

A HYPERLOOP STATION

exploring the potential of urban infrastructure

by Alexander Chase Couture

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Polytechnic Institute and State University in partial
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MASTER OF ARCHITECTURE
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ABSTRACT

A Hyperloop Station

The future is bright. Technology is progressing at accelerating rates. Cities are experiencing a resurgence in population growth, which in turn is pushing transport systems to simultaneously expand and improve. The resulting effects have led to intercity travel becoming faster, cheaper, safer and increasingly more convenient. With the introduction of the Hyperloop as a novel means to travel, a newfound interest has been sparked regarding the promising future of transportation and mass transit.

This thesis is a pursuit of an understanding for the relationship between urban infrastructure and architectural form. The means of movement within any city is a critical element for defining many of its social, economical, and physical characteristics. Mass transit is vital to not only the functioning of a city, but also its identity.

The proposed Hyperloop Station celebrates this monumental novelty for intercity travel. Through its architecture the station enables an experience that fosters a better comprehension and appreciation for the organization and structure of the surrounding urban fabric. Whether newly arriving or soon to be departing, the aim is to establish a unique dialog between the traveler, the city, and its transit infrastructure.

ACKNOWLEDGEMENTS

I give thanks to

My family for your continuing love and support throughout this amazing journey. Mom and Dad, you have always encouraged me to follow my dreams and never back down from a challenge. I have made it here because of you all and I am forever thankful for that.

My committee members: Hunter, Steve, and Patrick for your guidance and for sharing with me your immense knowledge in everything architecture. What I have learned during my studies over these last three years is invaluable.

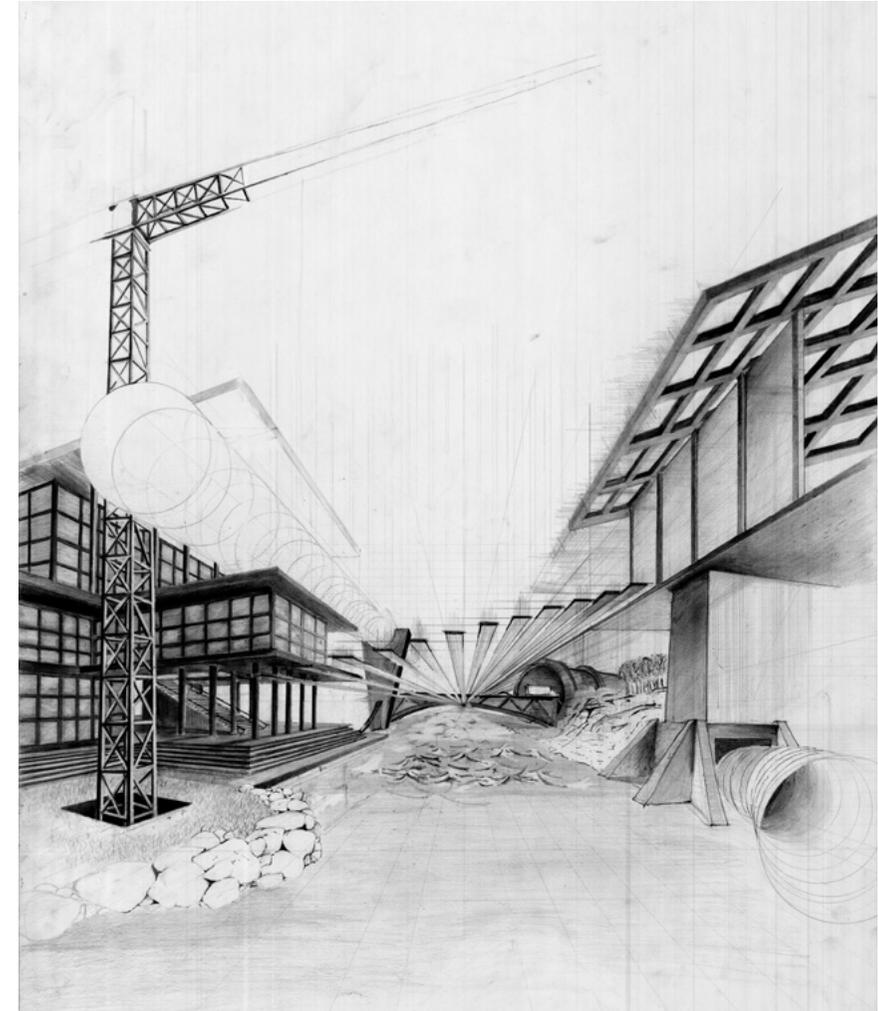
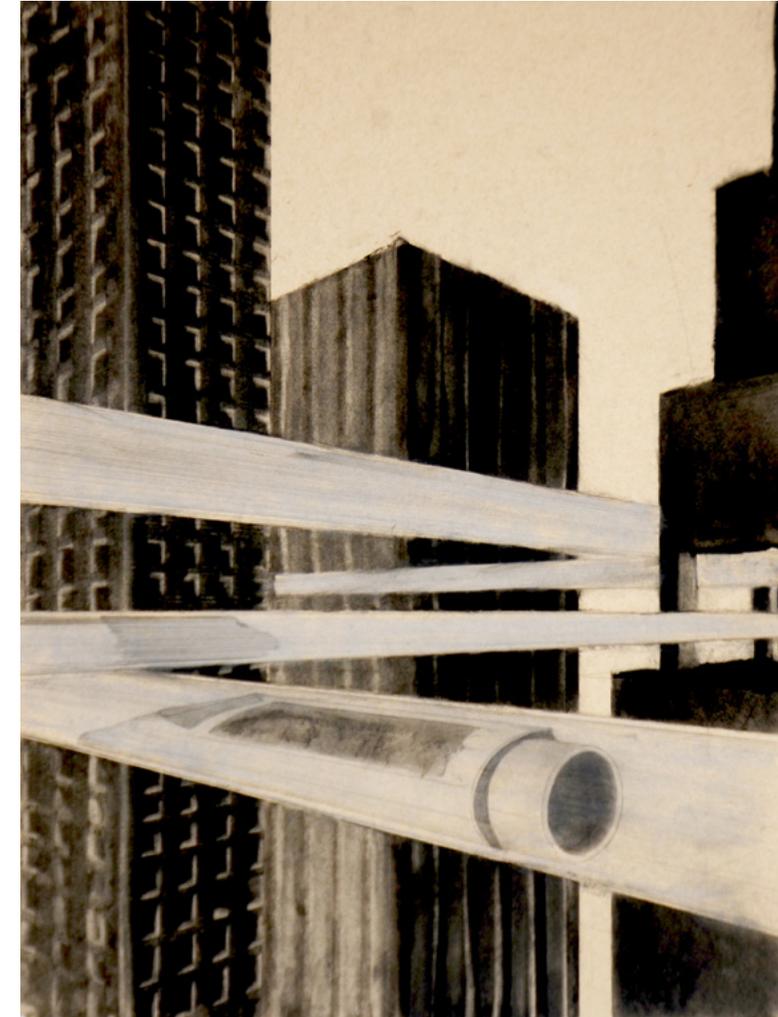


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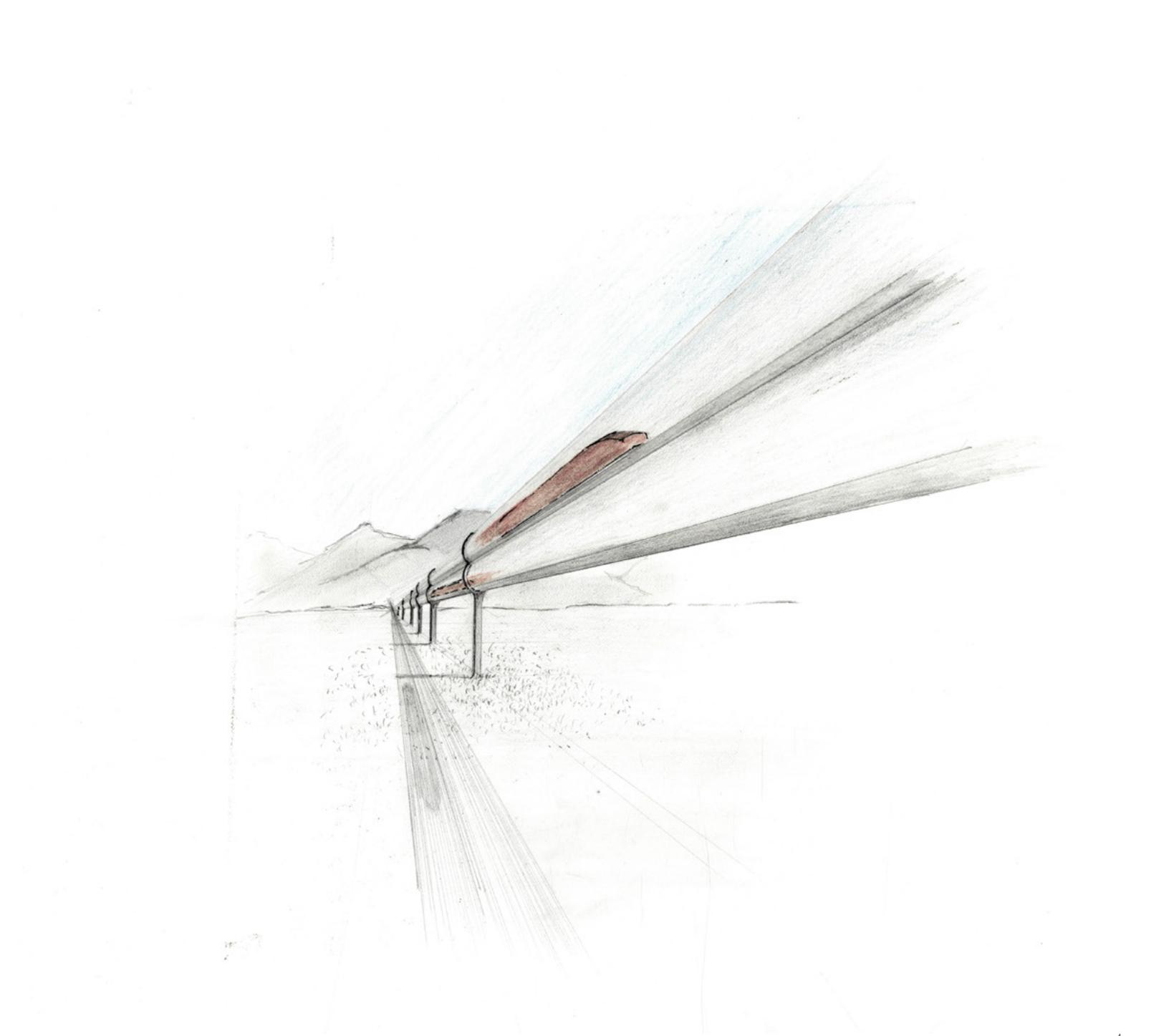


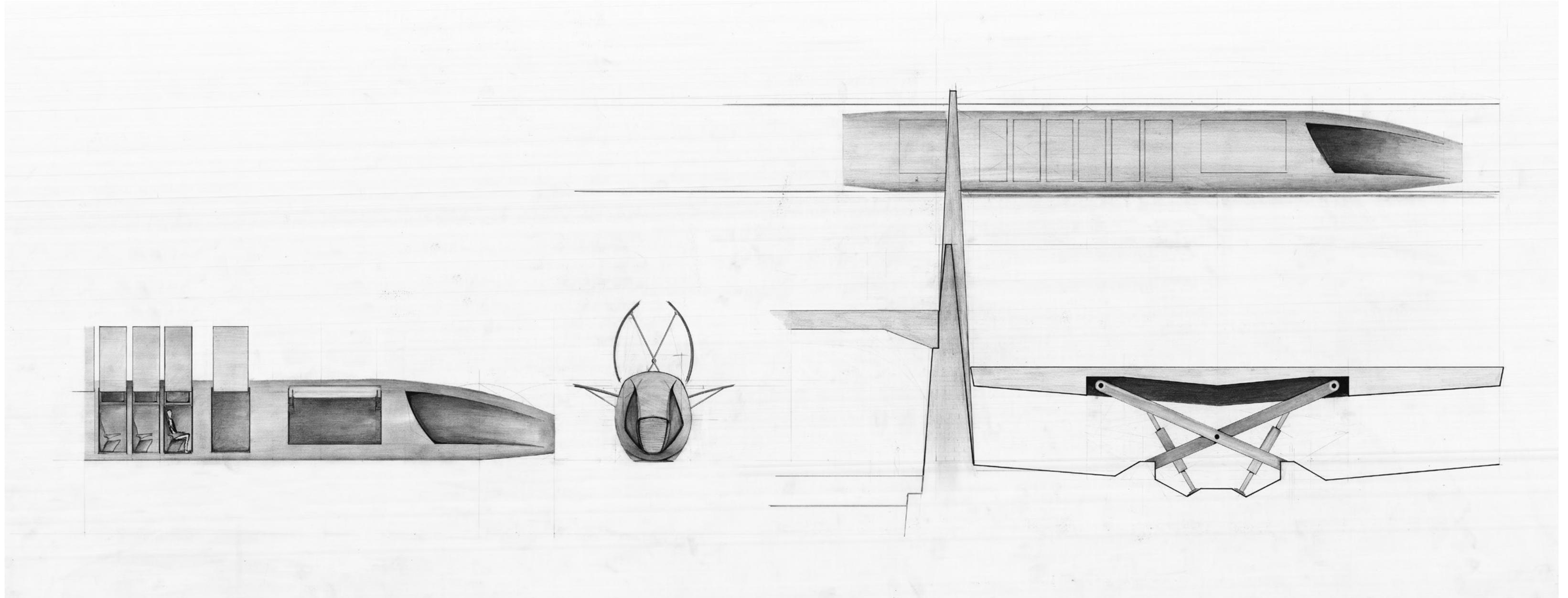
THE HYPERLOOP

The Hyperloop is a new innovative way to move people or things quickly, safely, efficiently, and with minimal impact to the environment. Inventor, Elon Musk, CEO of the aerospace firm SpaceX, first proposed the subsonic transportation concept in August of 2013 as a direct response to the highly anticipated and over budgeted high-speed rail planned to connect Los Angeles, CA with San Francisco, CA.

The Hyperloop uses electric propulsion to accelerate a passenger or cargo vehicle through a tube in a low-pressure environment. The autonomous vehicles or “pods” levitate slightly above the track to reach speeds upwards of 700 mph, and reduce a once 6 hour trip to a mere 30 minutes. The controlled environment also eliminates any direct emissions, noise, delay, weather concern and pilot error.

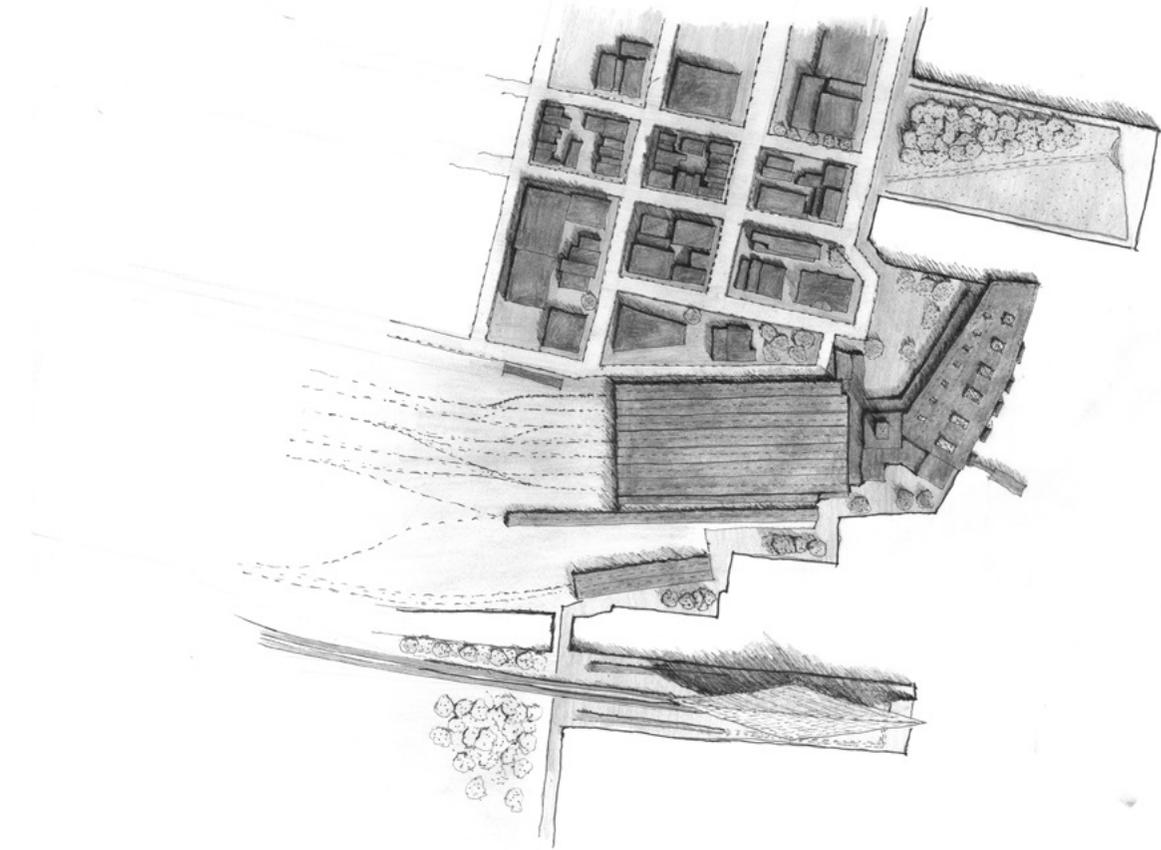
Passenger pods are anticipated to depart from stations every 5 minutes. They are expected to accommodate up to 20 people per trip. For the purpose of this thesis, pod dimensions of 60 ft. x 6 ft. x 7 ft. and tube dimensions of 12 ft. diameter will be assumed.

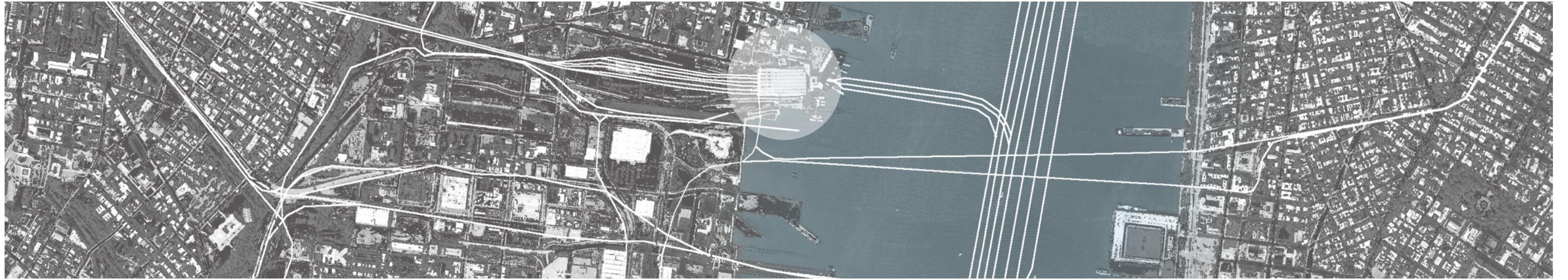




ESTABLISHING THE SITE

The site chosen for this thesis is an 800 ft. long pier located in Hoboken, NJ, extending into the Hudson River directly opposite mid-town Manhattan, New York City. One of the most dominant features of the site is the unobstructed view of New York City's infamous skyline. The location and proximity to the city strategically takes advantage of numerous modes of transit infrastructure leading to and from both mid-town and lower Manhattan, as well as the surrounding New Jersey area. Directly to the north and adjacent to the site are the Lakawanna Ferry Terminal, Hoboken railway station, regional New Jersey light rail station, and NJ-NYC Path Train (subway). Each of these stations are only short walk away, making access to the city both convenient and fast.





Jersey City, NJ

Hoboken, NJ

New York City, NY



Hyperloop



Ferry Boat



Train



Light Rail



Path Train

THE STATION

The main rhythm and organization of the station first begins with the roof. Spanning 540 ft. in length, its strong horizontal gesture comes as a direct result of the linear path necessary for the Hyperloop tube, as well as a personal search for a monumental form that encapsulates the nature of speed.

Upon approaching the station, travelers begin their gentle accent out on to the pier. The station is lifted up onto a narrow plinth, its southernmost end wrapped by a grand exterior stair. The intent of raising the station serves to celebrate both the novelty of the Hyperloop as well as the monumental form of the roof. In addition, its elevated height provides an improved vantage point for viewing New York City across the river.

The station is divided into two levels: the first floor or main terminal, and the platform. The terminal contains most of the stations programmatic needs. Its two circulation axes work to separate departures and arrivals and is essential to the overall order and movement of the Hyperloop. The main terminal contains a central hall, ticket booths, bathrooms, and shops.

The above platform mirrors the main level of the station with two waiting areas dedicated to arrivals and departures. The division aims to simplify movement within the station and reduce any congestion caused by incoming and outgoing travelers.



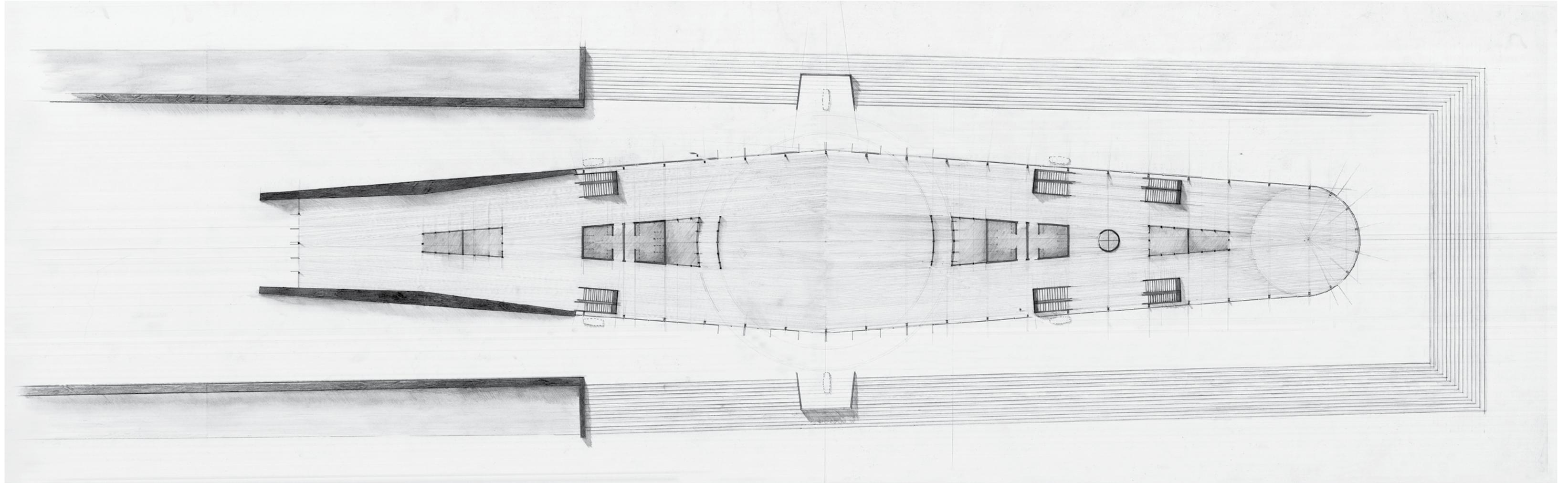


Image: *Plan (Main Level)*

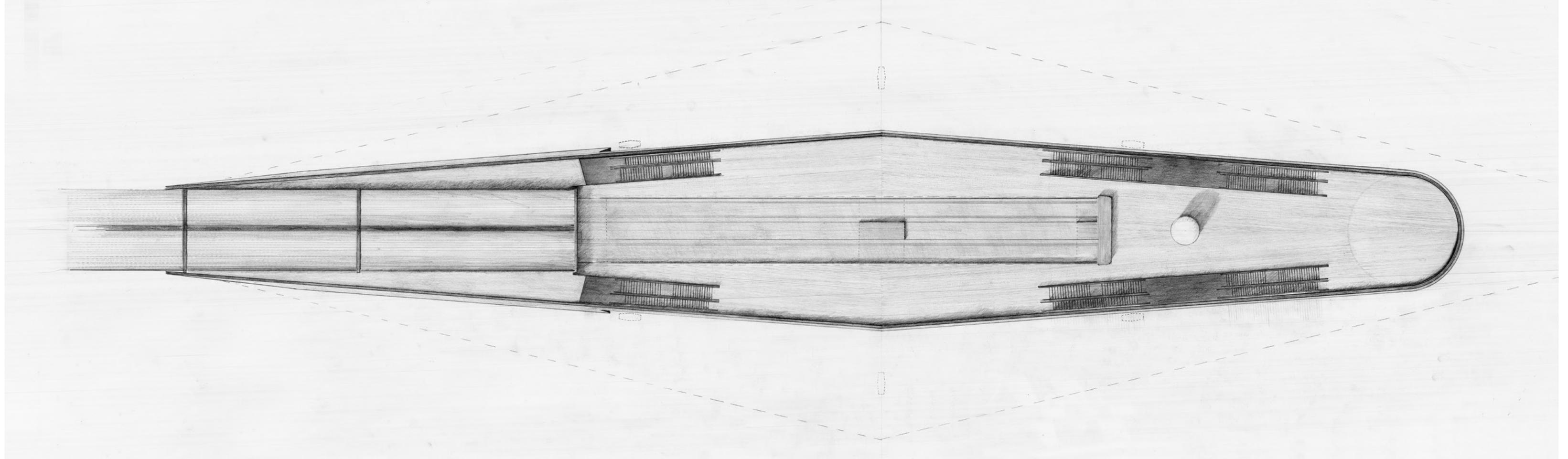


Image: *Plan (Platform Level)*



Image: *South Elevation*

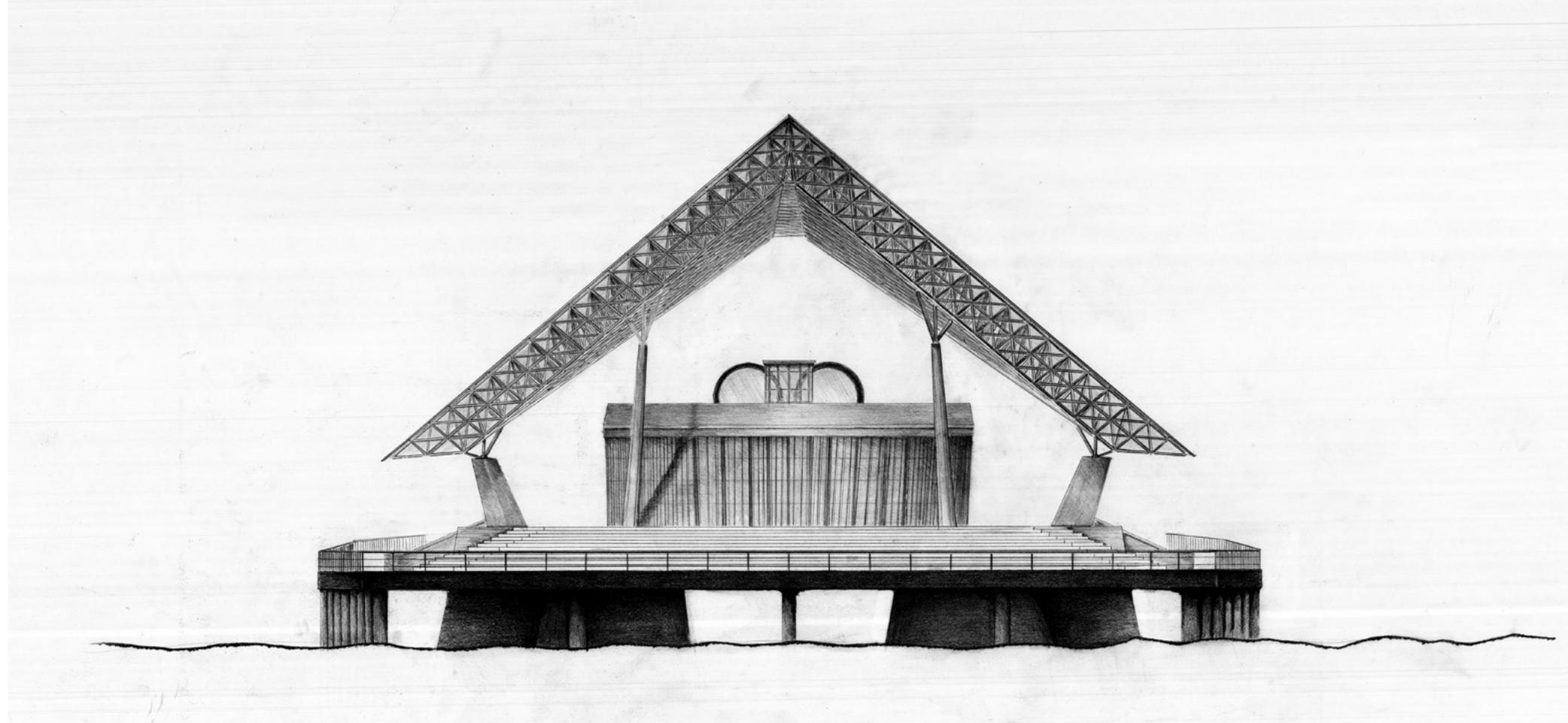


Image: *West Elevation*

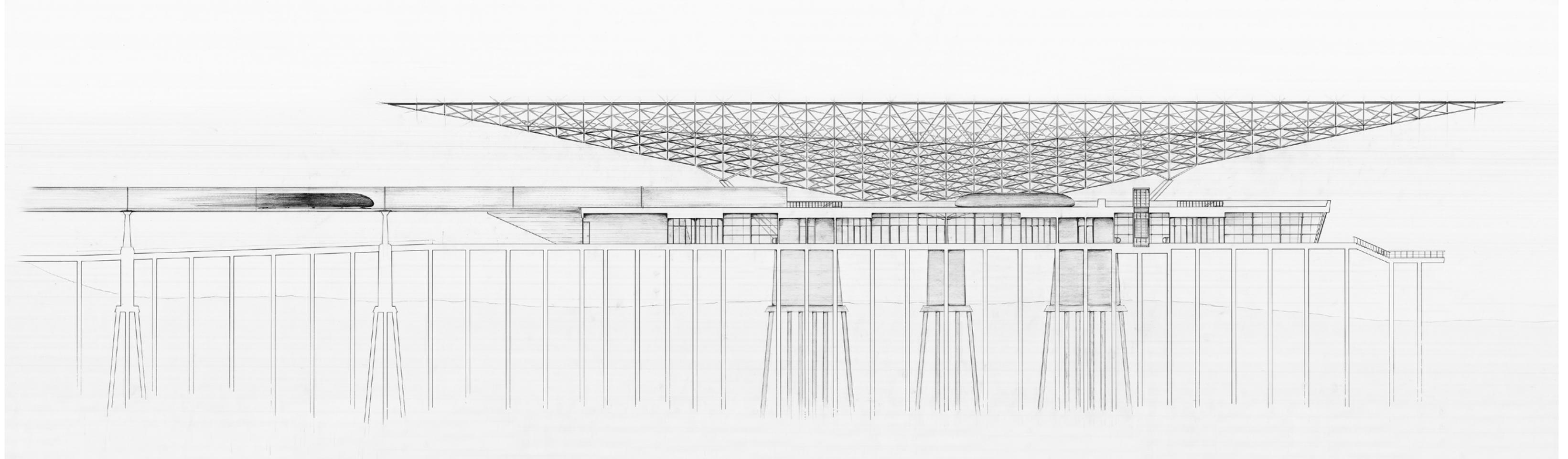


Image: *Longitudinal Section*

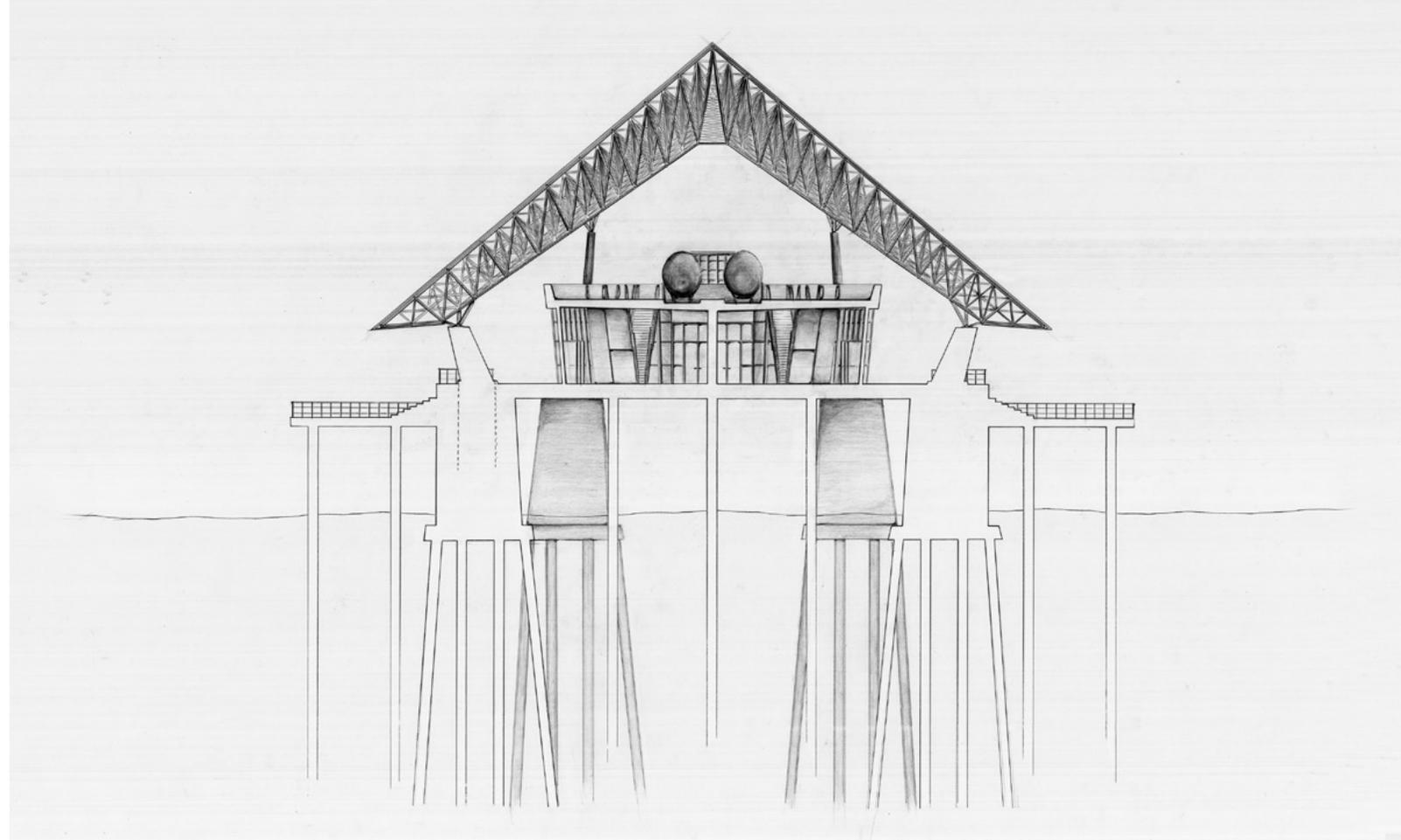


Image: *Transverse Section*

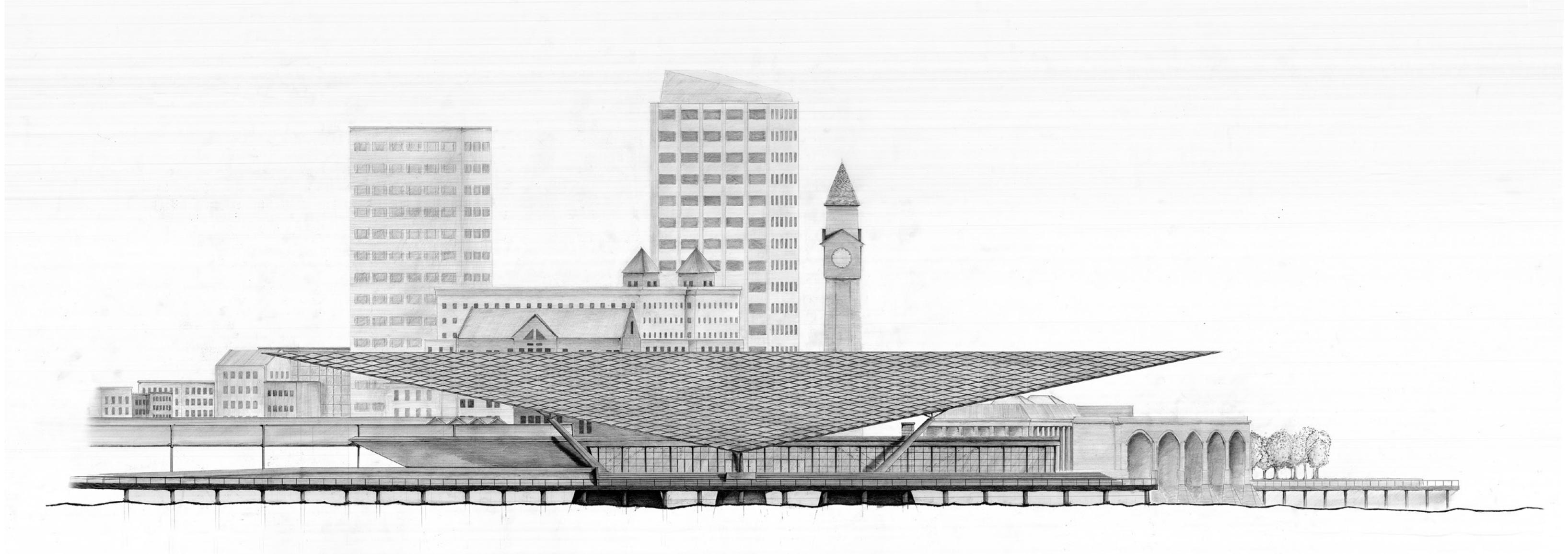
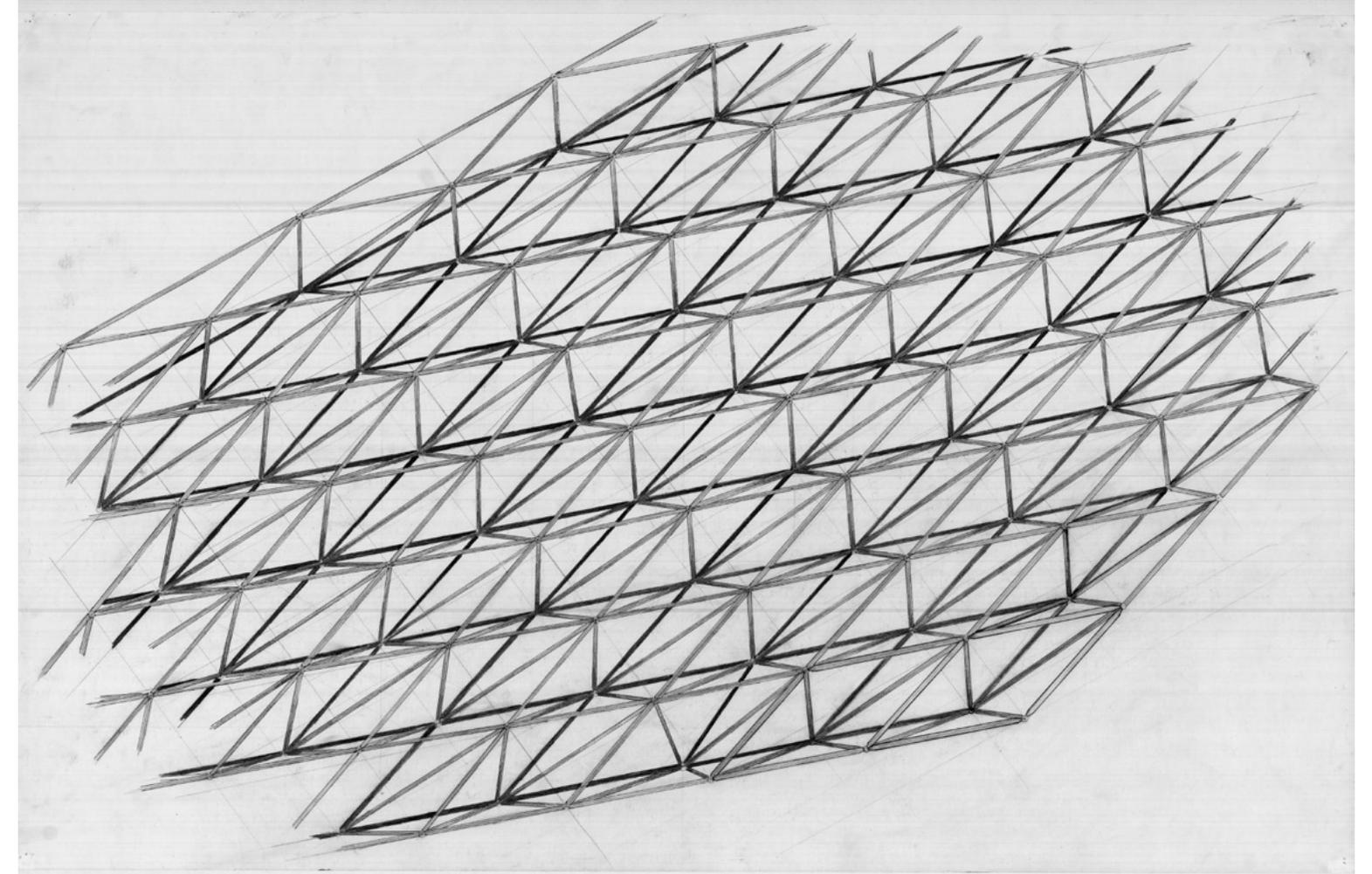


Image: South Elevation with City of Hoboken

THE ROOF

The development of the roof first began and has remained one of the most dominant features of the station. Symmetrical in form, it spans 540 ft. in length while cantilevering 154 ft. at its ends. Its composition is a space frame, made up of steel ball joints and tubular steel members ranging from 4" - 8" in diameter depending on structural loads. Two triangulated grids offset from one another make up its geometric pattern. As a response to the immense structural loads produced by the cantilevered ends, the depth of the roof along its spine steadily increases at a scale of 1:10 to reach a maximum depth of 20 ft. at its center.

The choice of a space frame for the roof's structure holds significance for the individual experience created within the station. Moving across the platform, the structure reveals itself when viewed in close proximity. There is a perception of lightness and openness. When viewed from a distance its members begin to blend into a singular planar surface, reinforcing an idea of mass.



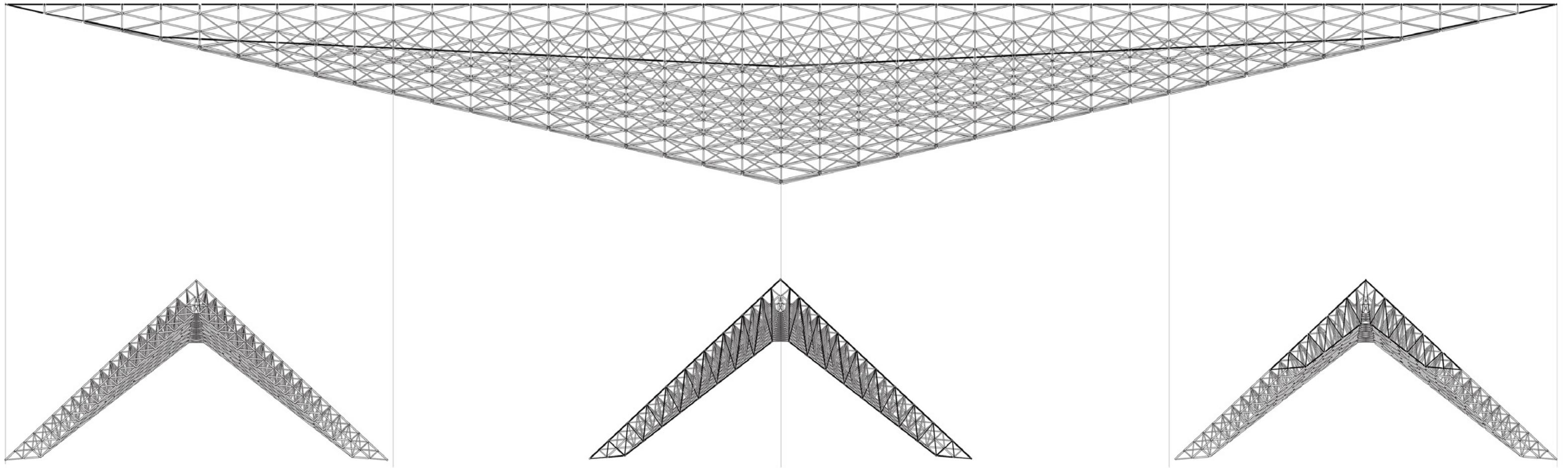


Image: *Longitudinal Section of Roof Structure*
Transverse Section Drawings at 1/3 intervals

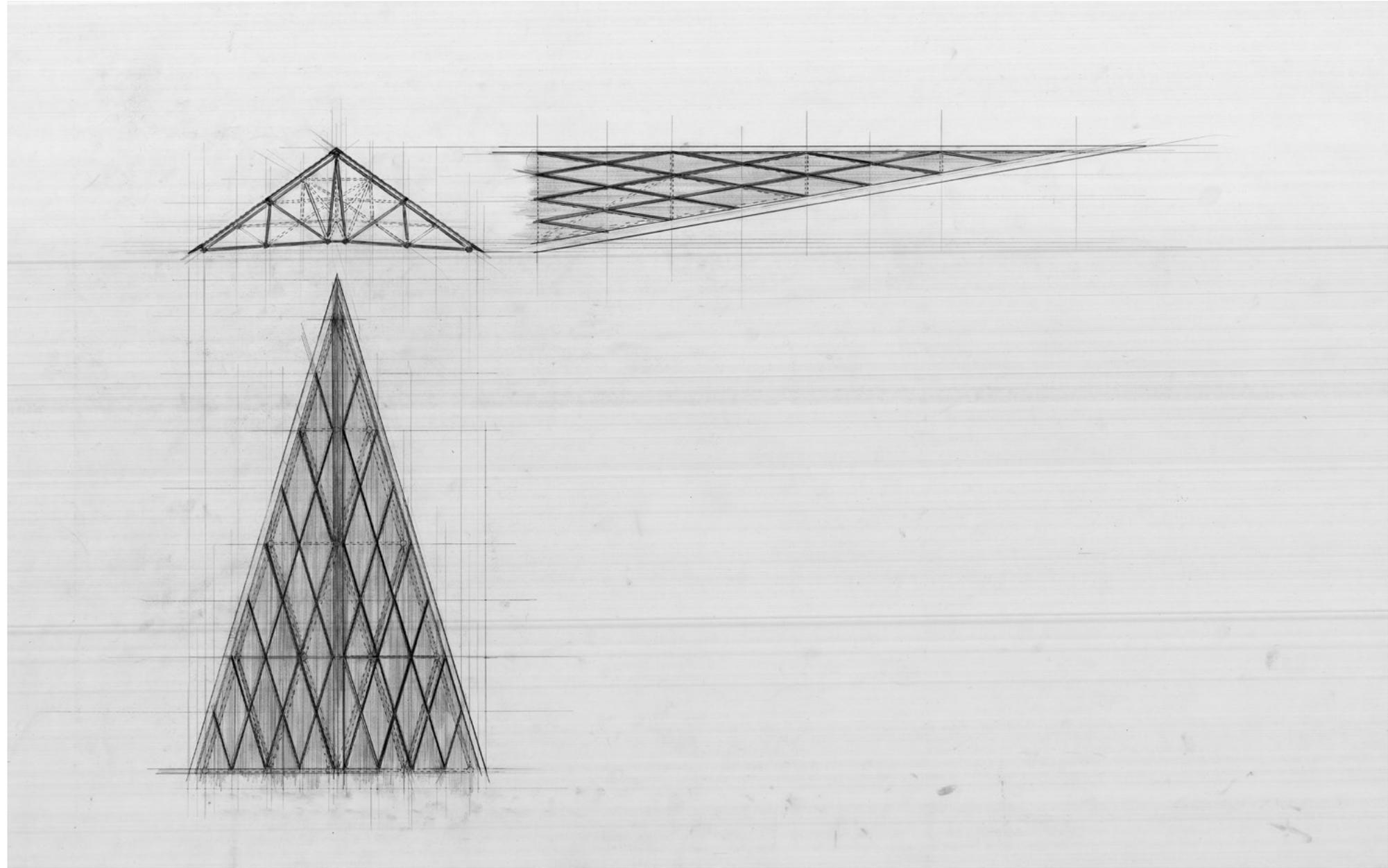


Image: *Plan, Section, and Elevation of Tip of Roof*

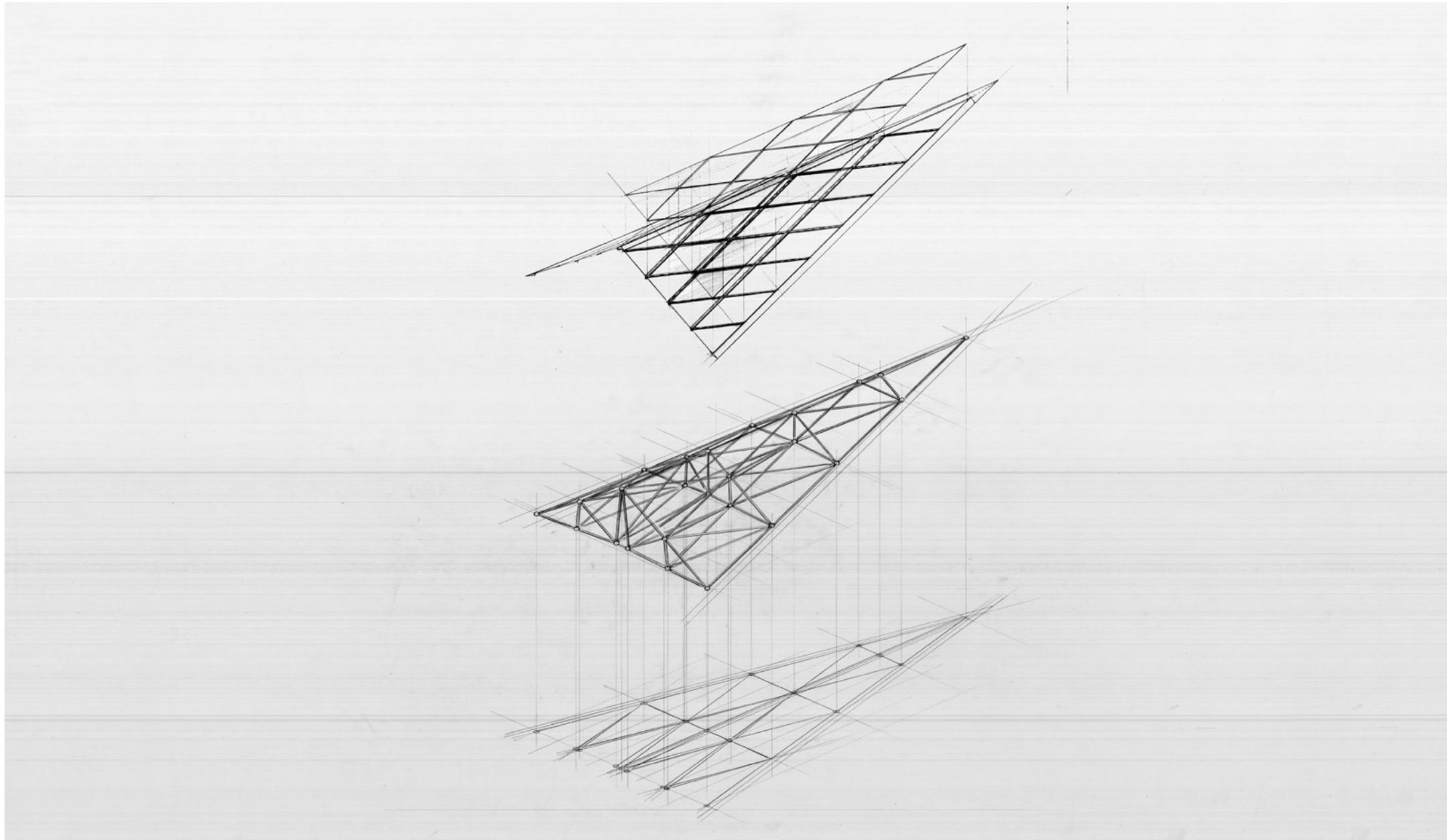


Image: *Exploded Isometric of Tip of Roof*

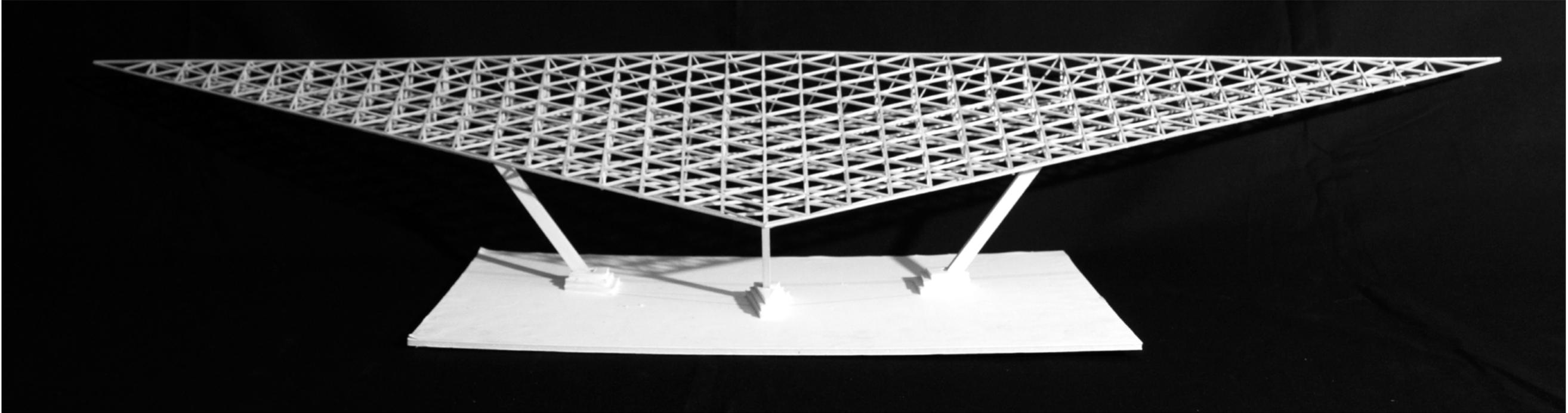


Image: Model Photograph 1: Section Model of Roof Space Frame
(Material: Basswood)

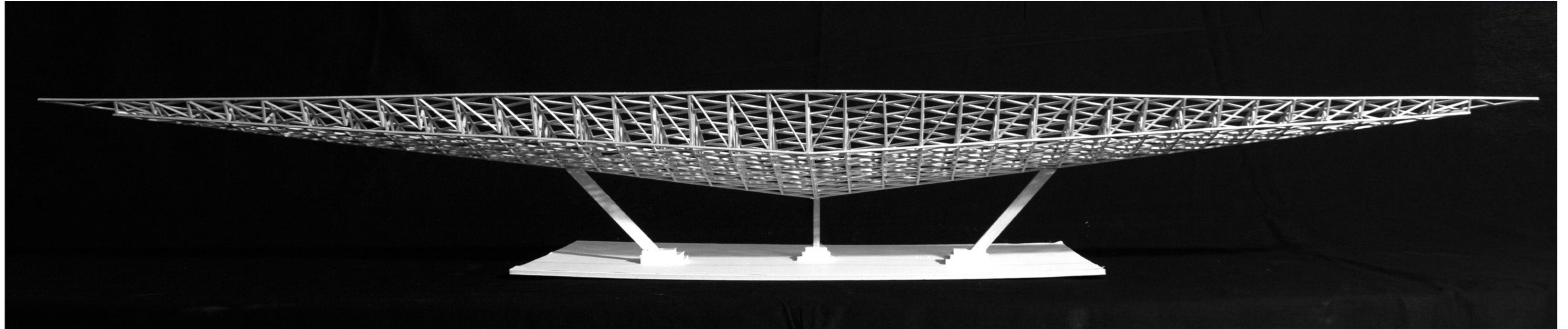


Image: Model Photograph 2: Section Model of Roof Space Frame
(Material: Basswood)

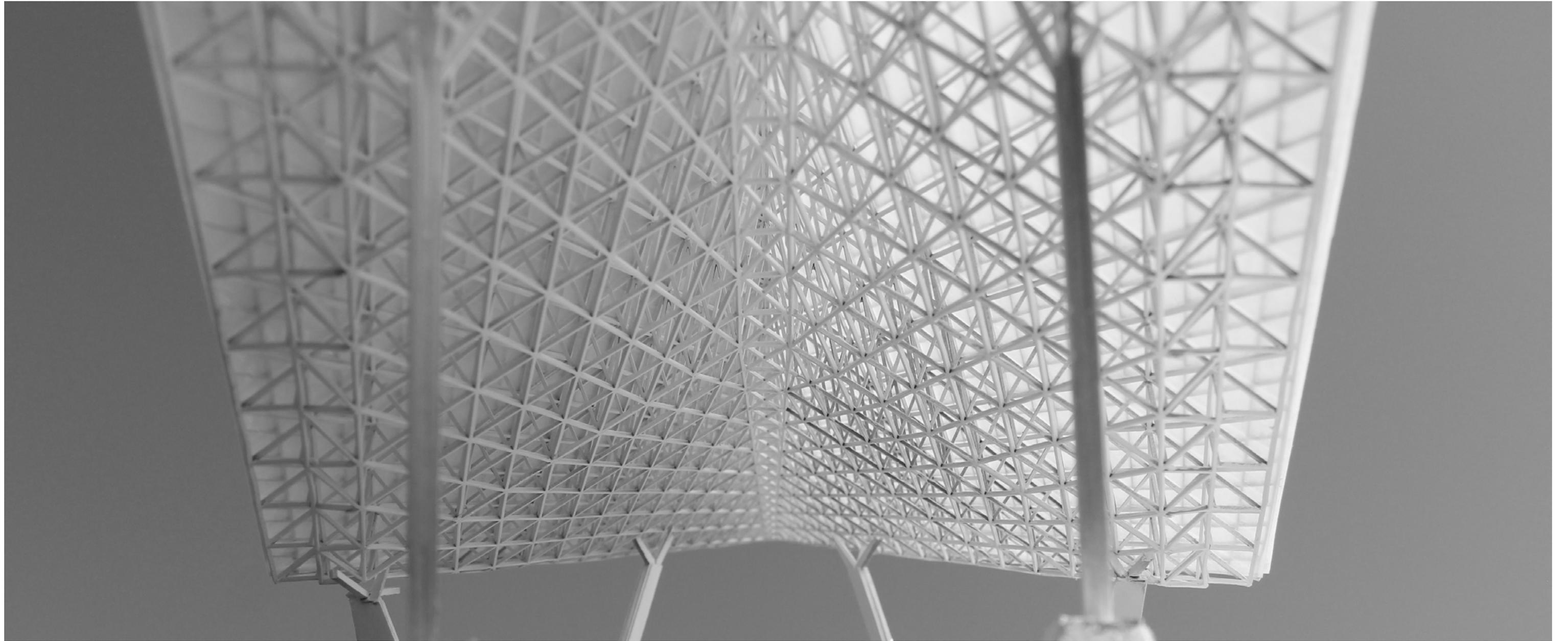
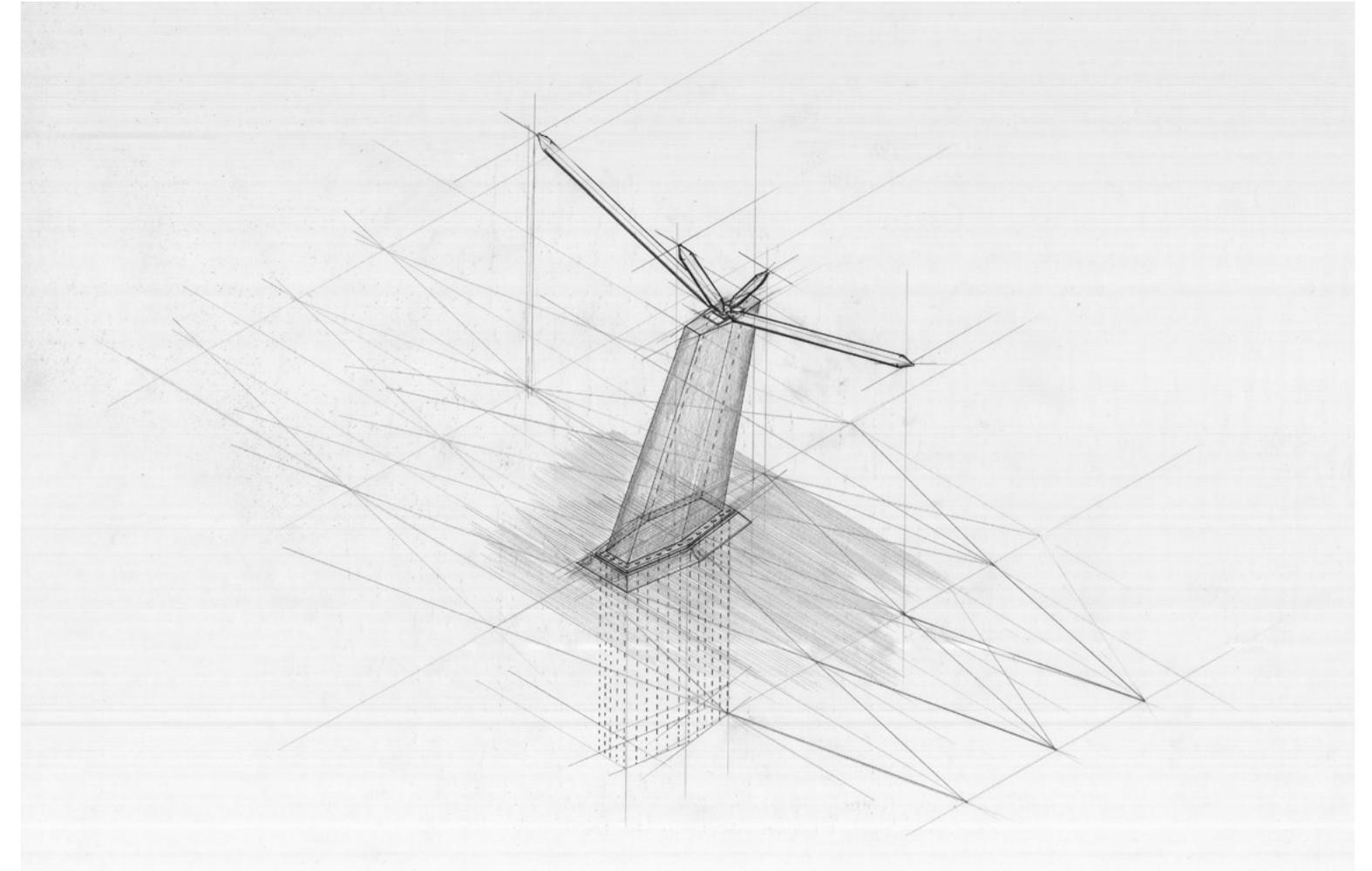


Image: Model Photograph 3: *Model of Roof Space Frame*
(Material: Chipboard)

THE COLUMNS

A total of six columns support the roof structure: two sets of longer columns extending outwards at each end, and two smaller columns providing support at the center of the roof's perimeter. The columns are topped by steel plates with ball joint designed to receive the steel members of the roof structure.

Seen from a distance, the supporting structure is intended to reinforce an overall balanced appearance of the station. While moving through the station however, the column's inclined form and close position to the exterior walls of the station prohibit travelers from ever experiencing more than two columns at any one time. Their inclined forms work to provide the perception of motion.



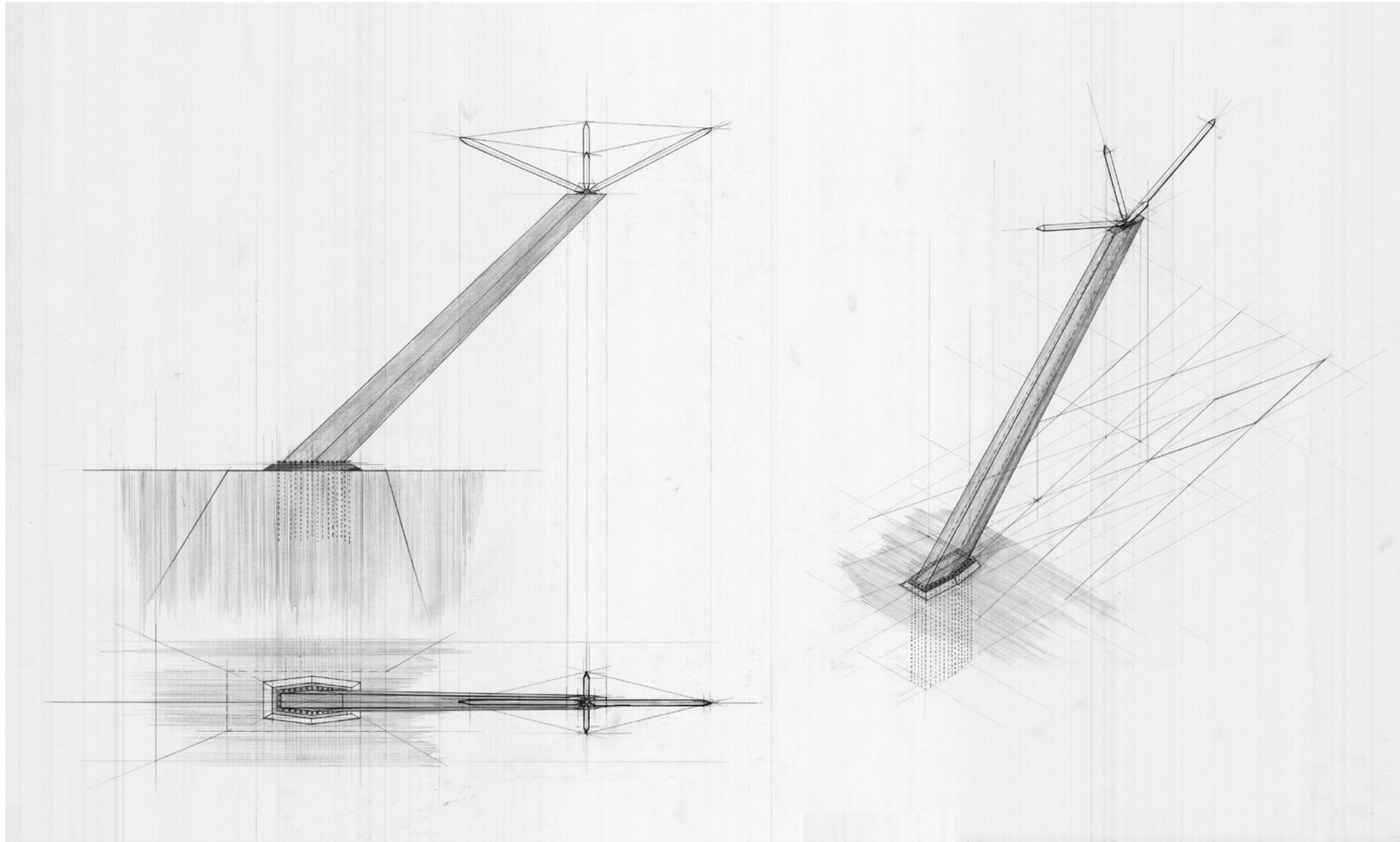


Image: *Plan, Elevation, and isometric Drawing of Larger Column*

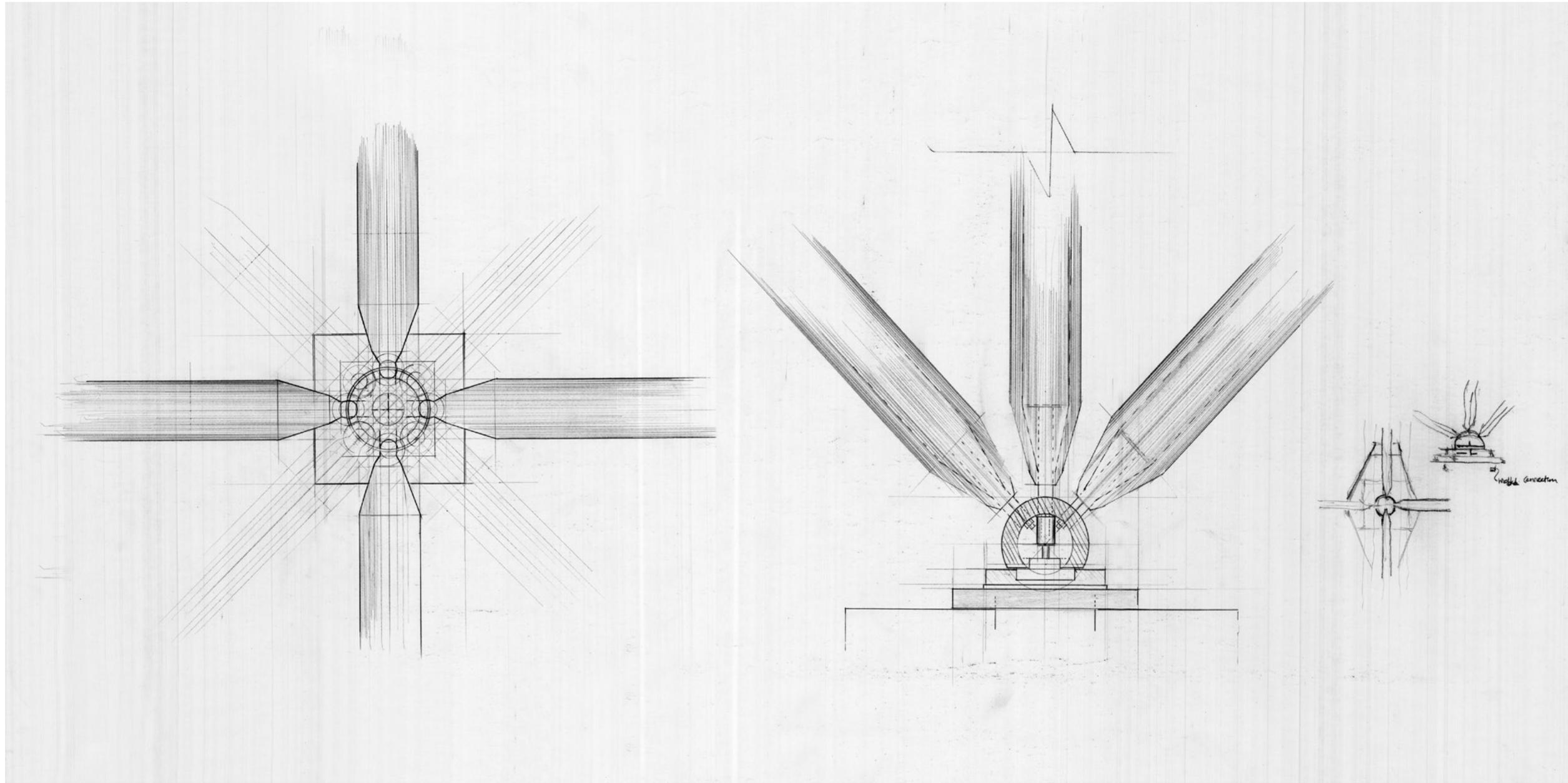
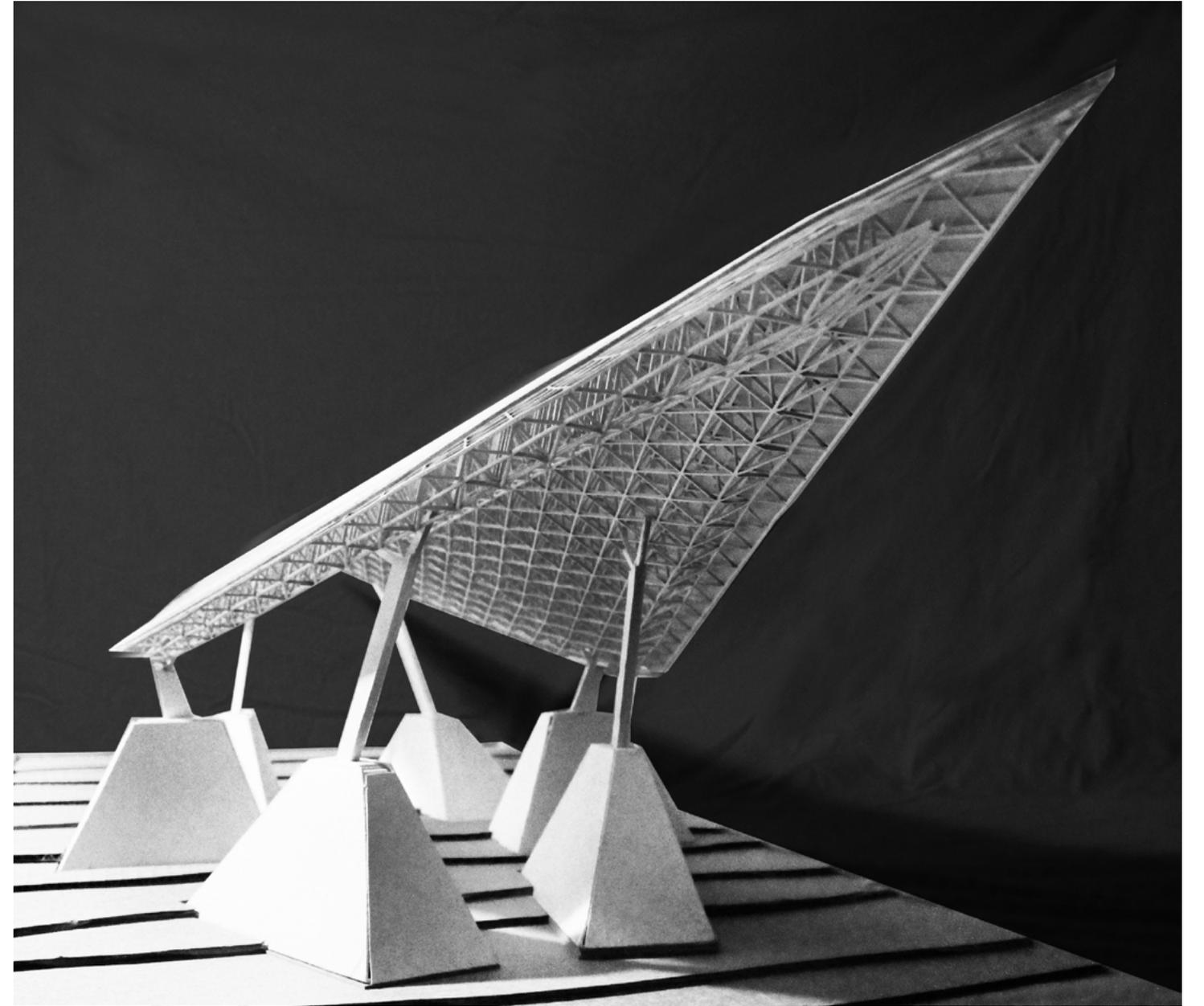


Image: Plan & Section Detail Drawing of Column to Roof Connection

THE FOUNDATION

Image: Model Photograph 4: *Model of Roof Space Frame*
(Material: Chipboard)



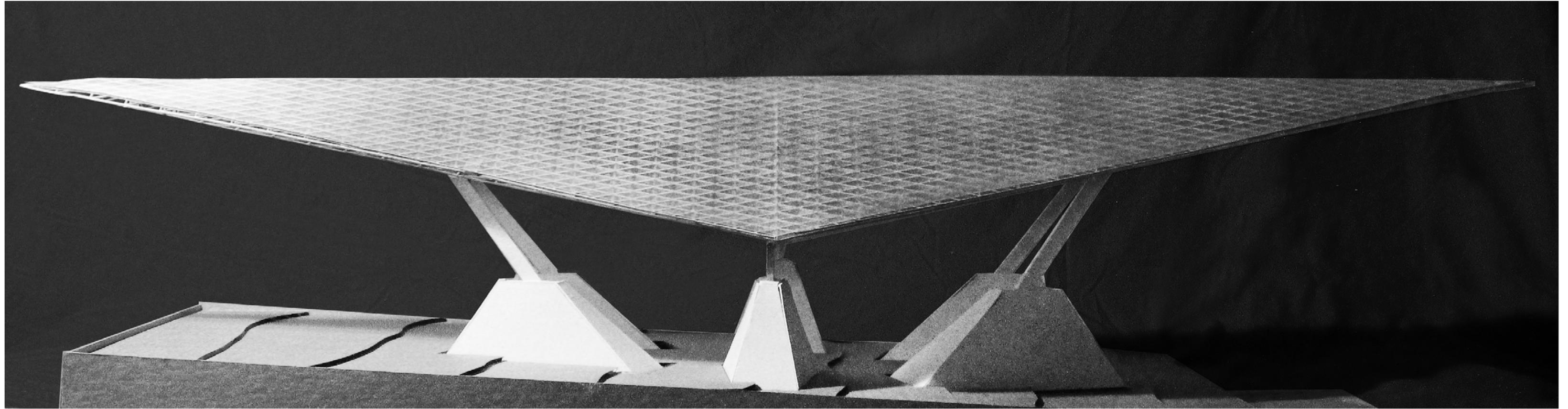
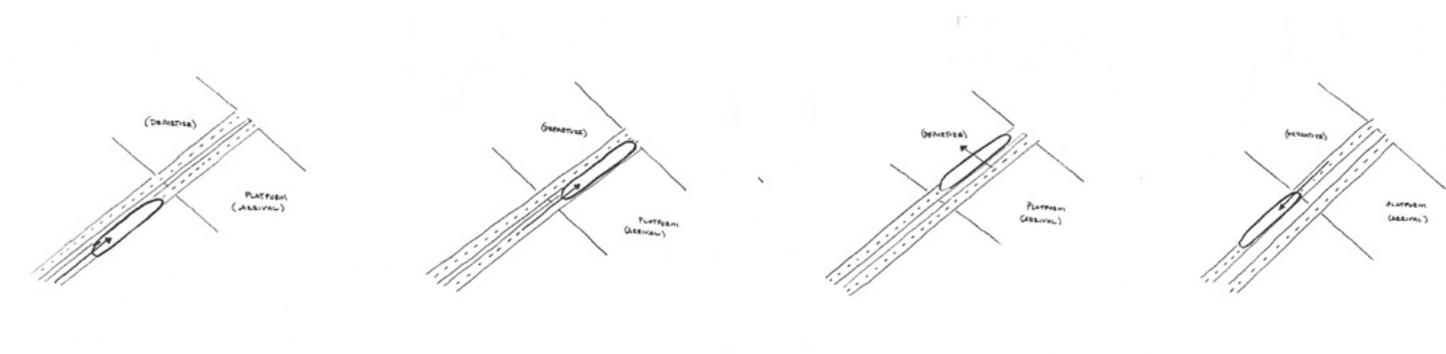


Image: *Model Photograph 5: Model of Roof Space Frame*
(Material: Chipboard)



THE PLATFORM

The passenger pods for the Hyperloop are to be designed to travel in both forward and reverse directions. Seats will rotate 180 degrees depending on the direction the pod is will move.

Upon arrival to the station, the pods first approach the arrival platform where passengers are unloaded. The pod will then shift laterally to the departure platform for the boarding of new passengers before departure.

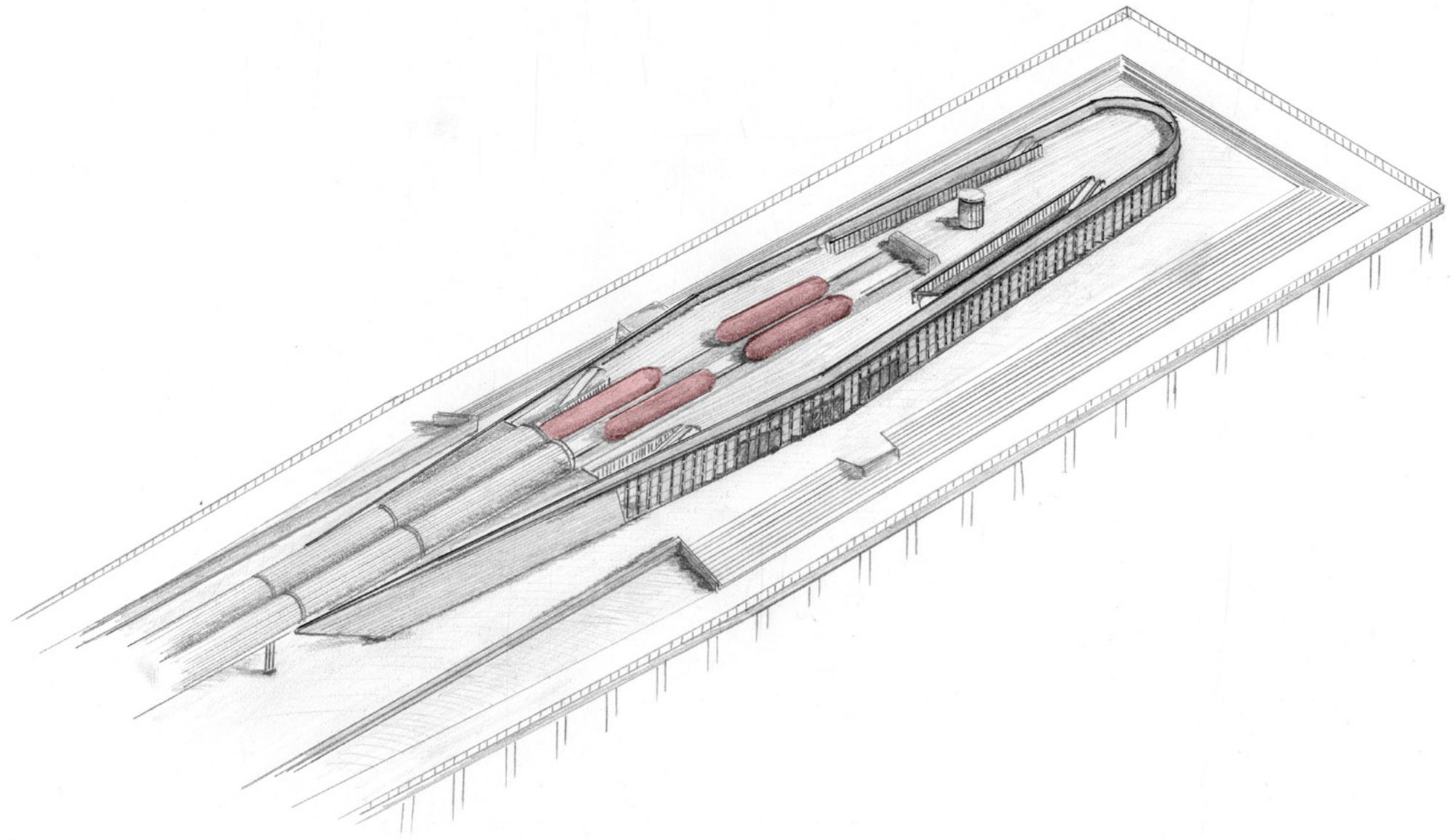


Image: Isometric drawing of main terminal and platform demonstrating arrival, transfer, and departure of passenger pods.

INHABITING THE SPACE

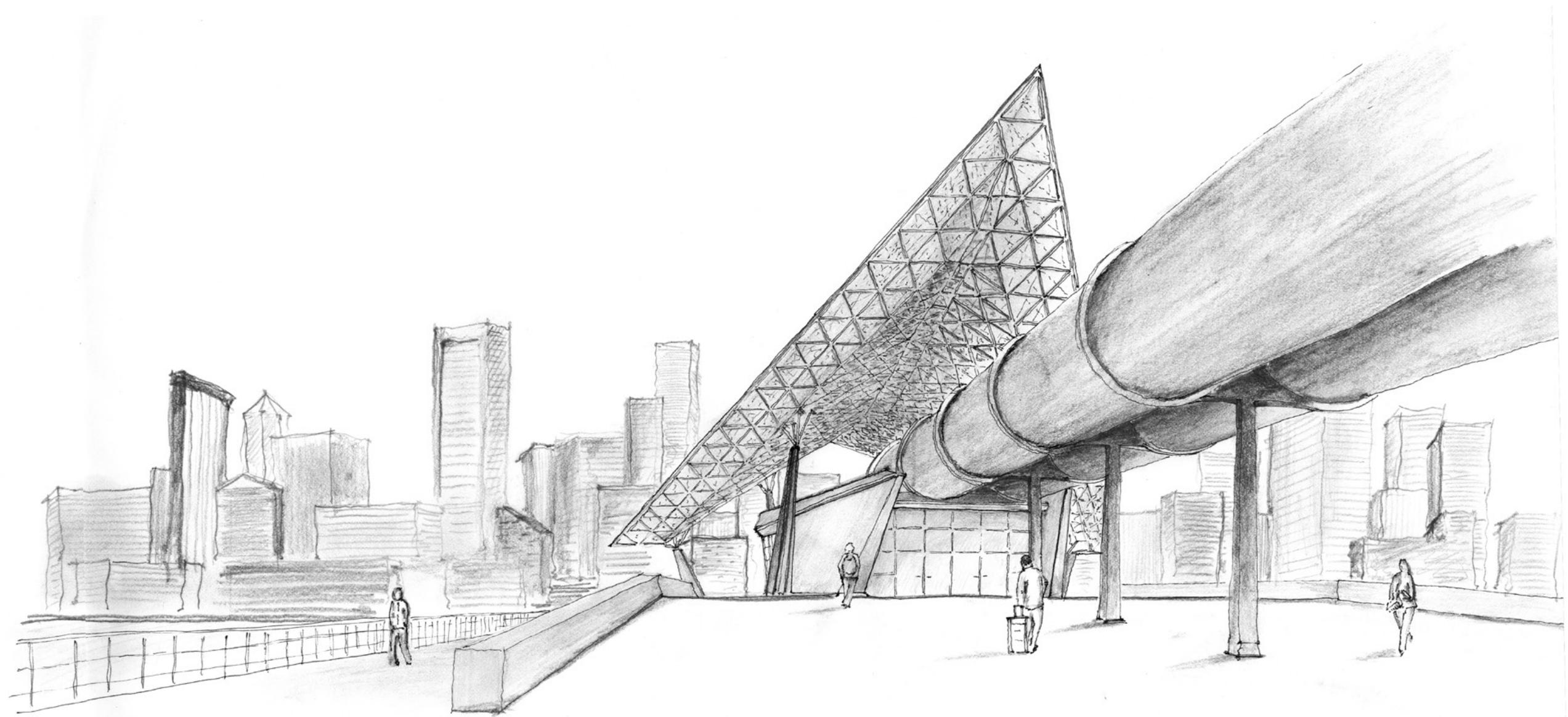


Image: *Perspective of approach to station*

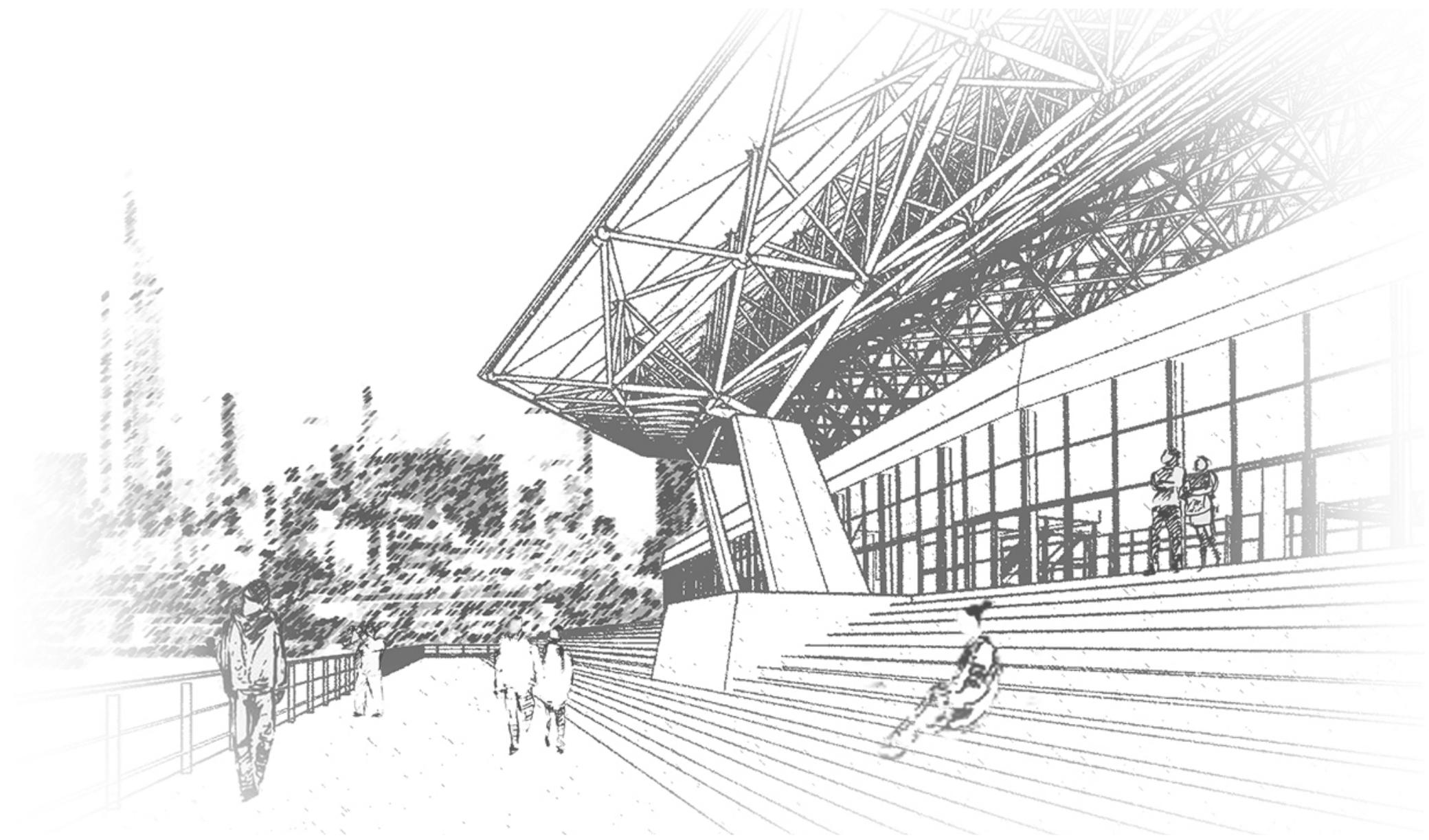


Image: *Perspective of North end exterior stair*



Image: *Perspective of Central Hall in Main Terminal*

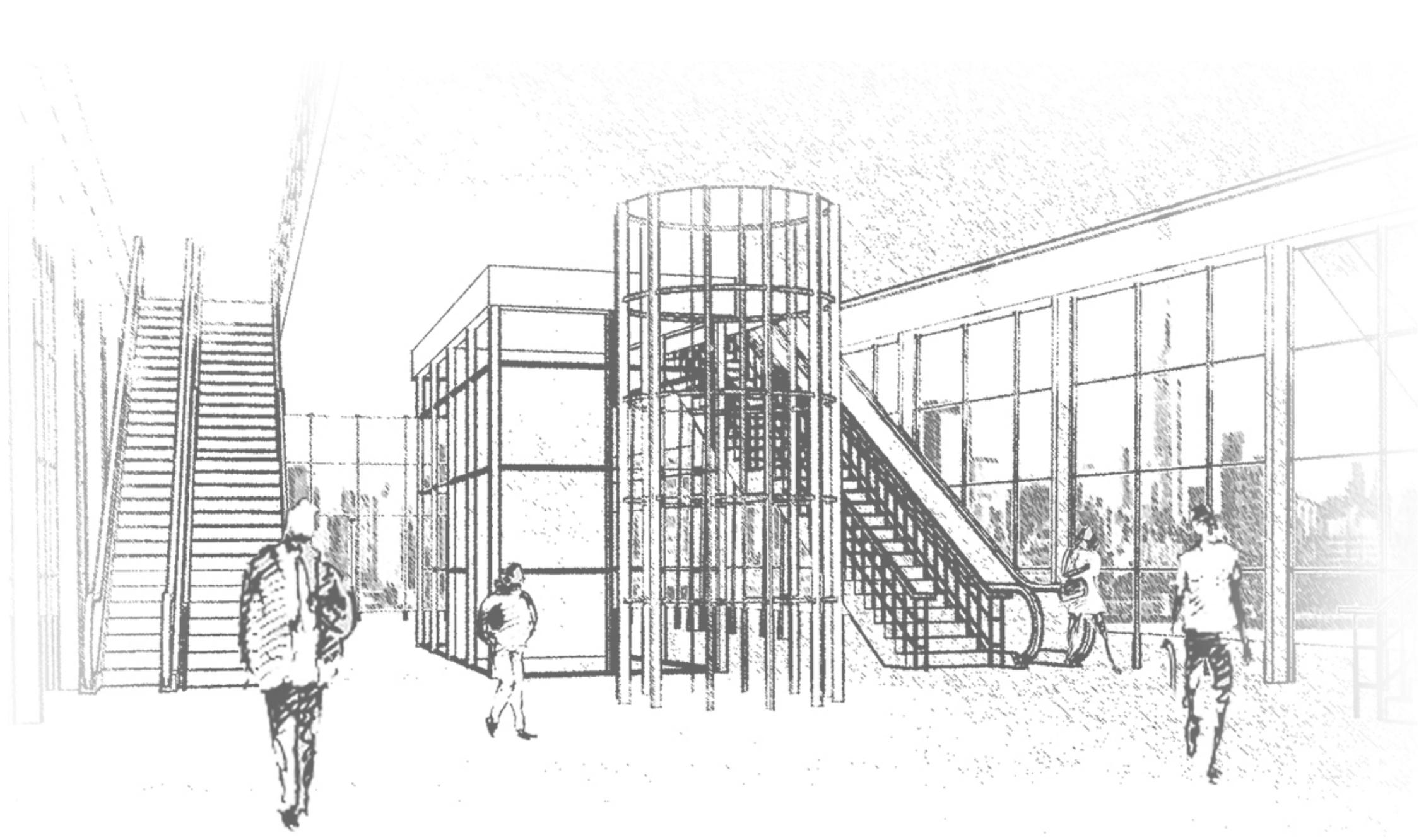


Image: *Perspective of Central Hall in Main Terminal*

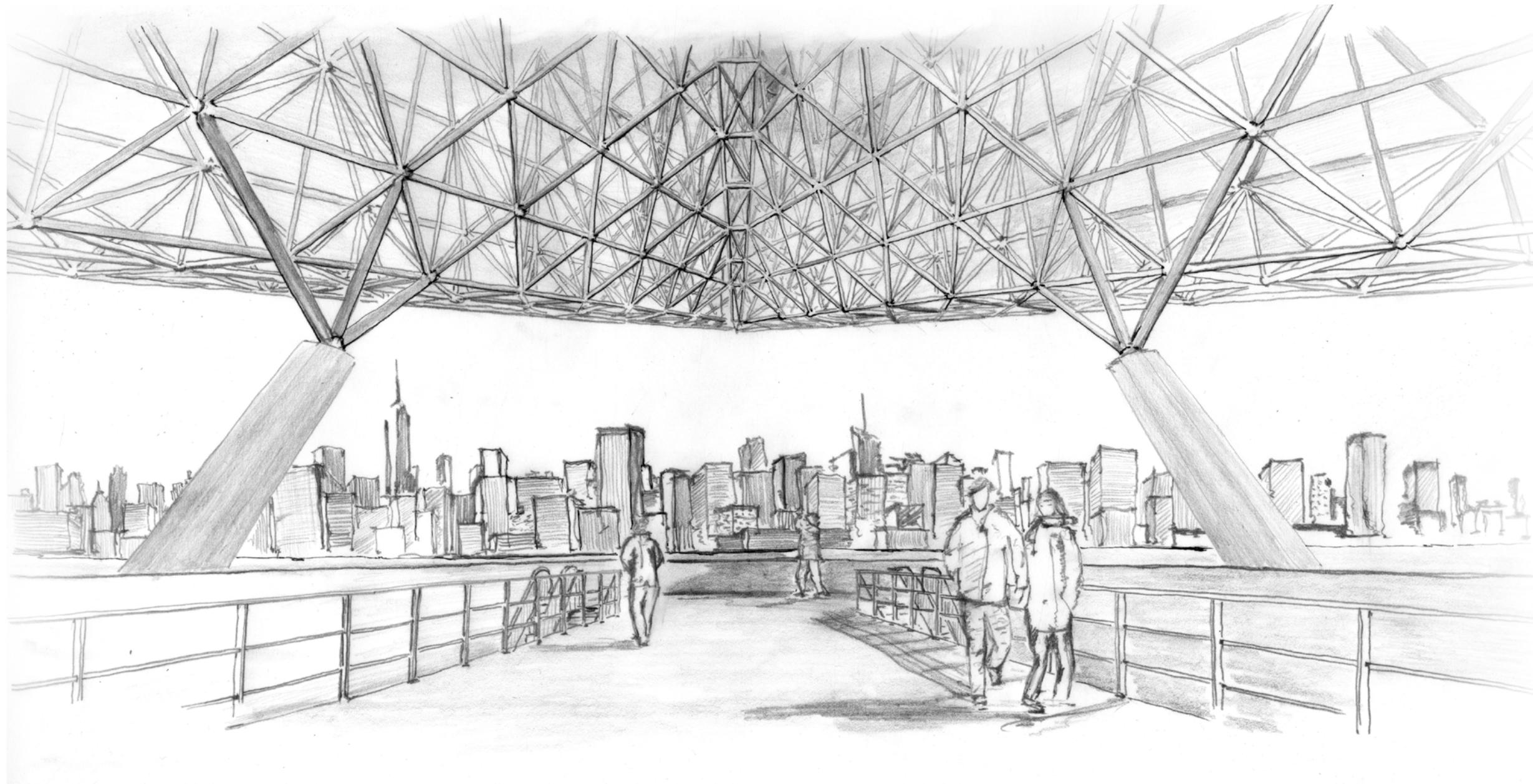


Image: *Perspective of East end of Platform*

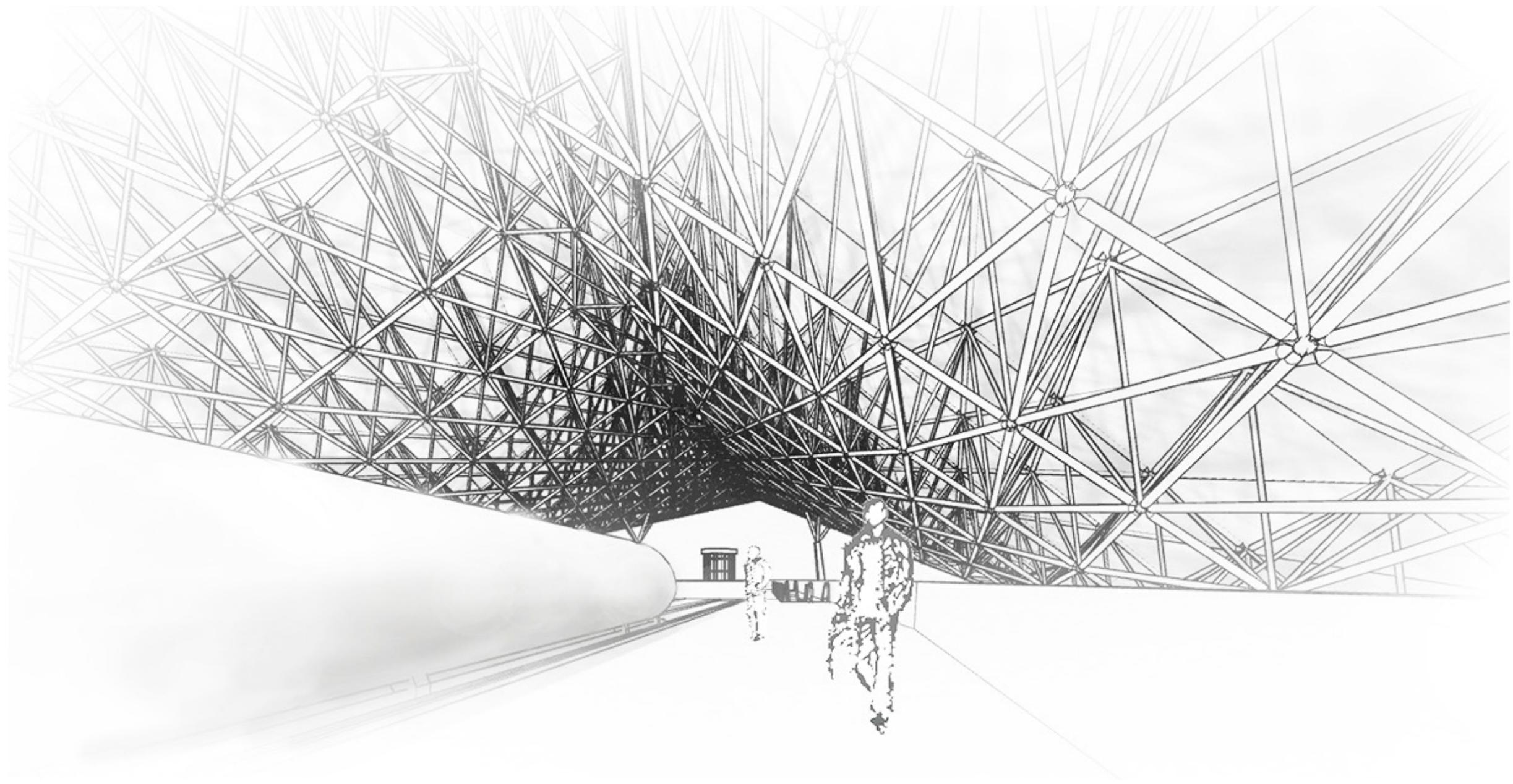
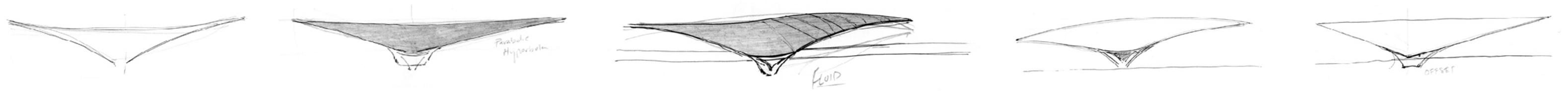


Image: *Perspective of South side of Platform*



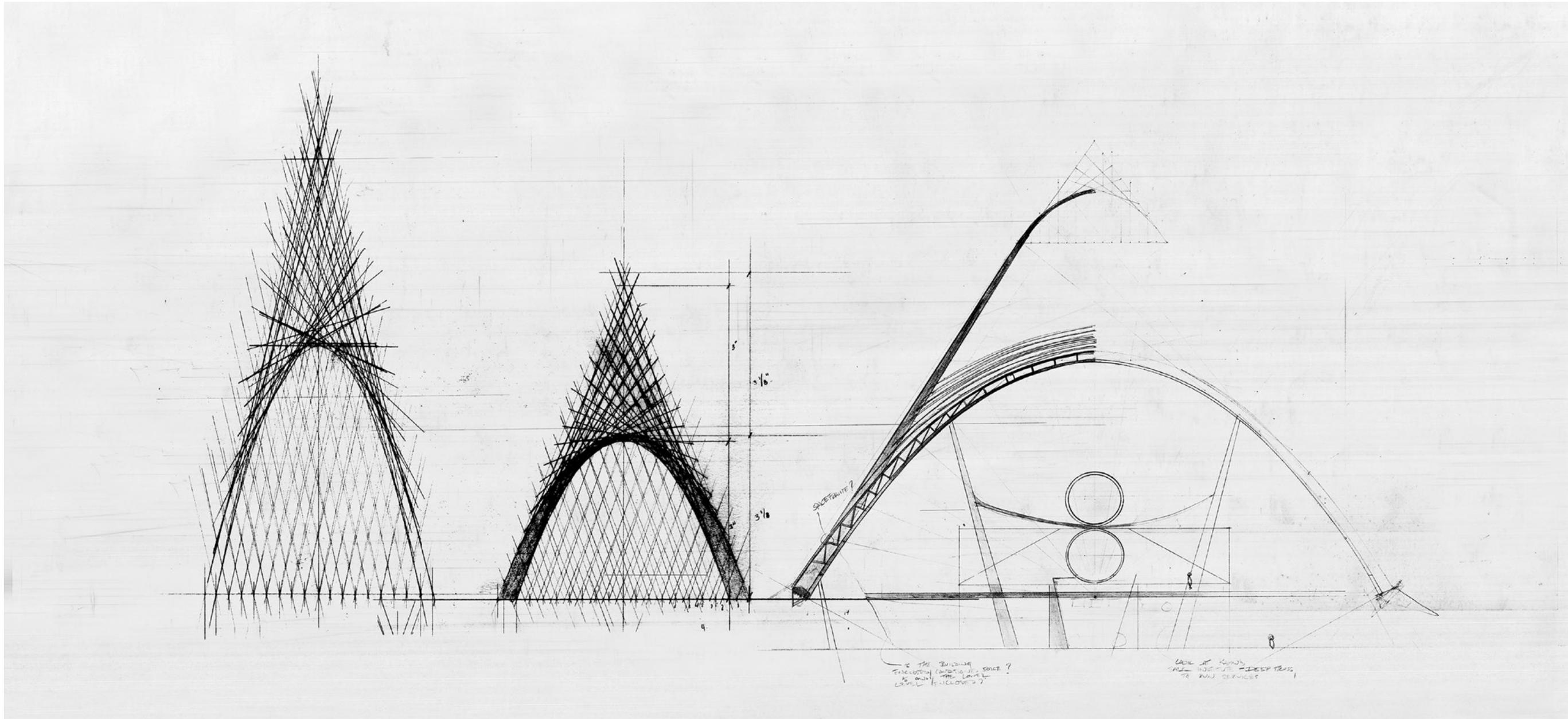
FINDING THE FORM

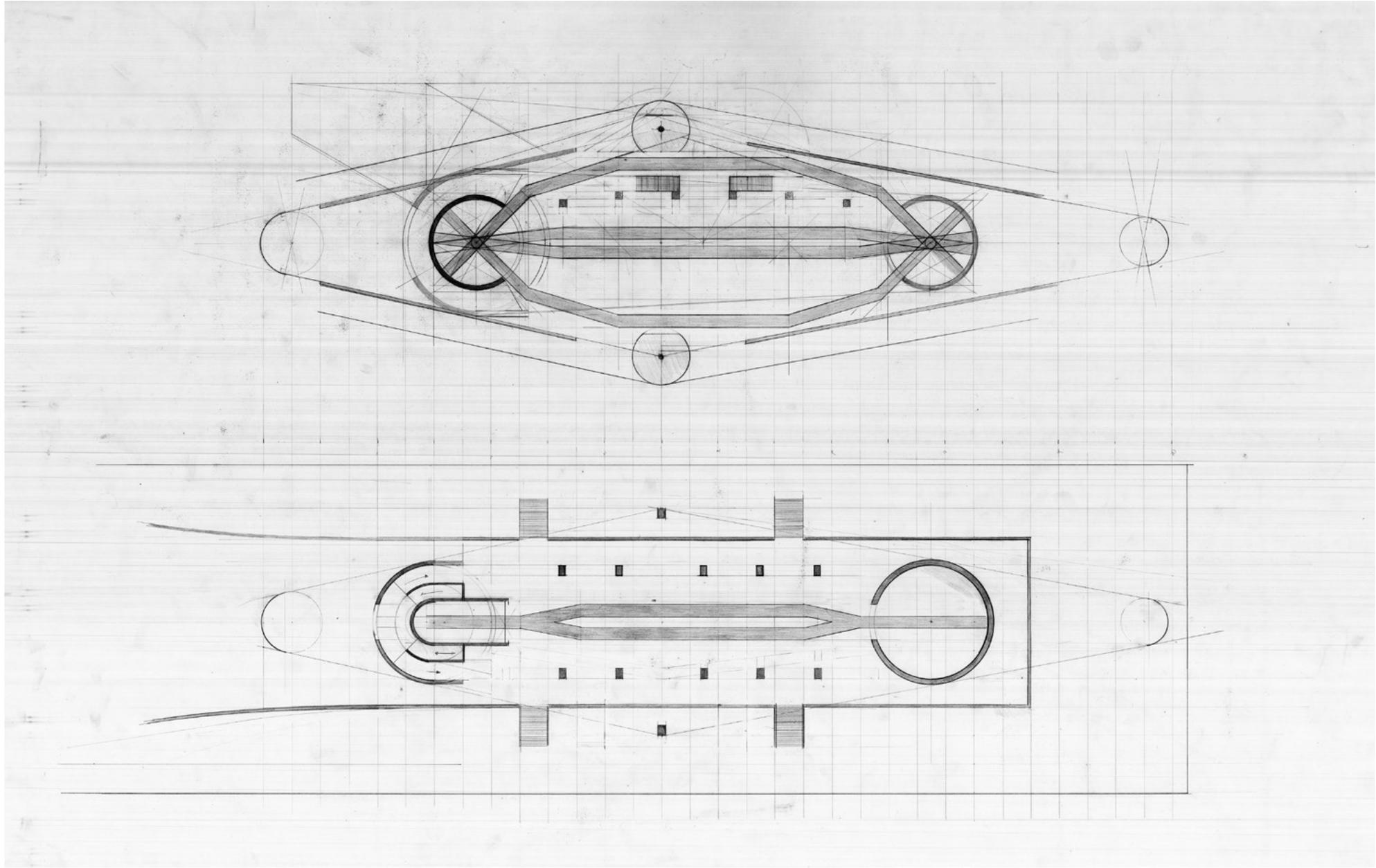
The design of the Hyperloop station first began with the conception of the roof and a simple question; how do you draw speed? From a simple straight line, quickly sketched across a page, the design progressed into the multiple variations which follow.

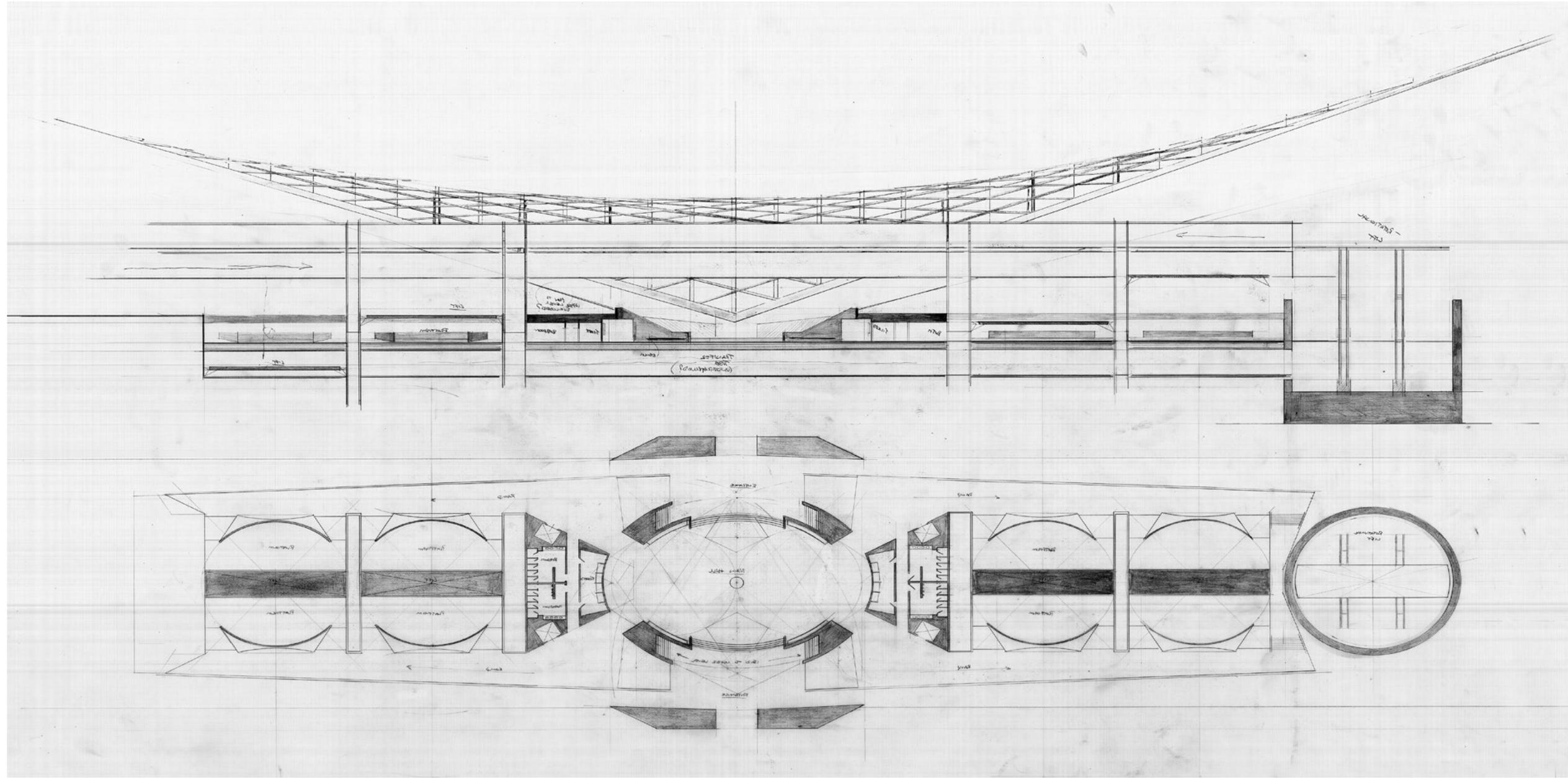


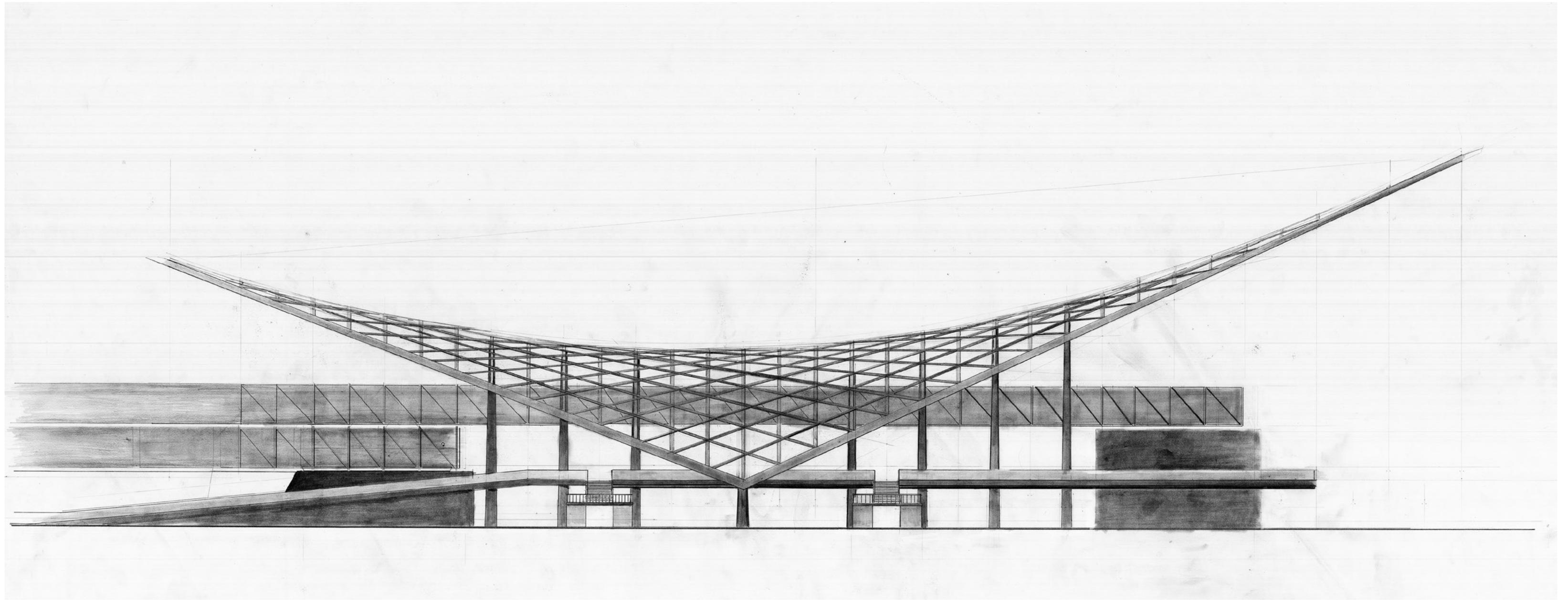


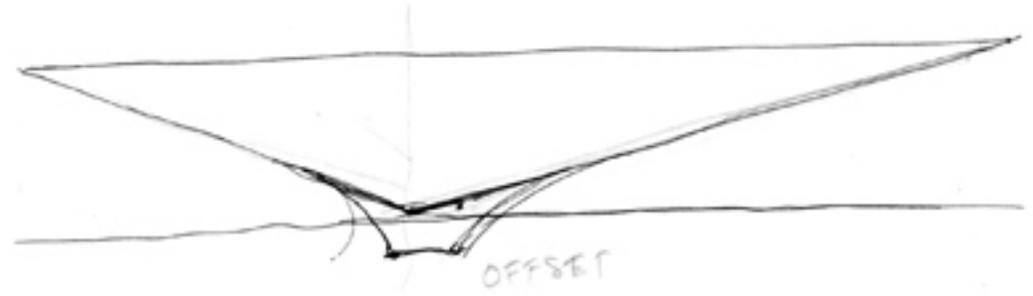
DESIGN CONCEPT 1: Hyperbolic Parabola



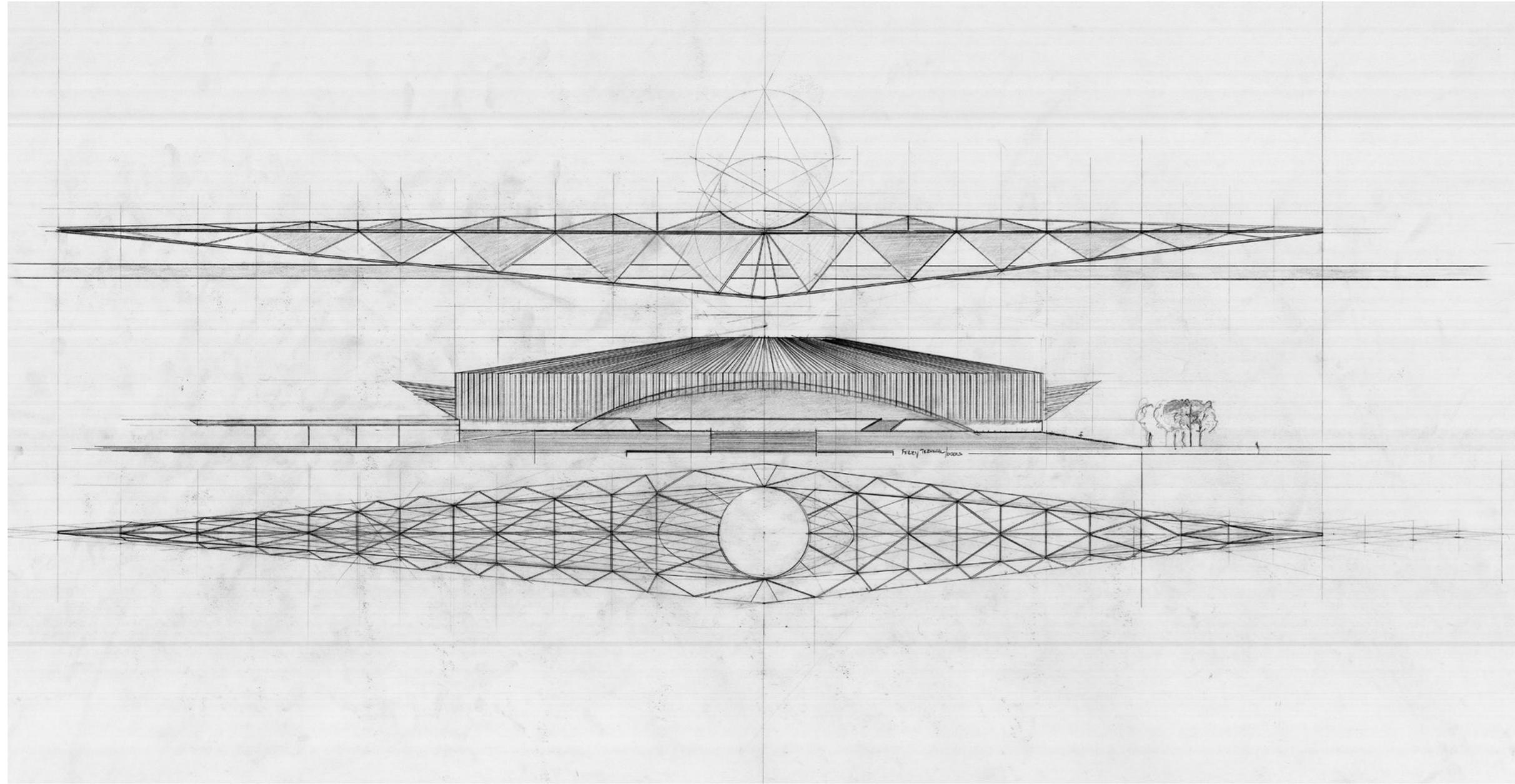


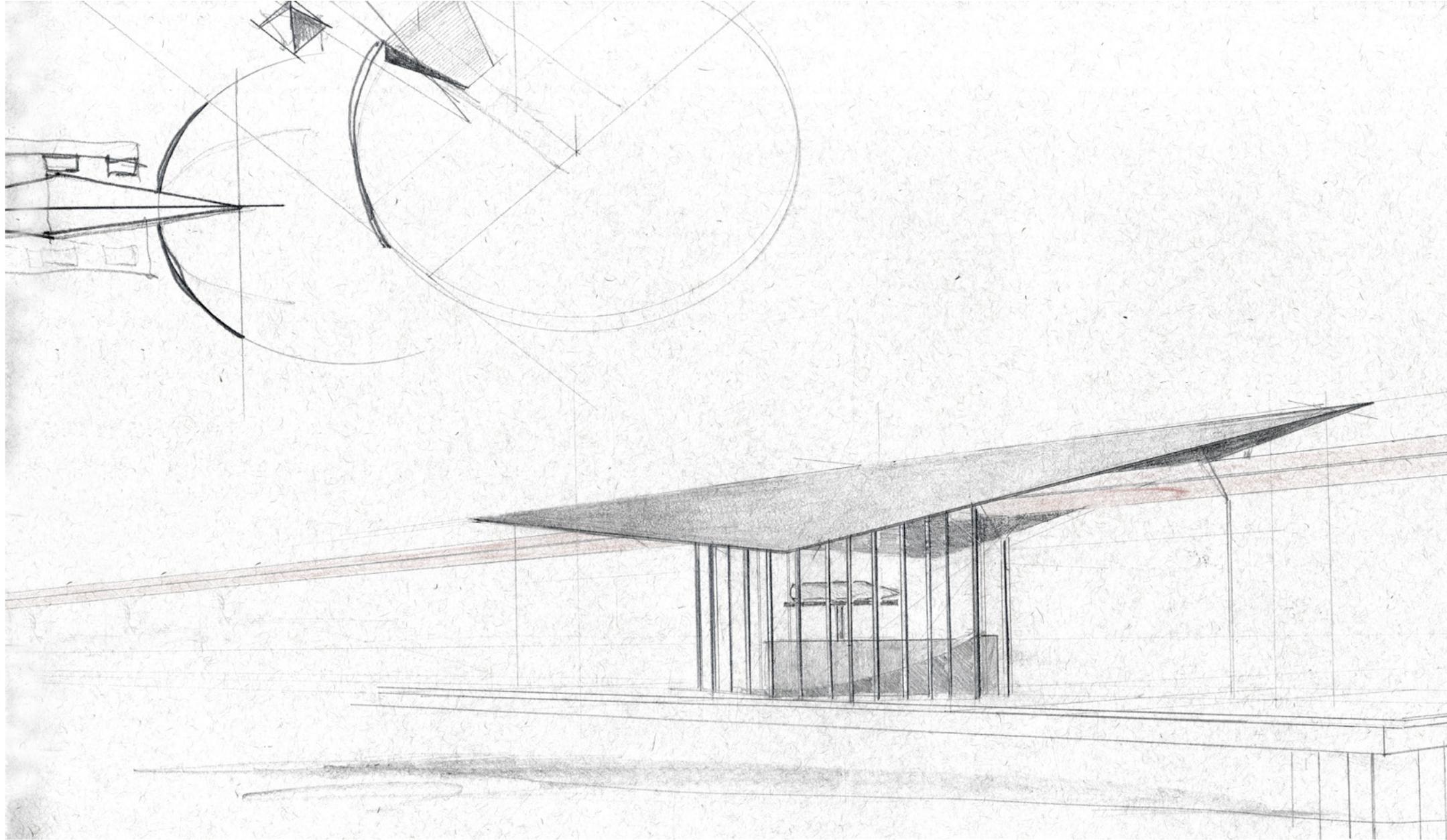




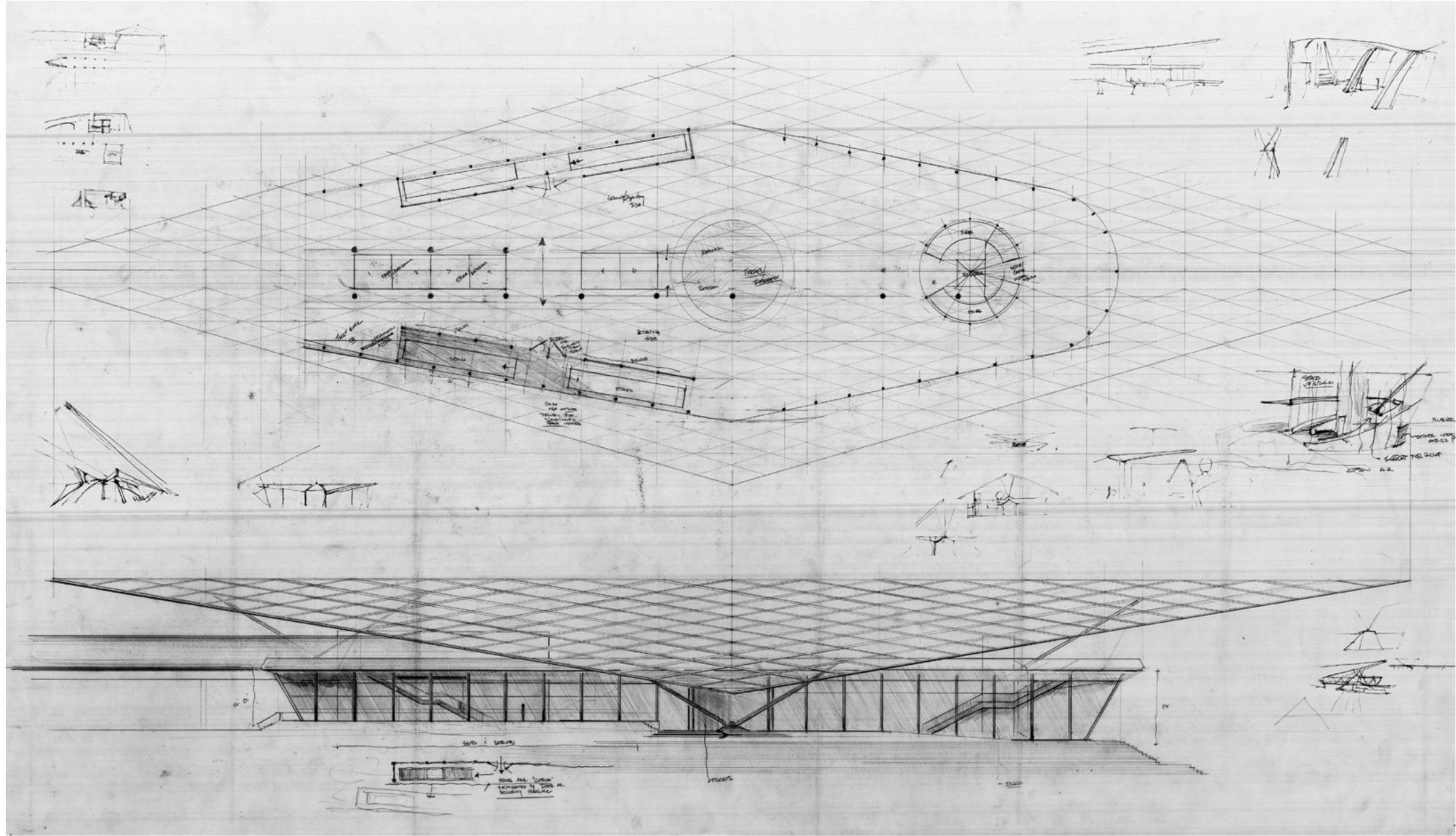


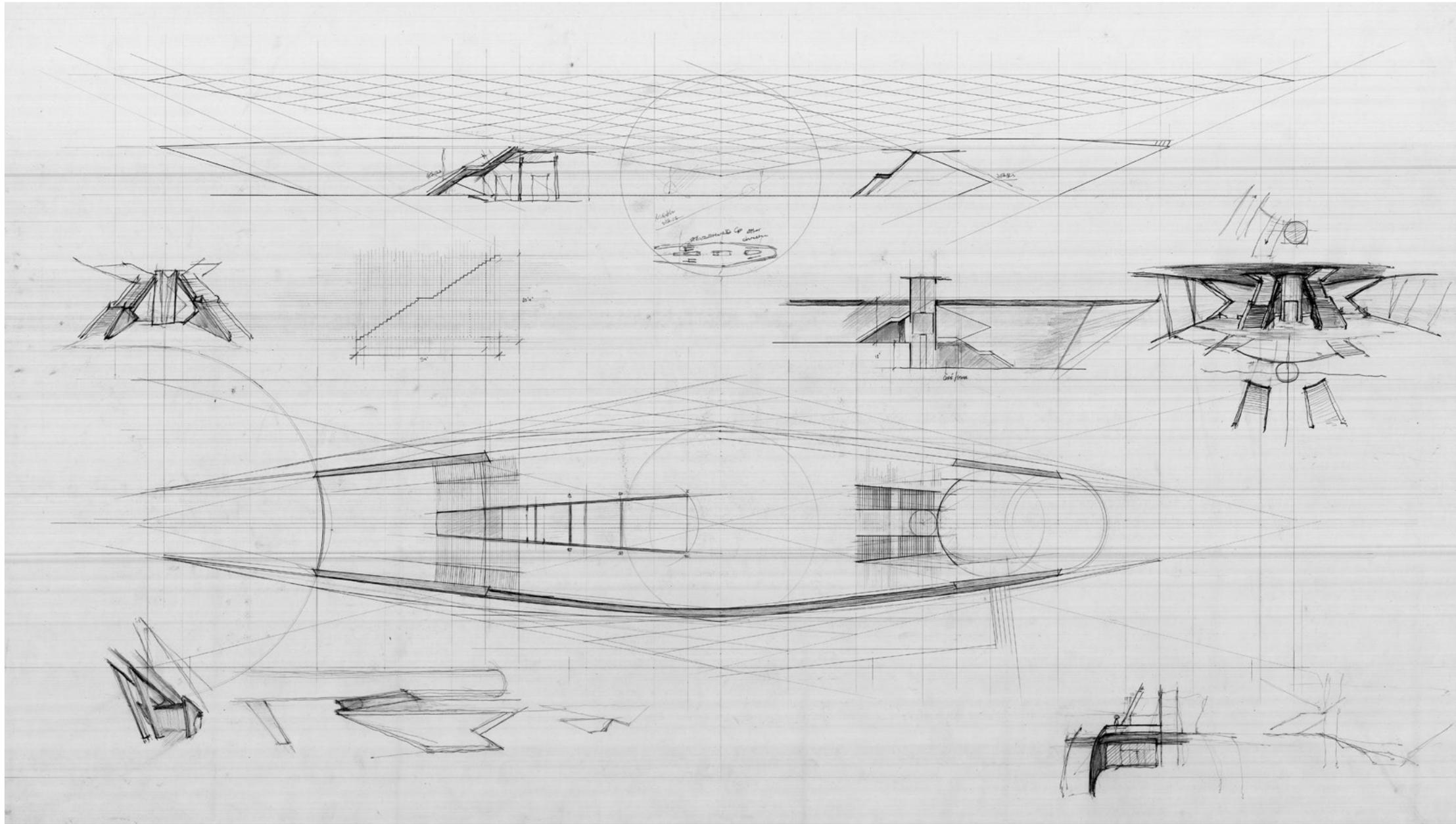
DESIGN CONCEPT 2 : Trangular

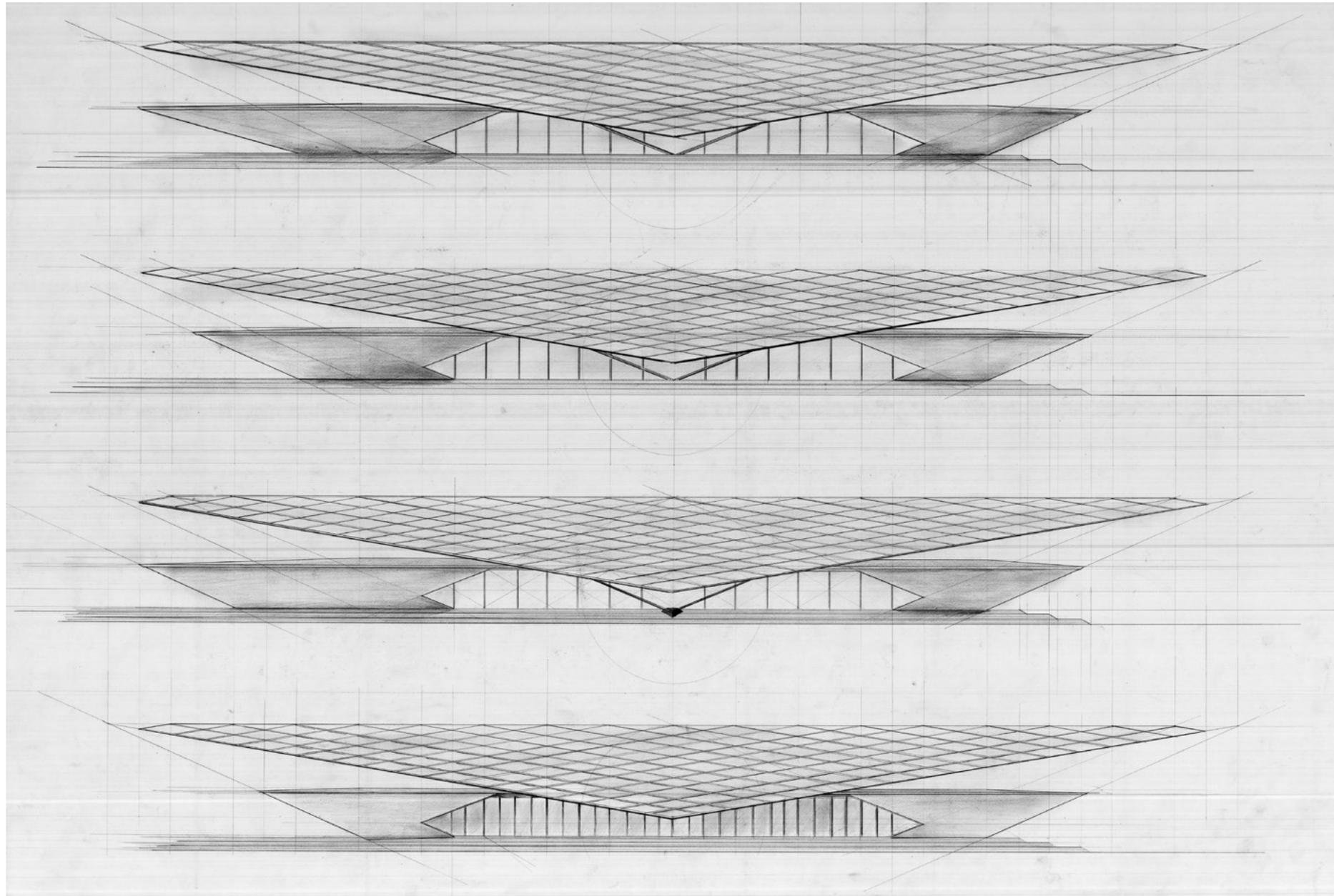


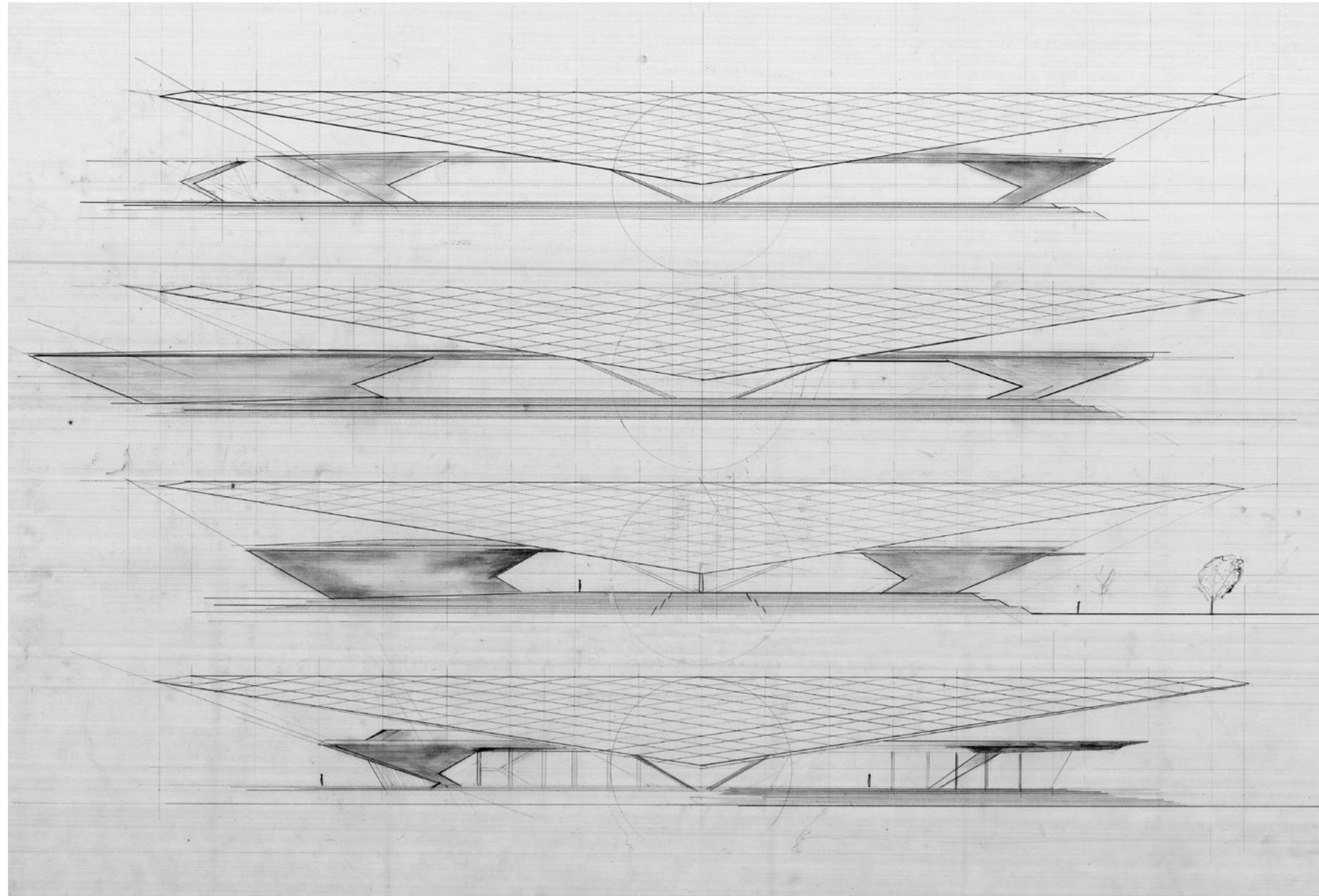




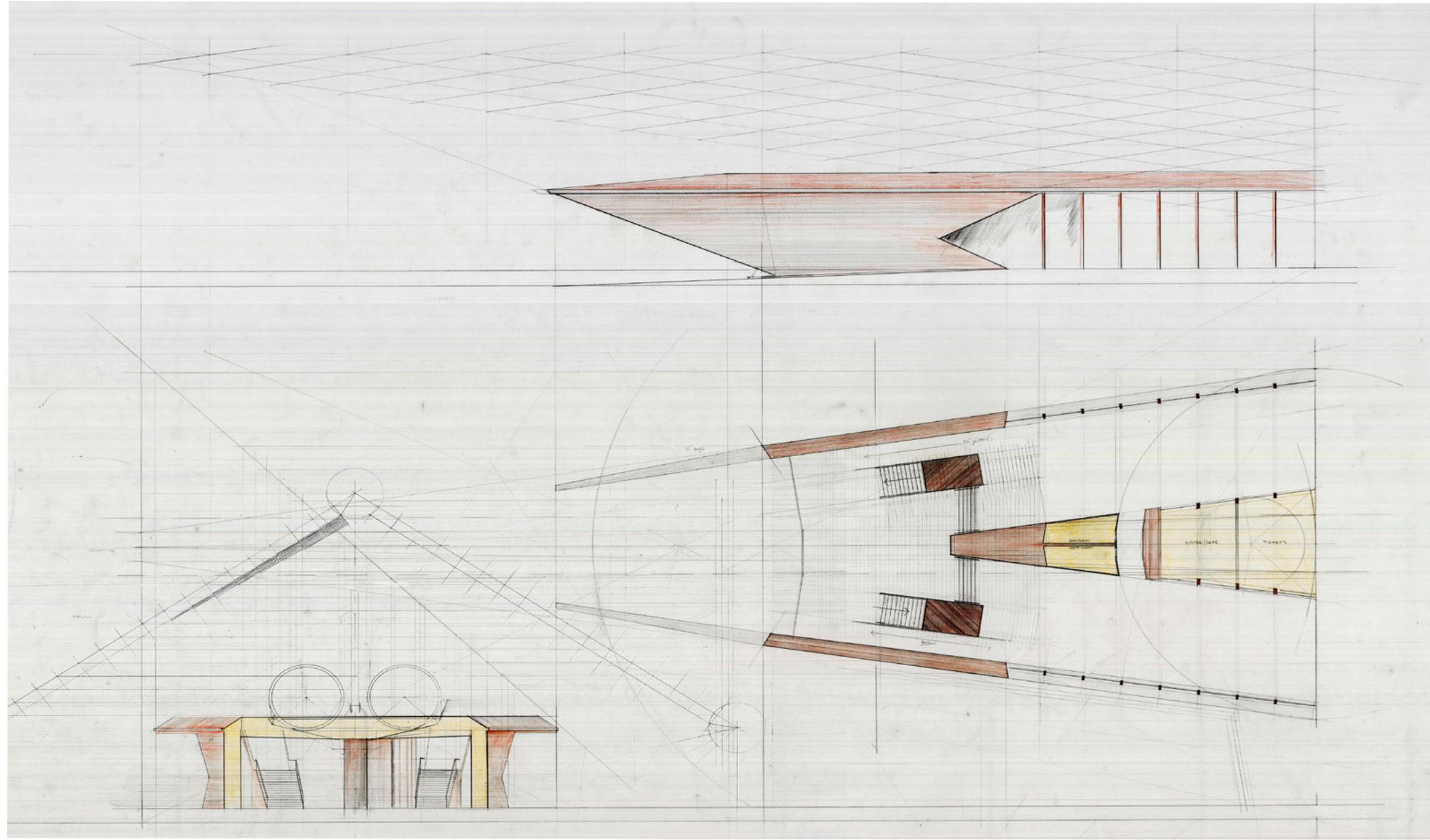


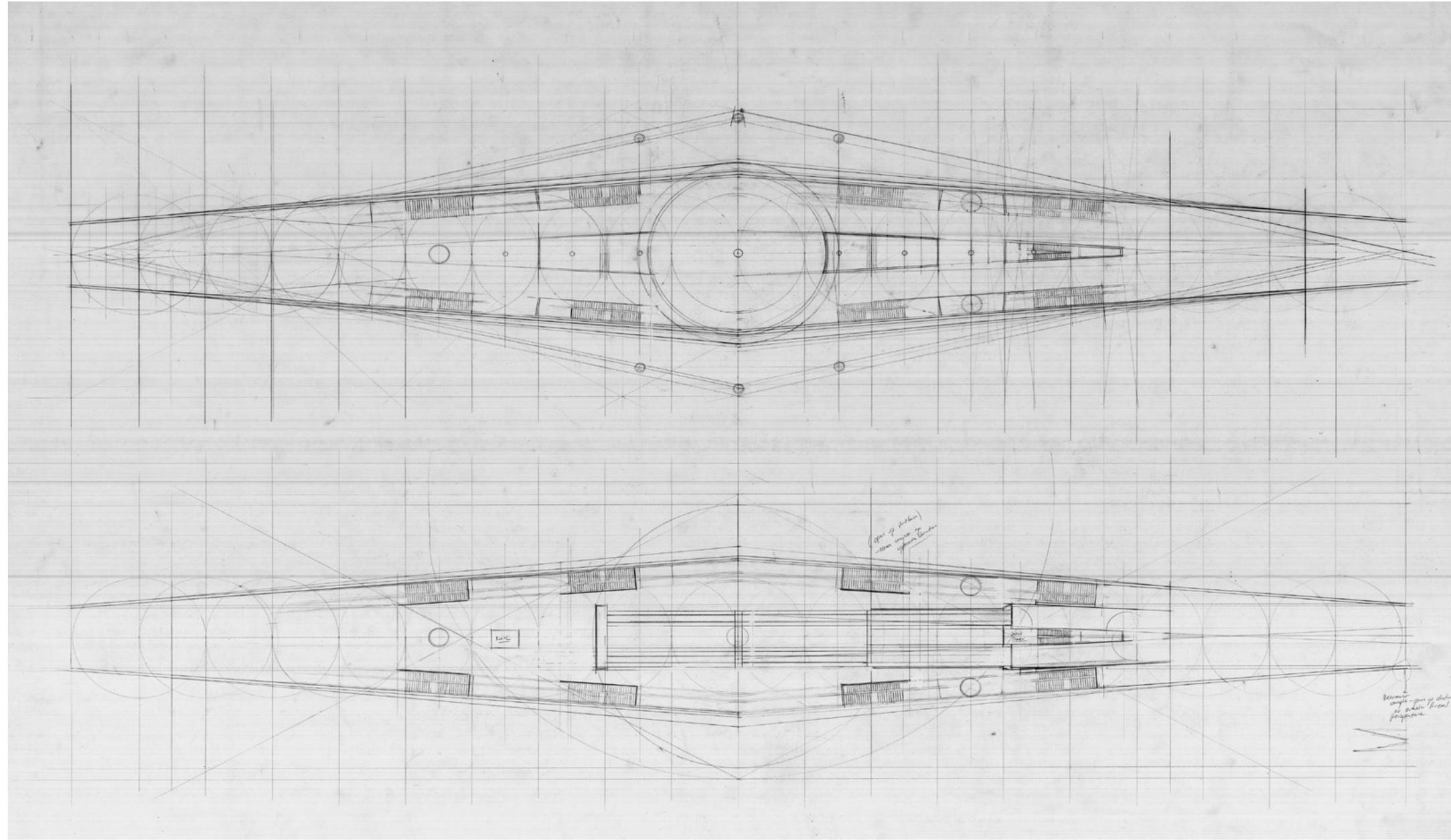


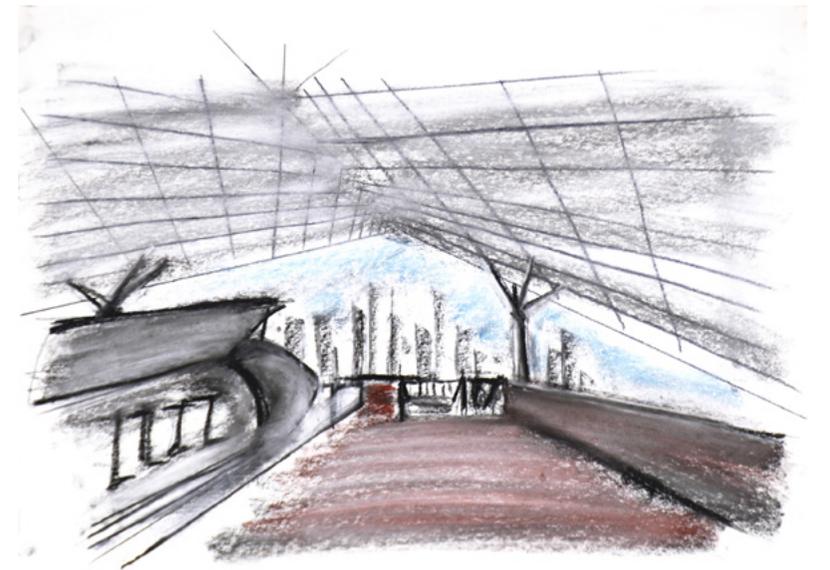
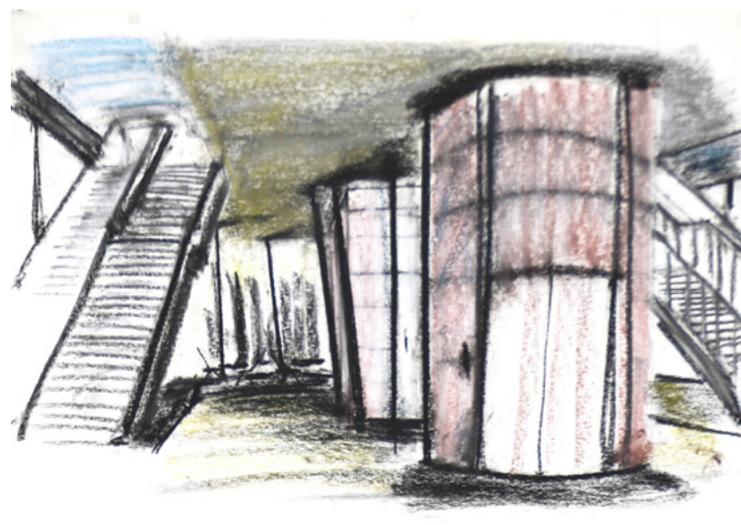


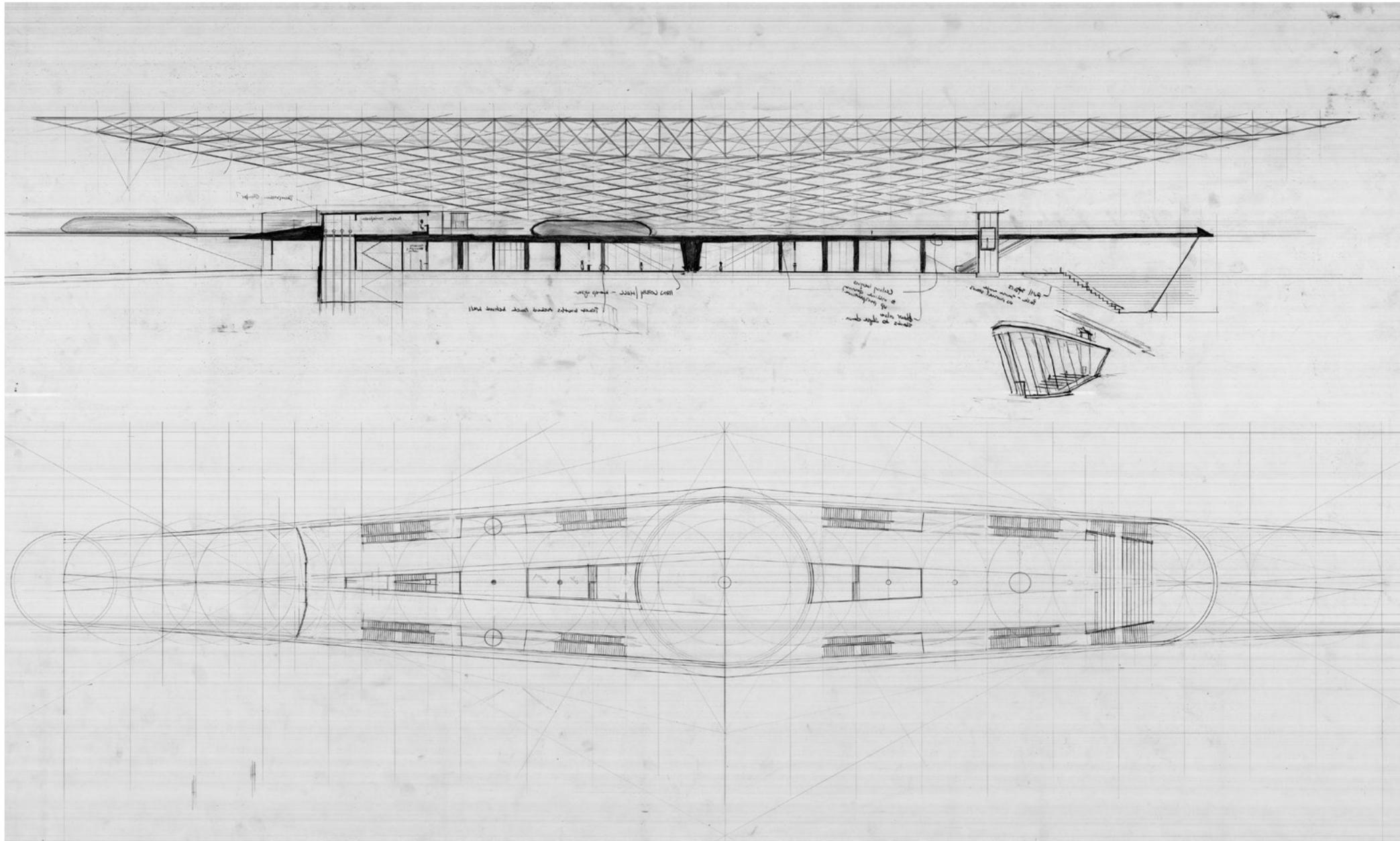


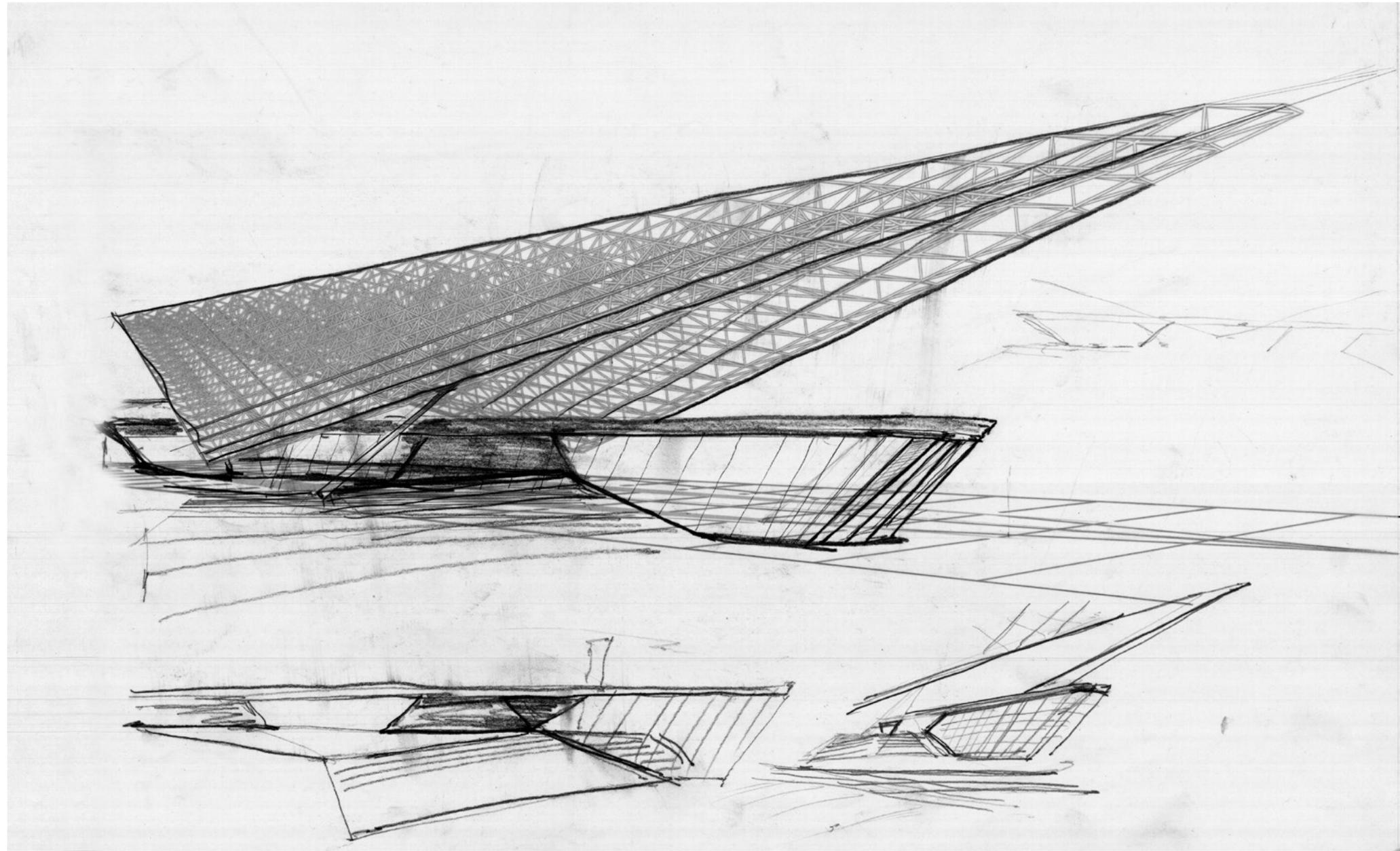


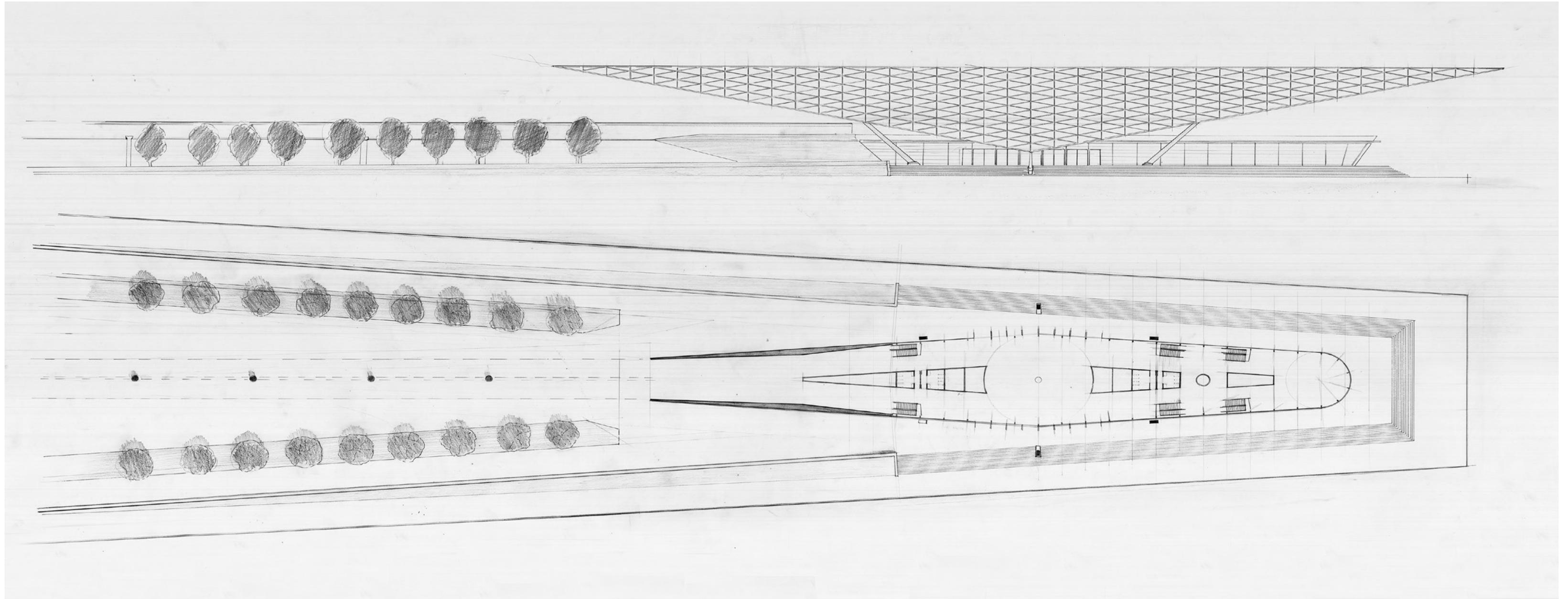












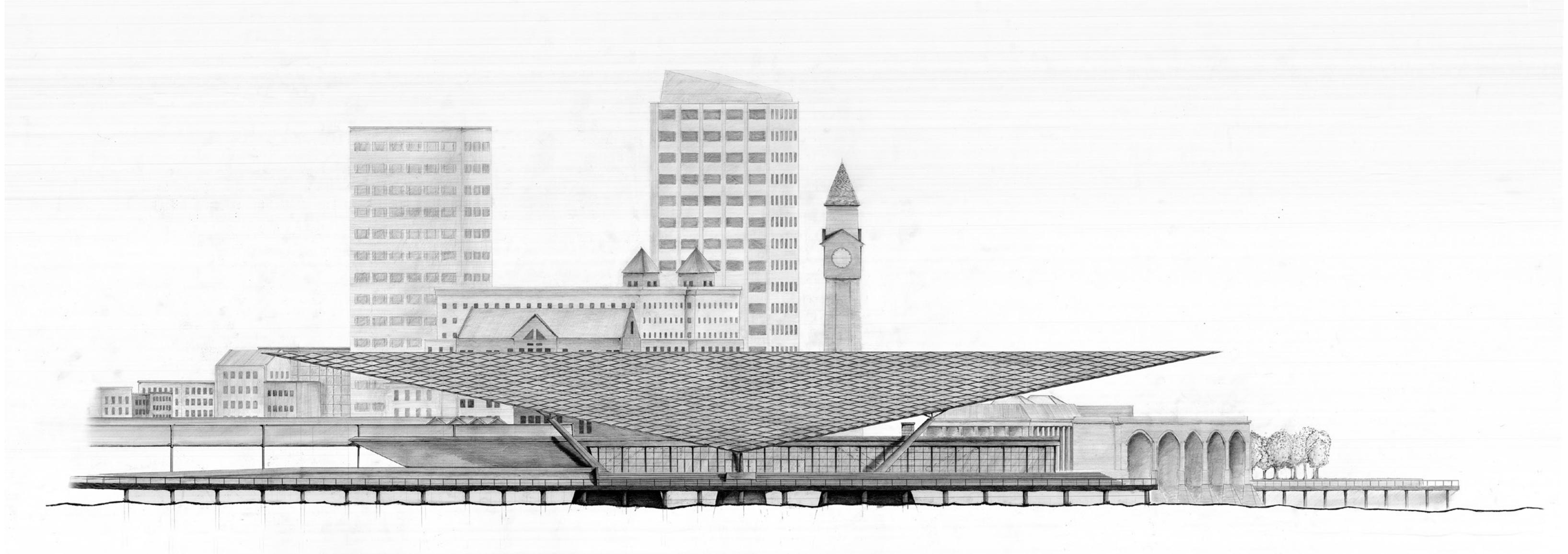


Image: South Elevation with City of Hoboken

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