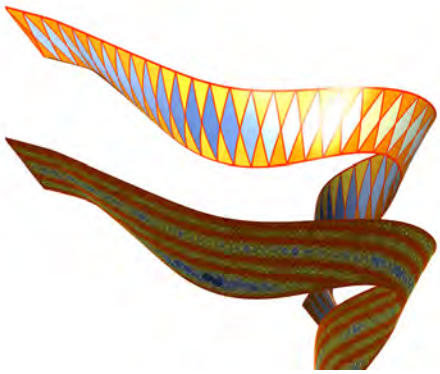
- Total number of mesh frames
- 42
- Mesh frame Area
- 35.27_ 184 m²
- Total mesh area
- 4648.41 m²

- Total number of mesh frames
- 468
- Mesh frame Area
- 4.14_ 9.08 m²
- Total mesh area
- 5800 m²

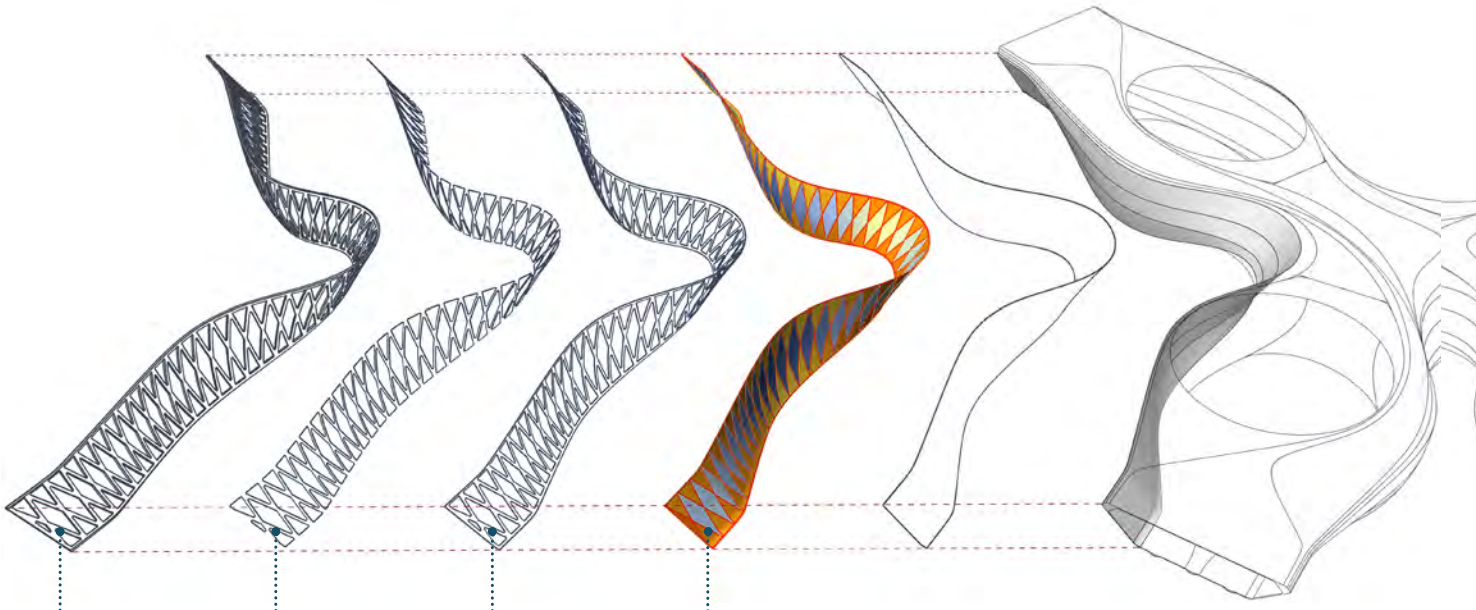


load distribution pattern diagram: conventional diagrid shell structure versus informed shell structure.

Developed in kangaroo/grasshopper based on Daniel Piker's mesh machine



conventional diagrid shell structure vs. informed shell structure

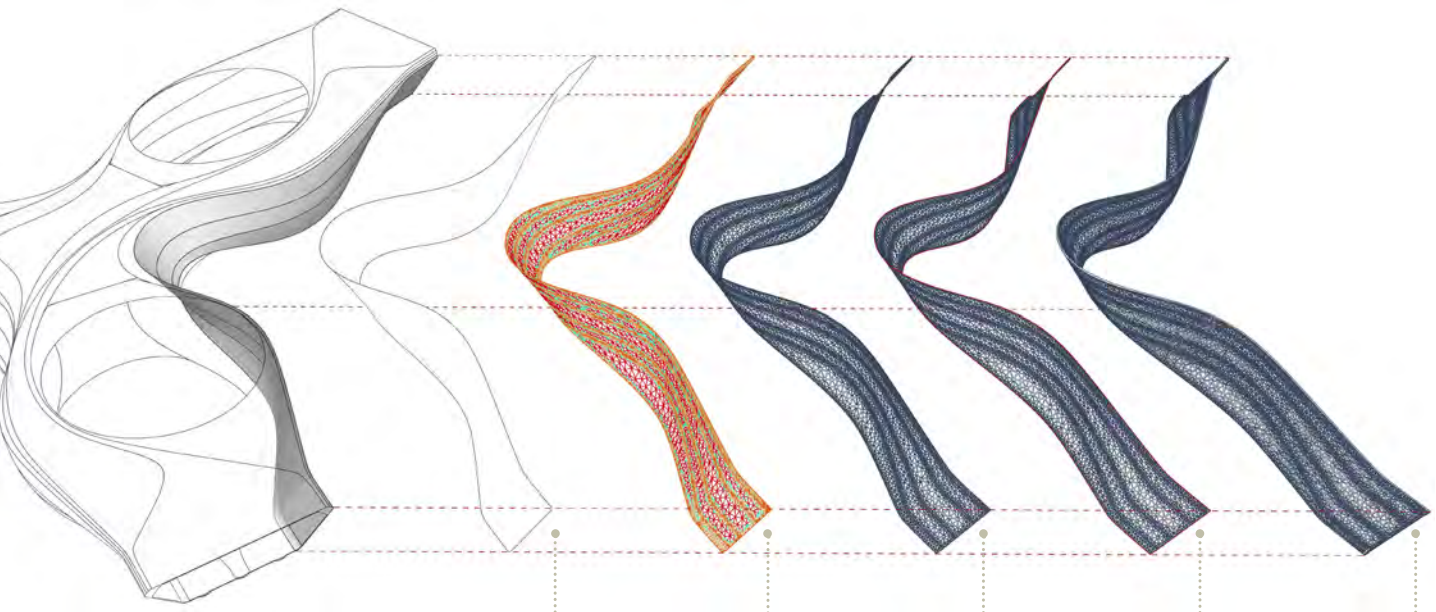


- Total structure volume
- 2823.27 m^3

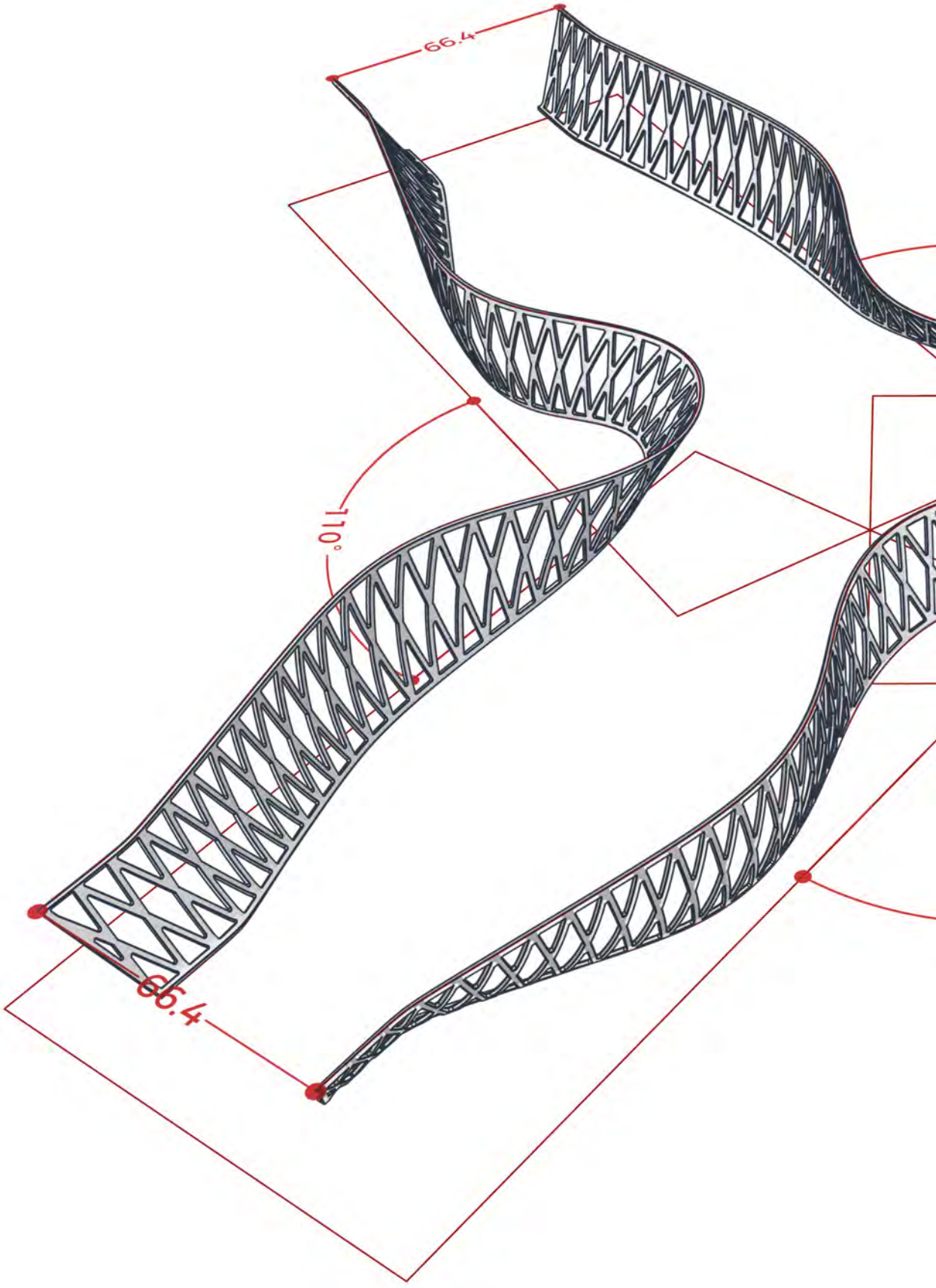
- Total mesh area
- 8210.72 m^2

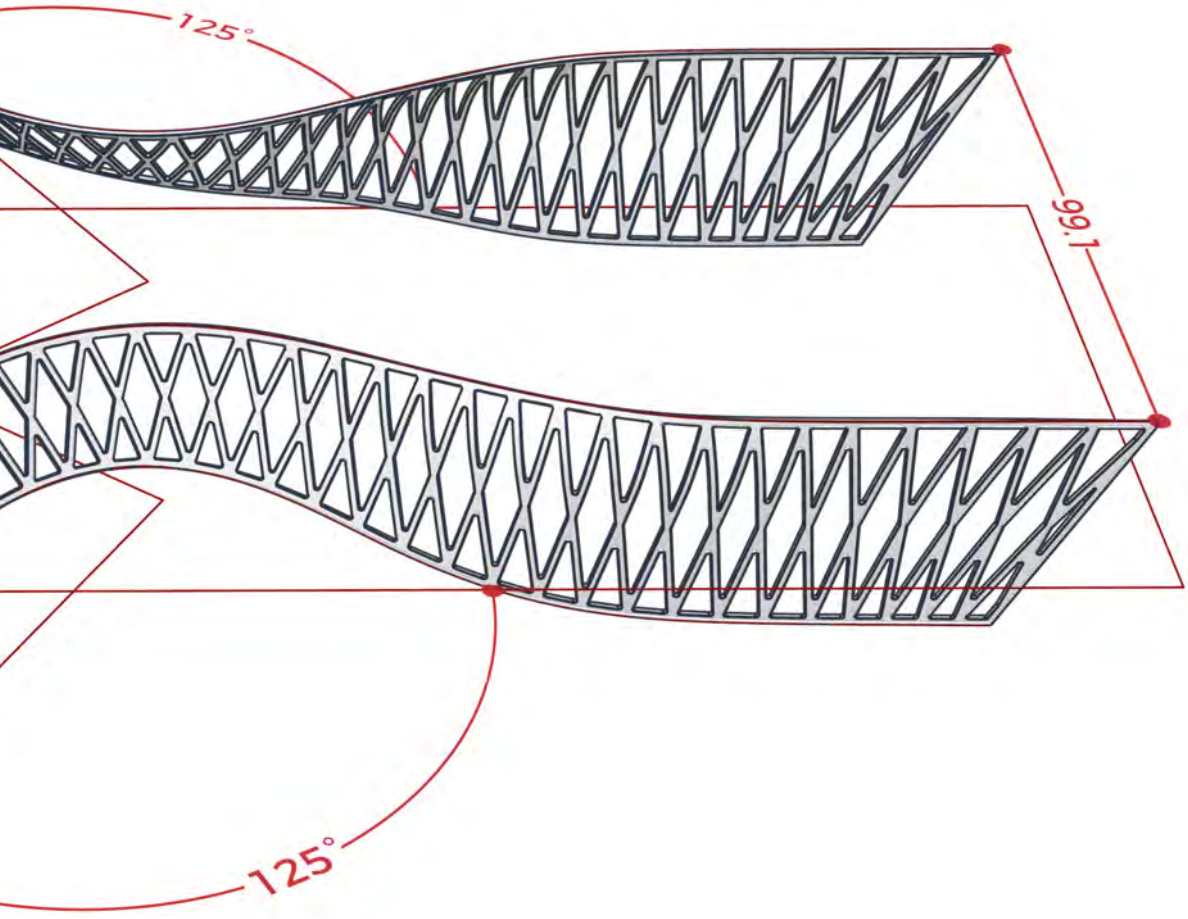
- Minimum Mesh area
- 19.06 m^2
- Minimum Mesh area
- 114.67 m^2

- Total number of mesh frames
- 145

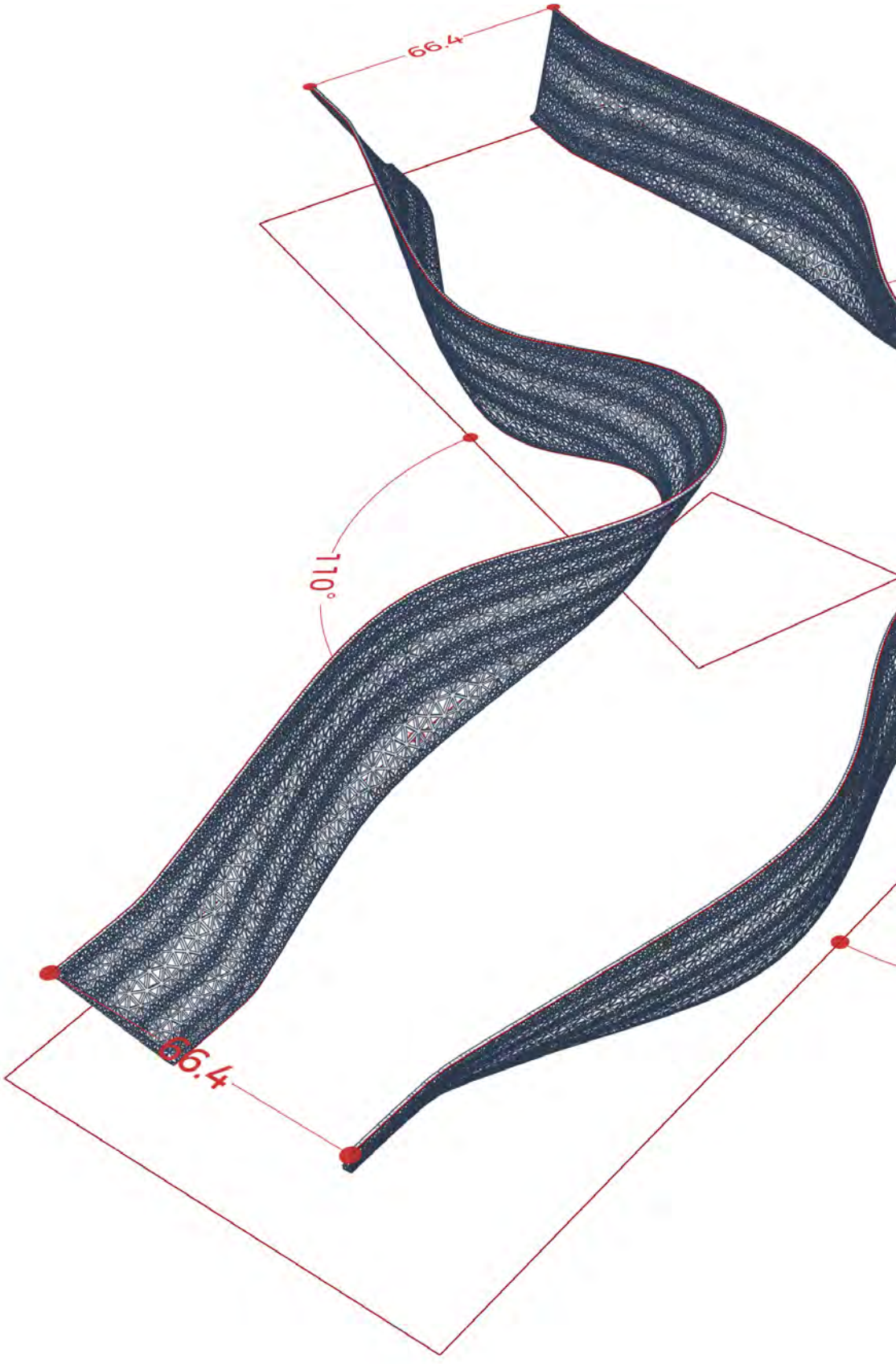


- Total number of mesh frames
  - 20604
- Total mesh number with element length less than 1.8
  - 1602
- Total mesh number with element length more than 1.8
  - 3224
- Total mesh number with element length less than 1.0m
  - 8188
- Total mesh number with element length more than 1.0
  - 7590
- Minimum Mesh element Length
  - 22cm
- Minimum Mesh element Length
  - 504cm
- Total mesh area
  - 10209.67 m^2
- Total structure volume
  - 3191.4 m^3


66.4
110°
66.4



Main structural elements
Conventional diagrid shell structure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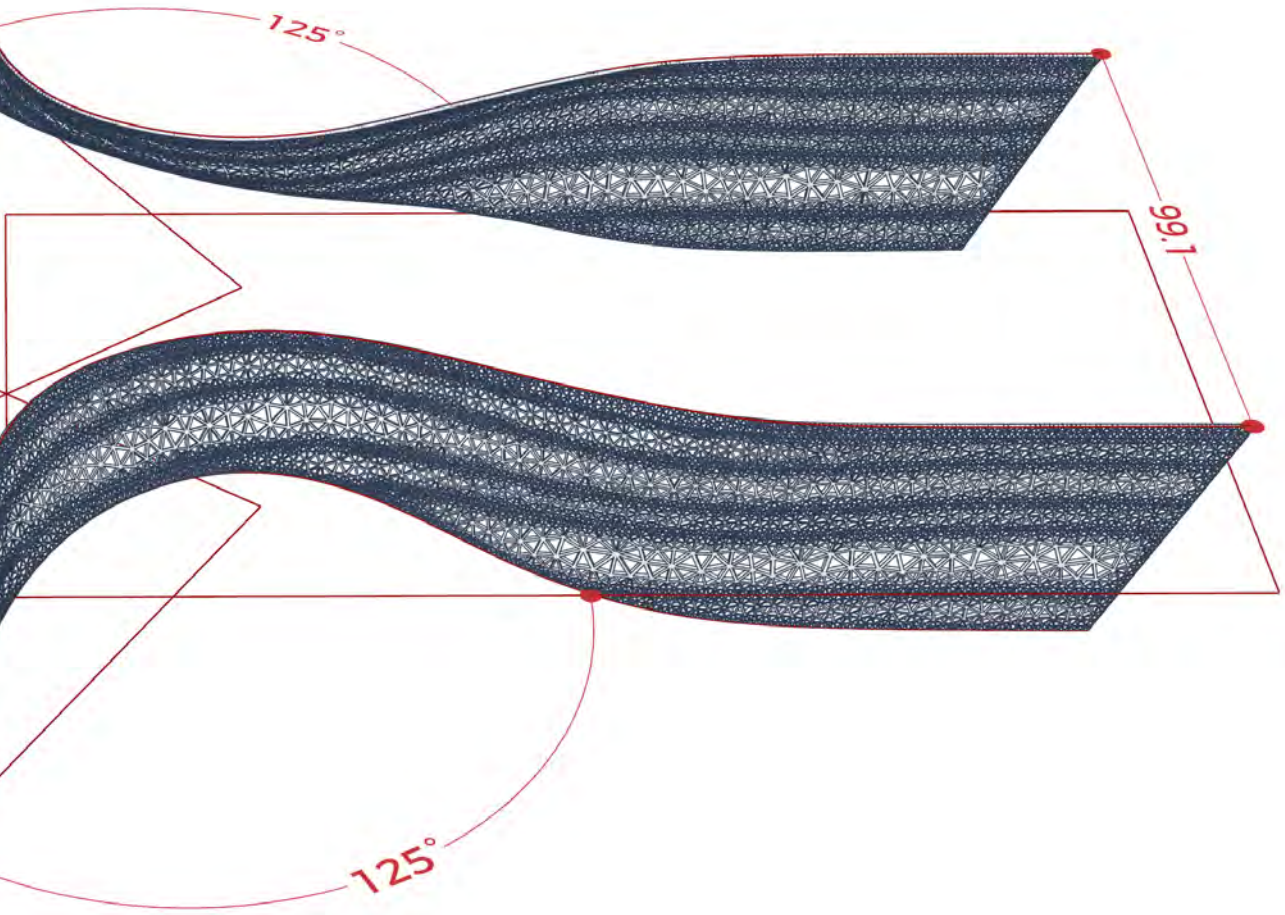
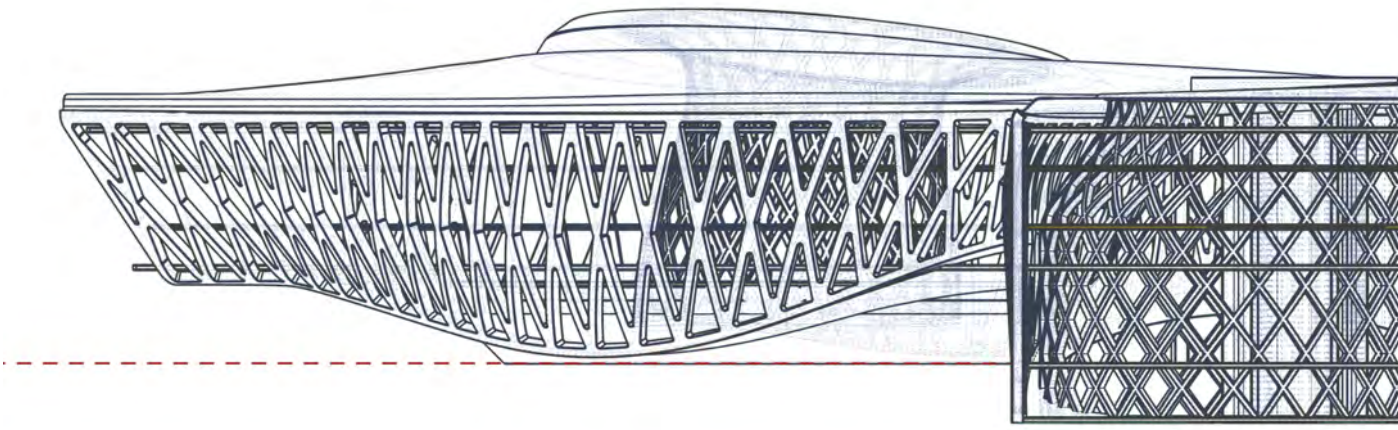
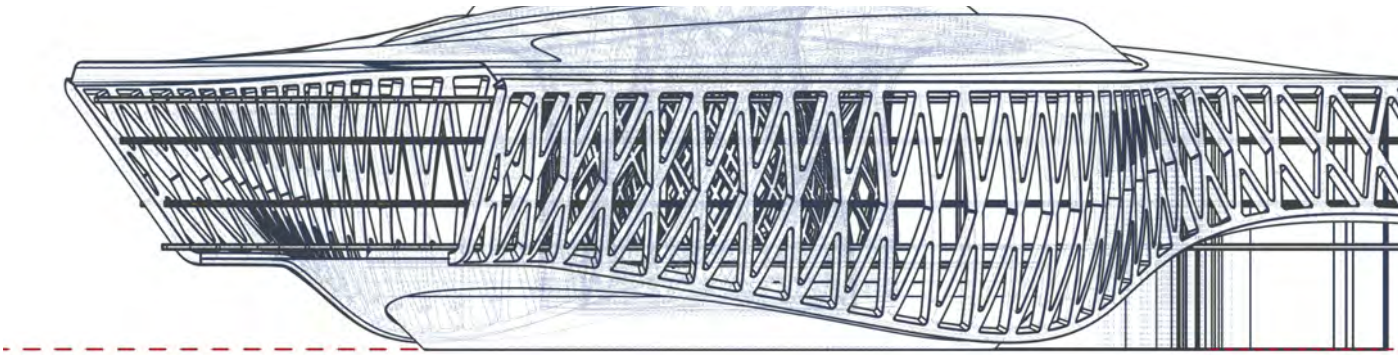


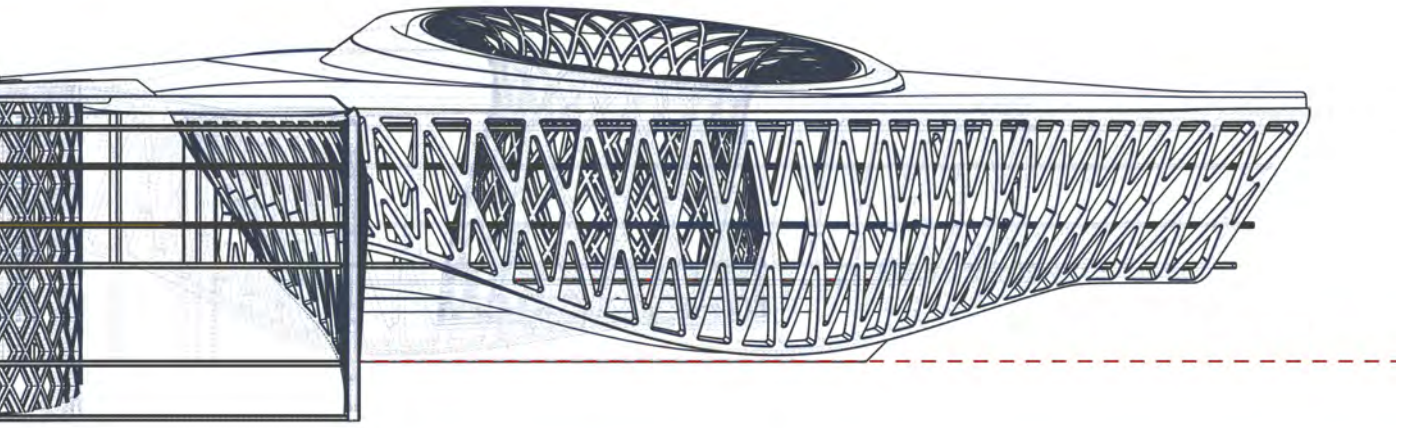
Main structural elements

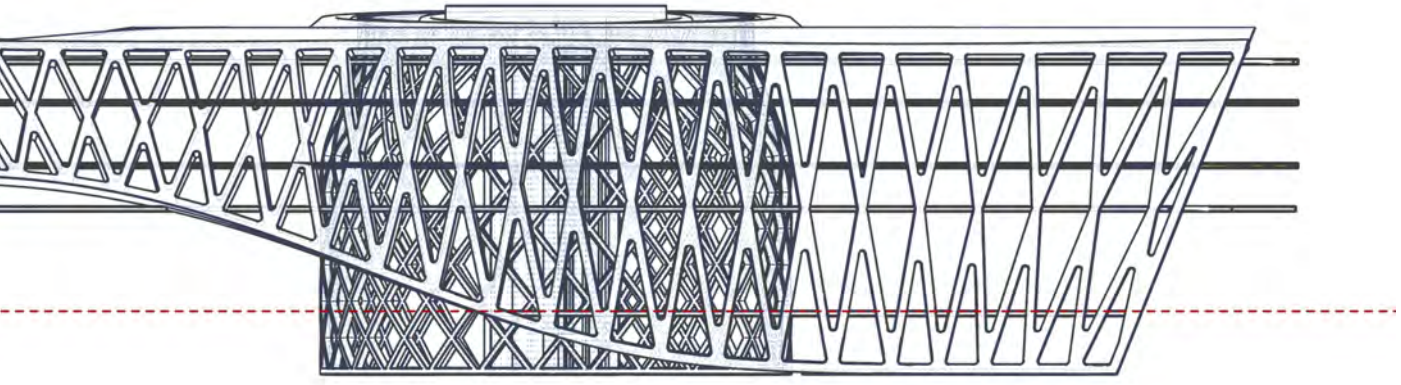
Adaptive mesh structure try out

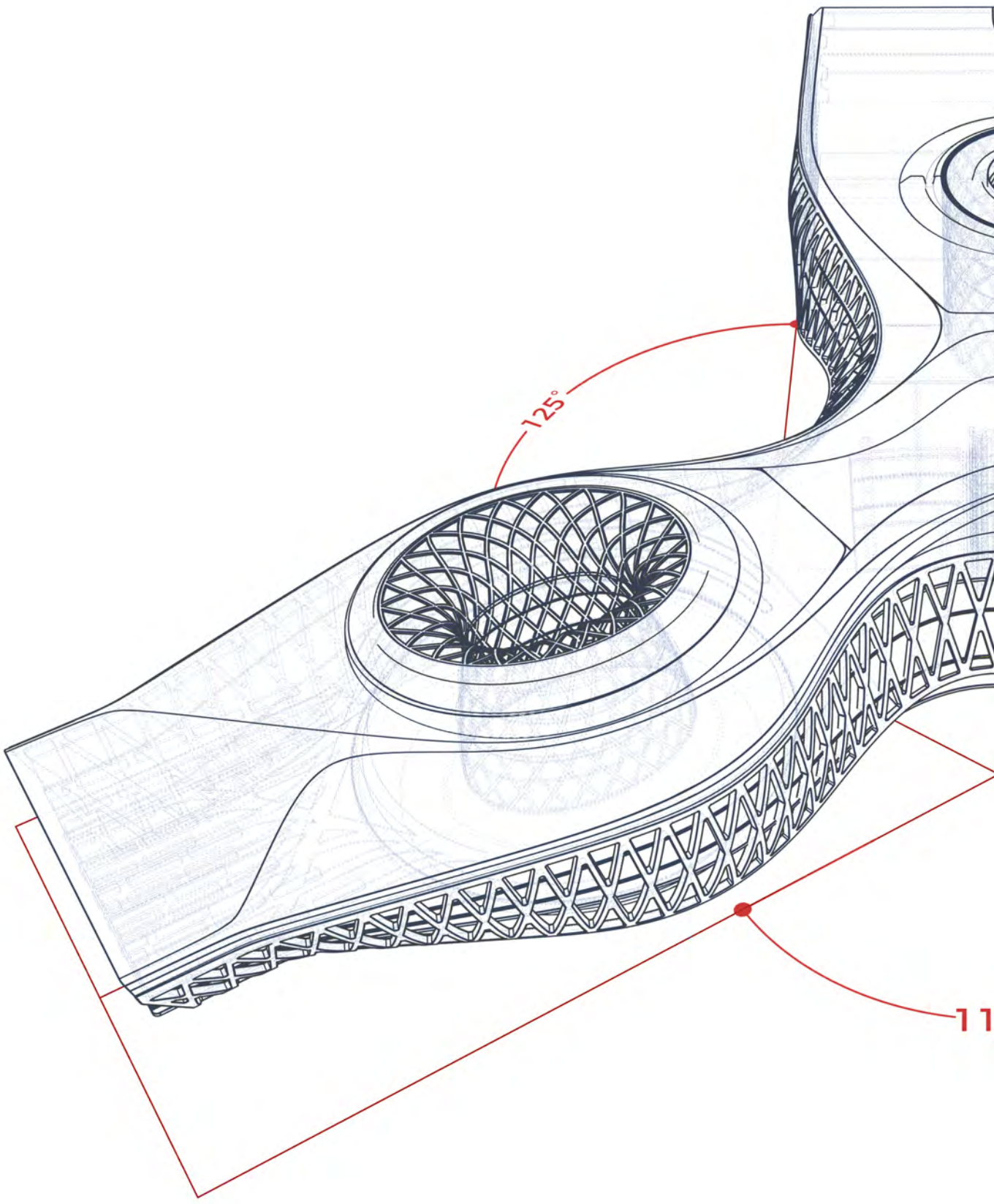
Developed in kangaroo/grasshopper based on Daniel Piker's mesh machine

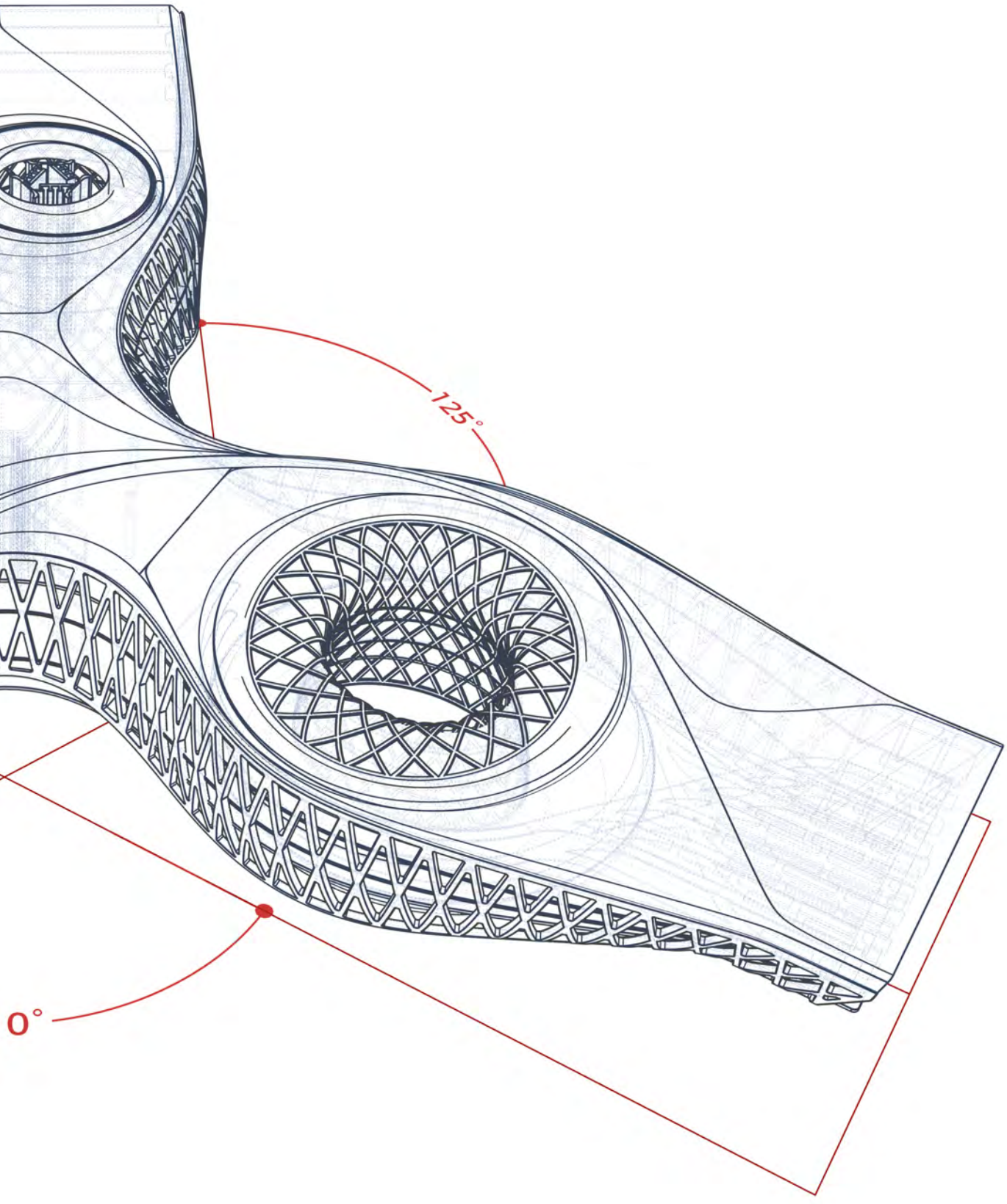









125°
11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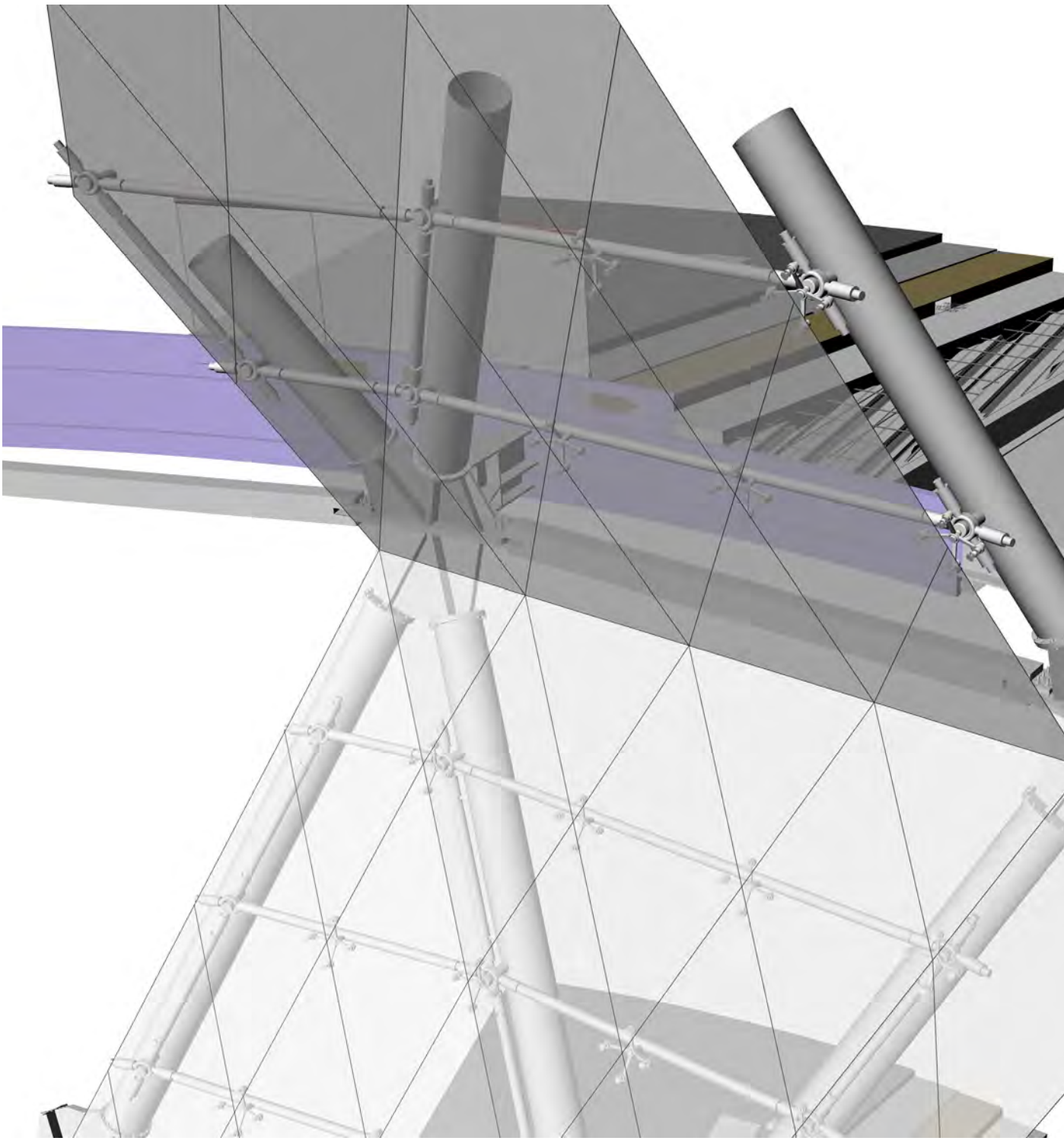
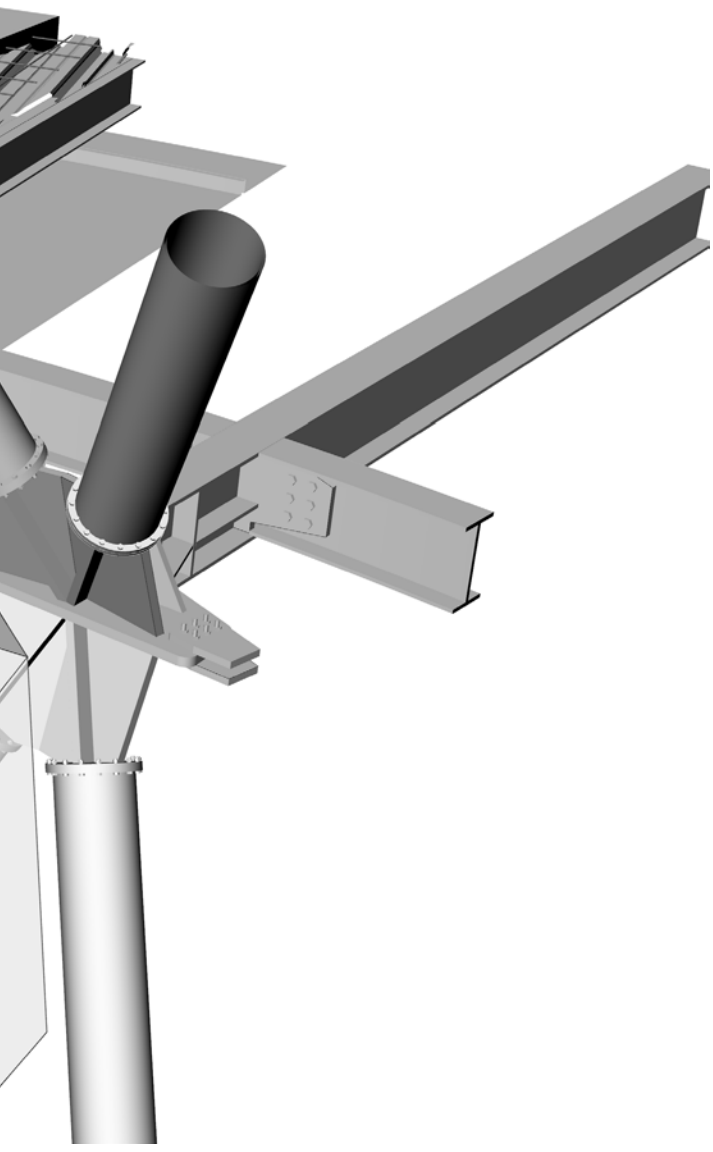
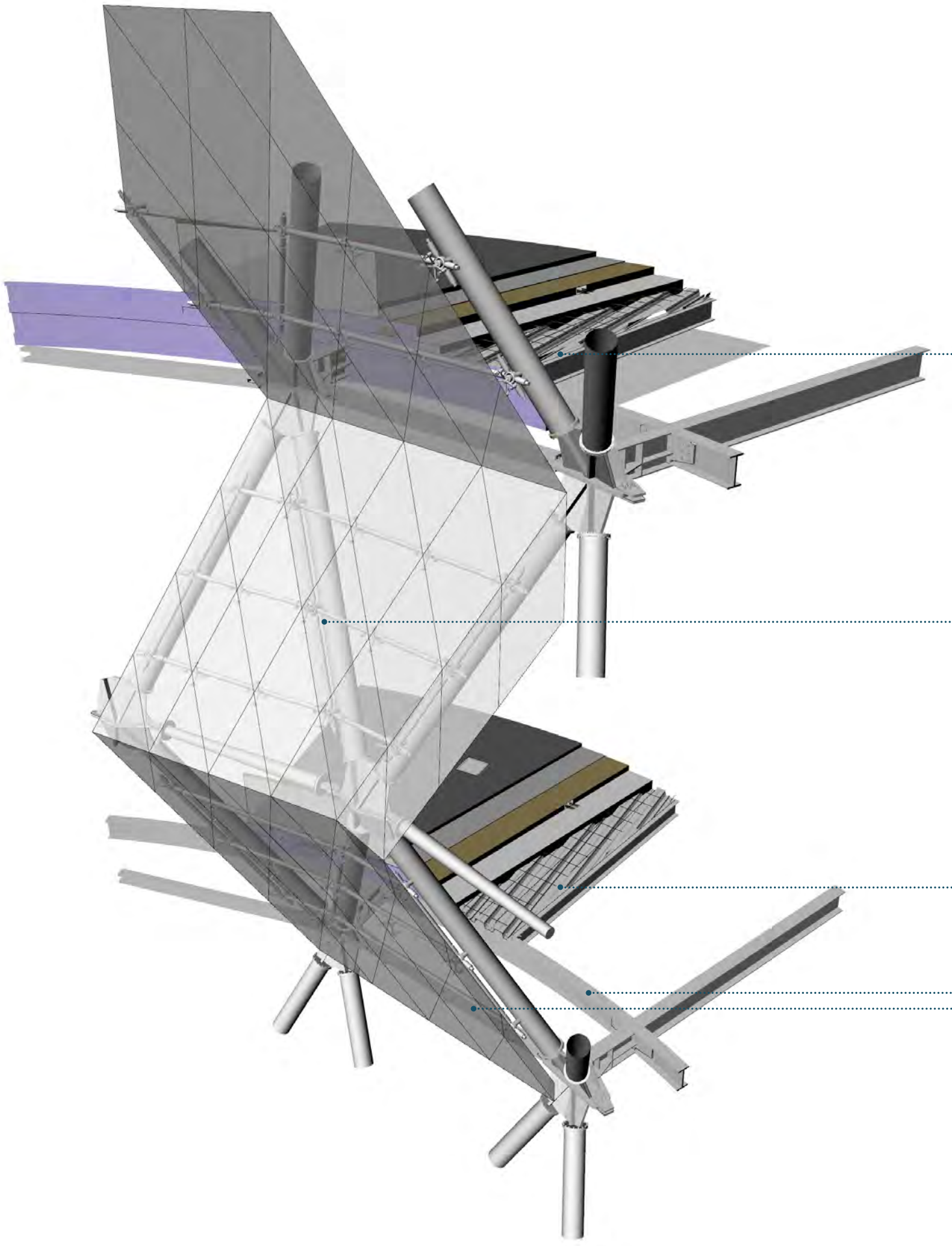
0°



Construction Details





Floor construction with suspended ceiling

12.0	Monolithic concrete slab
	Polyethylene foil
3.0	Sound proof/insulation
8.0	EPS- polystyrene
30.0	Reinforced concrete slab
	Metal deck
	Bridging Truss
20.0	Suspended ceiling

Diagrid shell structure

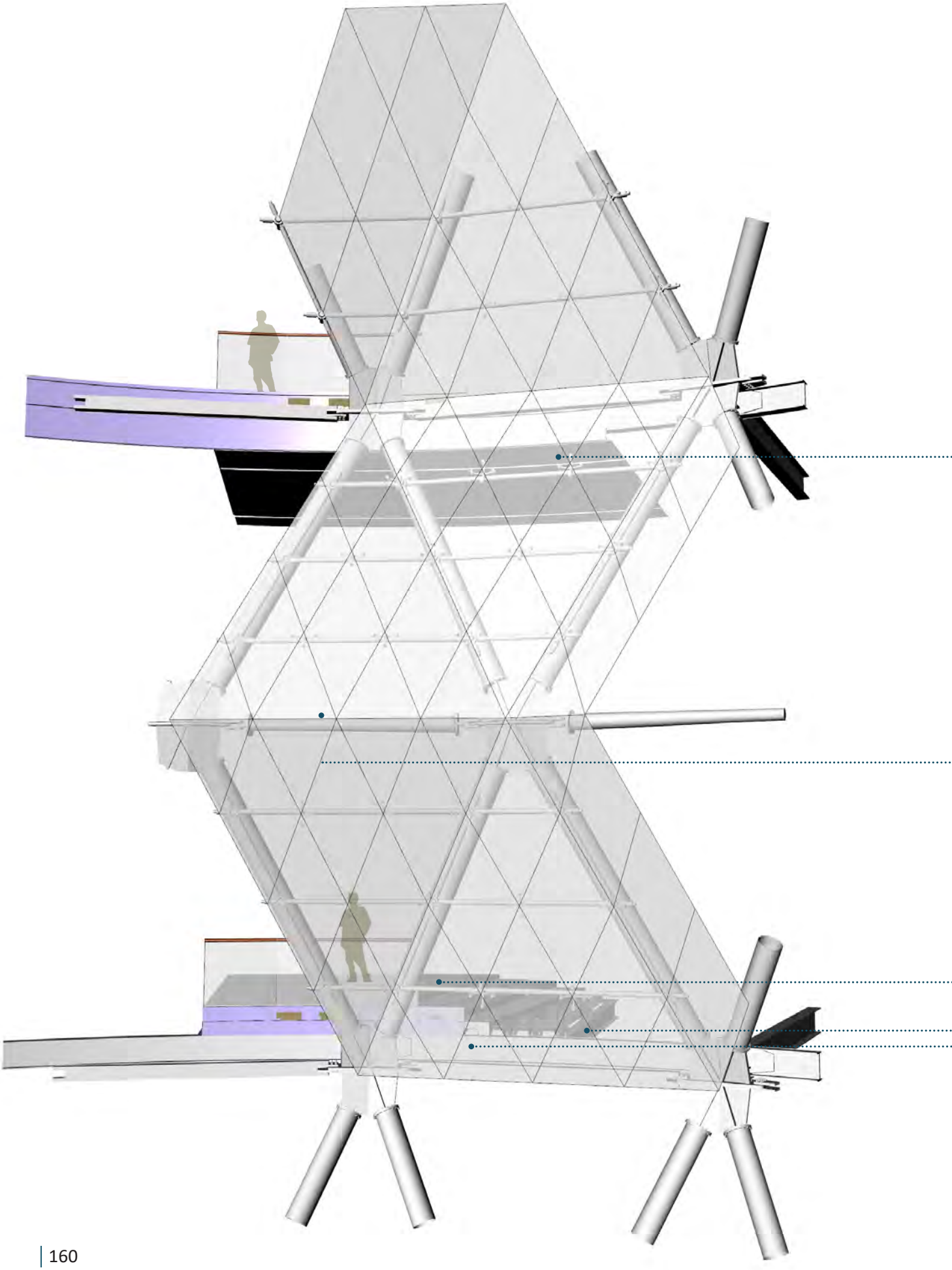
30.0Ø	Cylindrical hallow section
1.4*1.4	Extruded panelized aluminium cladding system
20mm	Double glazed clear glass

Floor construction

12.0	Monolithic concrete slab
	Polyethylene foil
3.0	Sound proof/insulation
8.0	EPS- polystyrene
30.0	Reinforced concrete slab
	Metal deck

Horizontal structural tie

Edge Beam



Floor construction with suspended ceiling

12.0	Monolithic concrete slab
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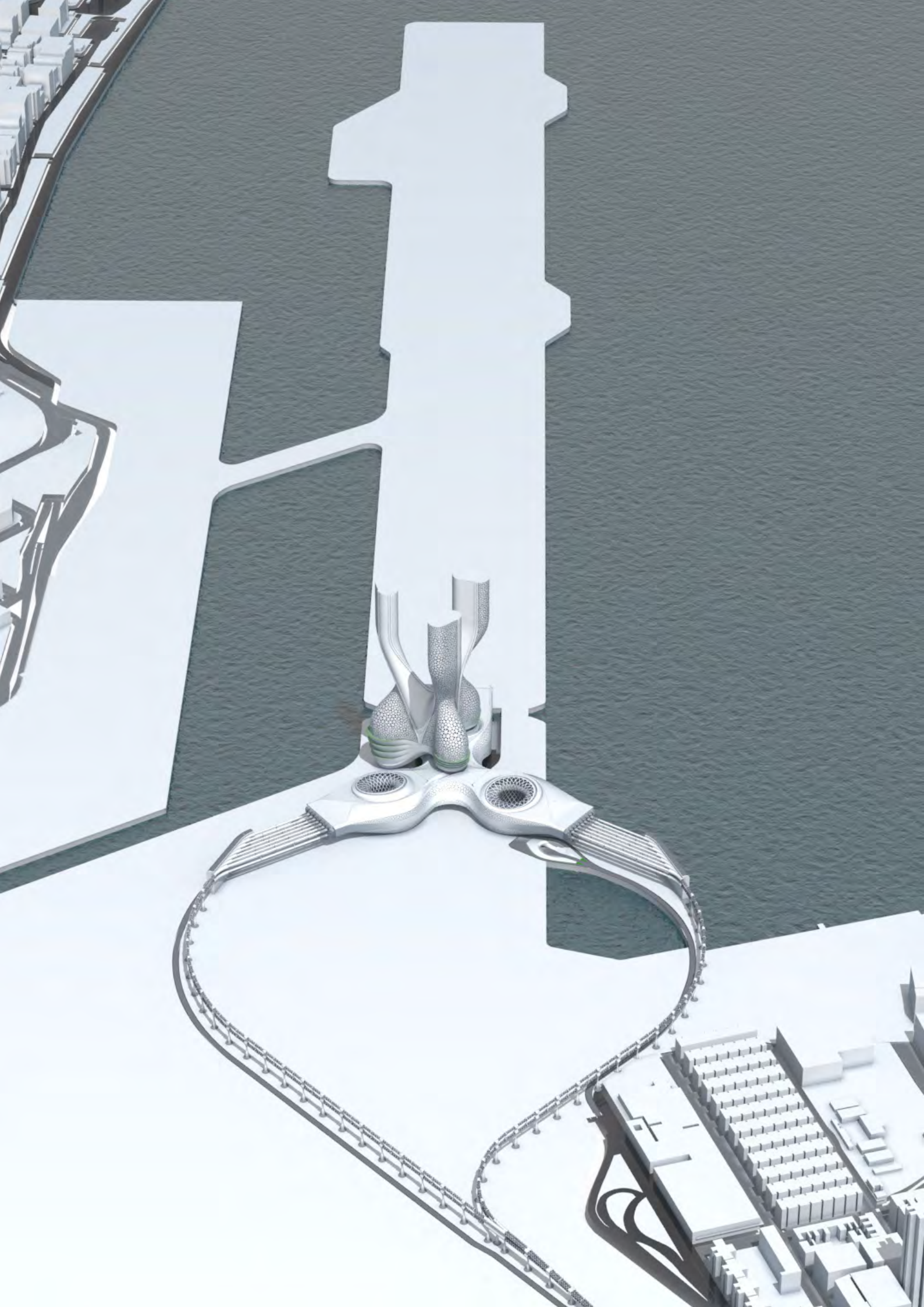
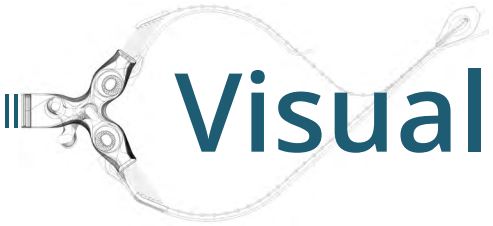
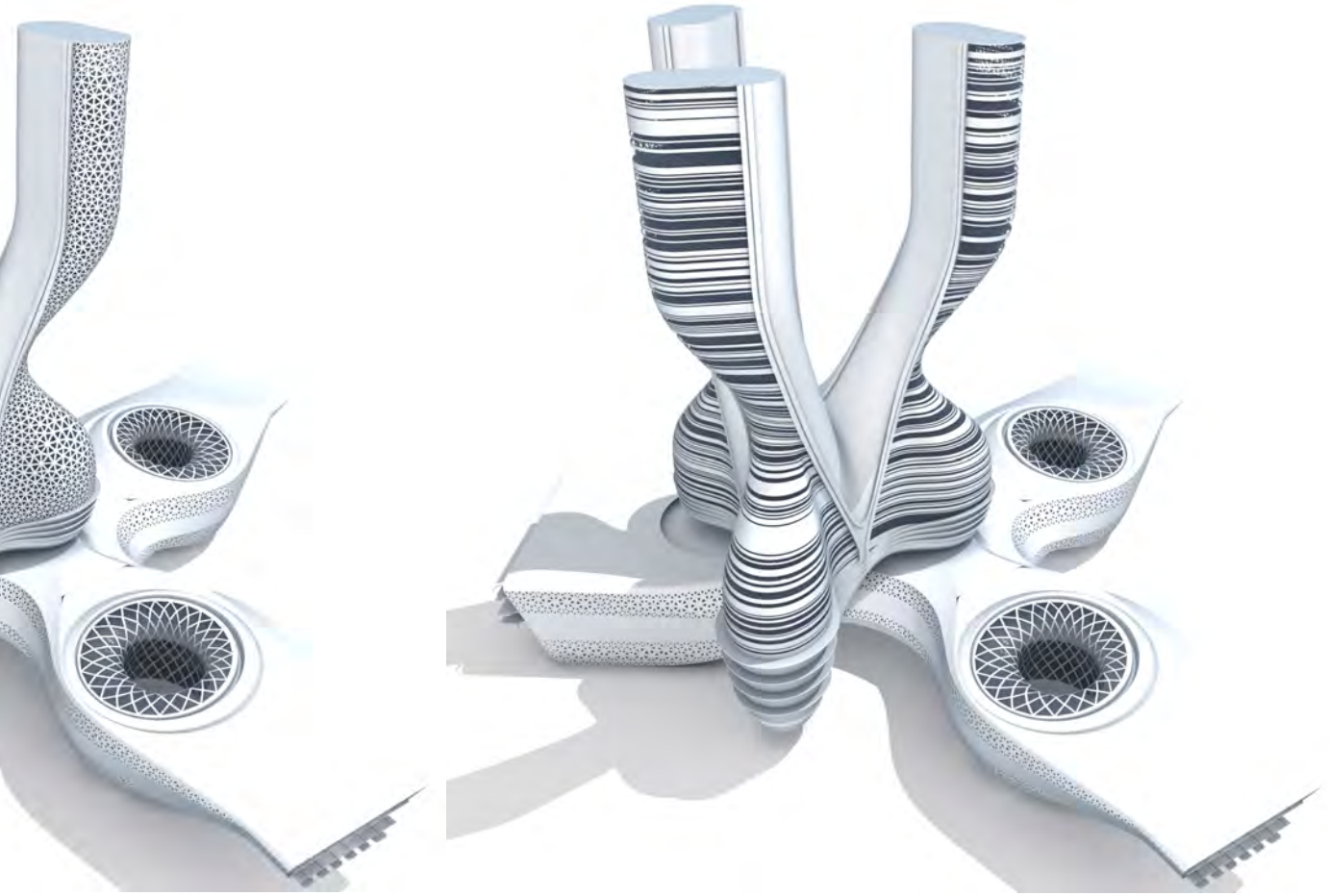
Horizontal structural tie

Edge Beam





Visualization



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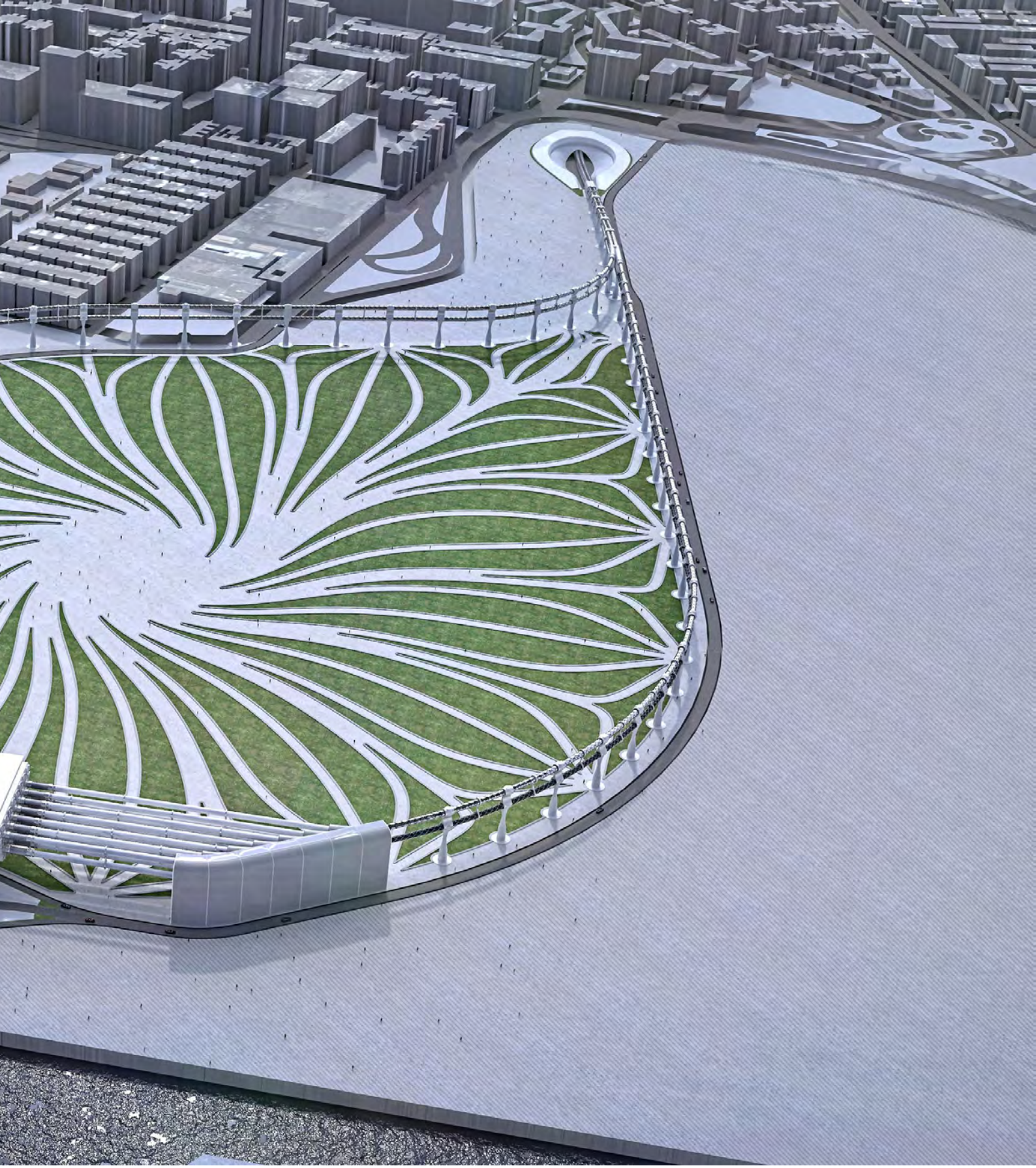

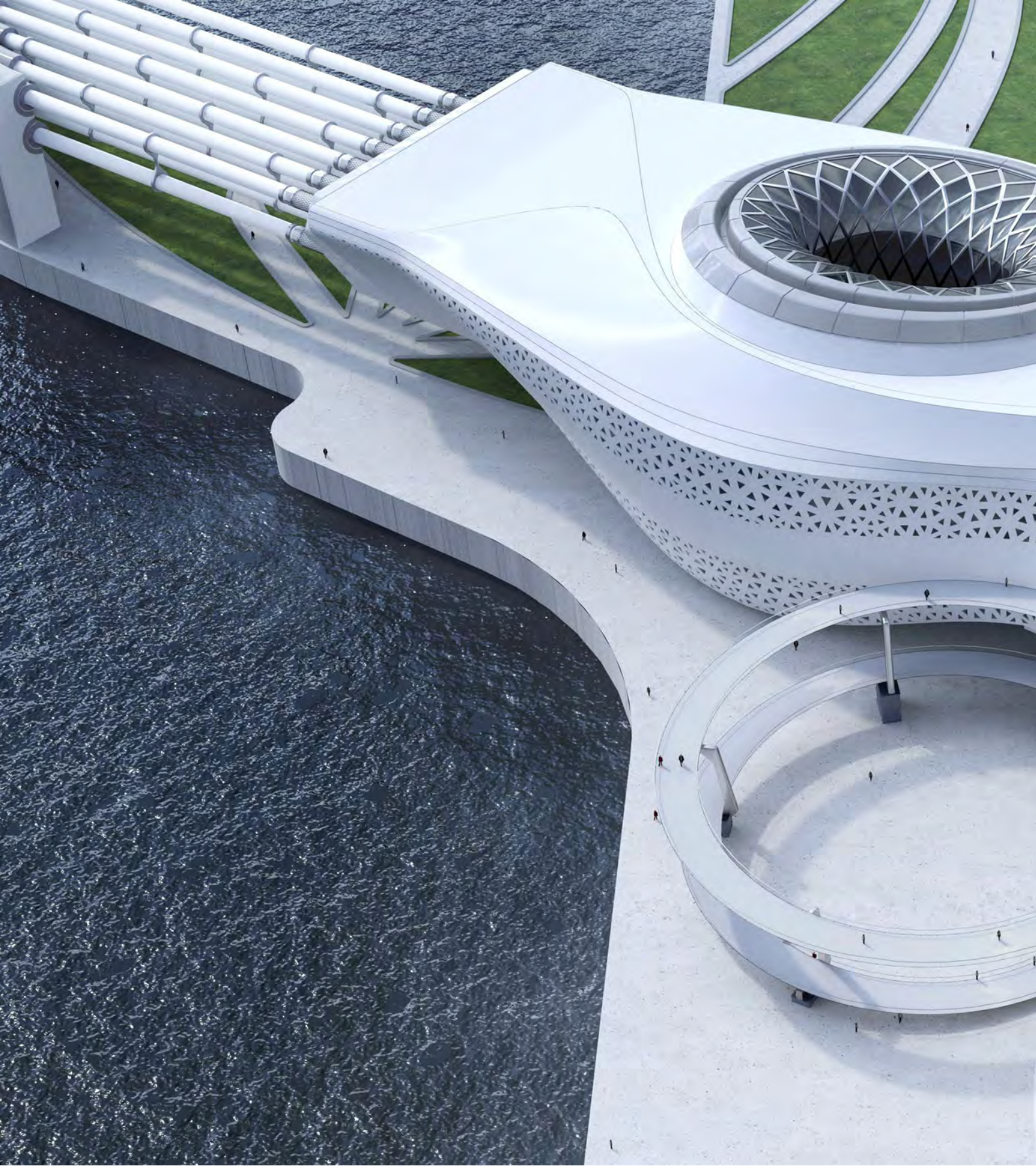

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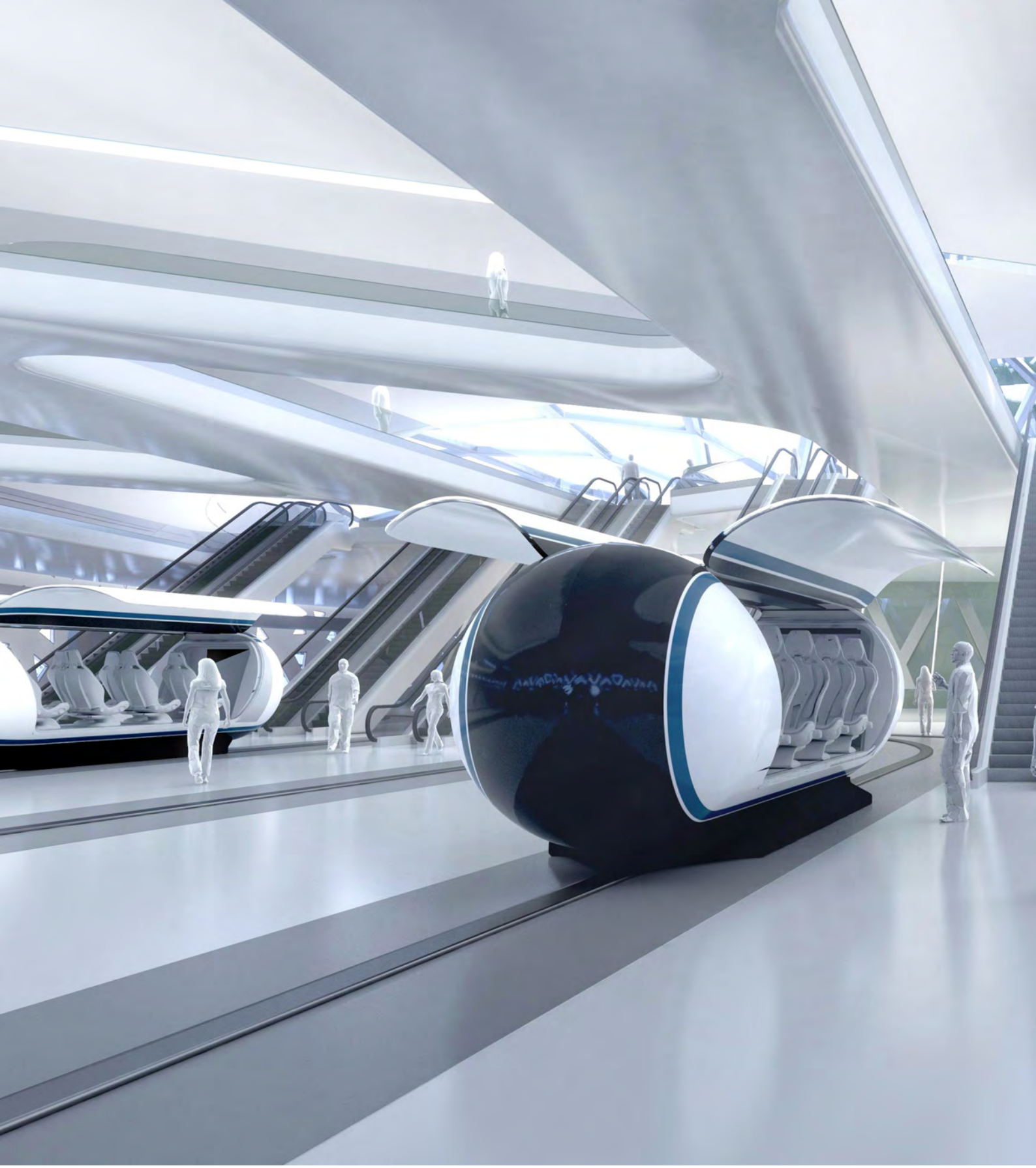

image #76

image #77

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Image #73-77
Rendered by Klemens Sitzmann
Image #
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Curriculum Vitae

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Email: mahsa.asaei@gmail.com
Date of birth: 18-09-1984
Discipline: Architecture

Education:
2012-2017:
Studying Master of Architecture in Technical university of Vienna starting from winter semester2012
2002-2008:
Bachelor of Architecture, Iran University of Science and technology, Tehran-Iran
1998-2002:
Undergraduate diploma in mathematics, Tehran-Iran

Professional experiences:
Naghsh e jahan Pars 2012
Projects:
Shams e tabrizi shrine competition, khoy-Iran, selected best 10 projects, position: project architect
Shandiz shopping mall competition, Mashhad-Iran, 1st prize, position: project architect

Fluid Motion Architects (Reza Daneshmir, Catherine Spridonoff) 2010-2011
Projects:
Essay for Architectural design -AD- (special issue for Iran 2012, Urban-past, present, future), Position: cooperating with Reza Daneshmir on writing the article named Qanats an infrastructure in forming cities
Mellat Bank of Iran, Tehran-Iran, Position: Project Architect
IMAX, Tehran, Iran, Position: project Architect

The Group's Studio 2007-2009
Projects:
Mohammadieh competition (Urban design), 2nd prize, Position: Project Architect
Bagh e noor competition-mixed use, 4th prize, Position: Project Architect
Razavi competition –mixed use, 2nd prize, Position: Project Architect
Shopping center for old square of Isfahan, Position: Project Architect

Iran Housing developers 2004-2007
Projects:
Residential complexes in Tehran, Position: Project Architect
Qazvin trade center, Position: Project Architect
Residential complexes in Kish, Position: Project Architect

Academic Activities:
Secretary of Architecture Student's Scientific Association, Architecture Faculty, IUST

Skills:
Languages:
English (very good)
German (good)
Persian (native Language)
Turkish (good)

Computer Science and Software:
Rhinoceros-very good
Grasshopper-good
Cinema 4D-good
3D Studio Max-very good
Vray rendering-good
Maya-intermediate
AutoCAD-very good
Adobe Photoshop-very good
Adobe InDesign-intermediate
CorelDraw-good
Pepakura Designer
MS office