

Thesis submitted to the faculty of Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

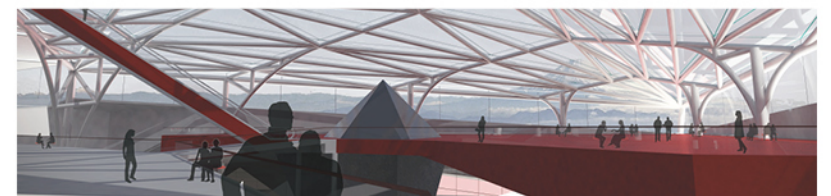
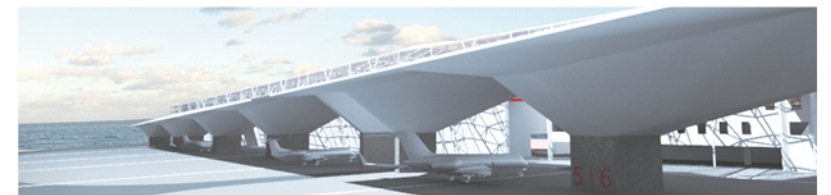
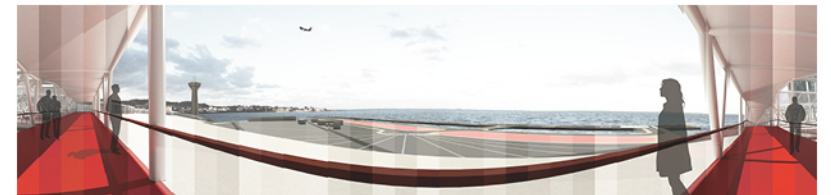
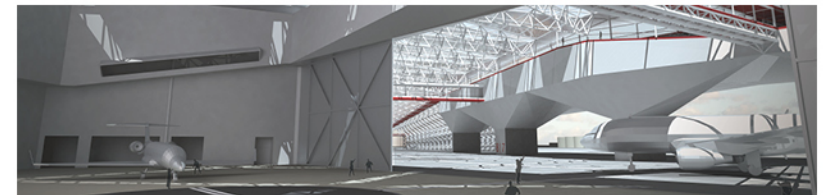
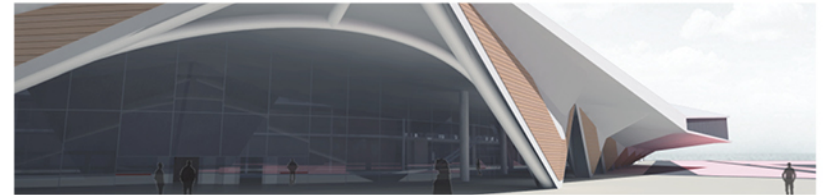
Master of Architecture

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AN AIRPORT ON **DISPLAY**

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Keywords:
display, general aviation airport, aircraft, the public, architecture



ABSTRACT

Display and function are a pair of conflicting concepts. The thesis focuses on displaying a sequence of functional spaces which are commonly not exposed to the eyes of the public, in this case, a general aviation airport. The greatest challenge over the course of the study was how to create displayable spaces without overlooking basic functional programs and deepen both concepts in the process.

The airport is designed to fulfill the dual attributes of display and function. It is an aircraft museum, displaying the behind-the-scenes system from arriving, to maintaining, to towing, to parking, and to departing. As well, it is a fully-functional airport, consisting of a sequence of functional spaces, including: runway, taxi area, maintenance hangar, towing corridor, parking spots, and auxiliary spaces.

In the context of the thesis, “display” means to expose the elements — aircraft and air travel — as an exhibit to be viewed or to be noticed by the public through spatial organization and scales of engagement.

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INTRODUCTION: DISPLAY

Display and Architecture

In the thesis, the airport is not only a place for aircrafts to land or to take off, but also a museum exhibiting different aspects of aircraft and air travel. Coming to this airport is not a necessity for people who are taking a flight, but an experience for everyone.

Architects have made many attempts to apply the idea of display in different types of projects. The CNN Center in Atlanta is one of these examples. It provides opportunities for people to see the newsrooms and anchors. In the studio tours, visitors can obtain general knowledge of the technologies and learn how the broadcasting system works. Another example is El Gaucho, a Seattle steak house. It has an open kitchen and diners can see the careful performances by the chefs. The concept is to treat restaurant dining as theater. The visible kitchen is more than an aesthetic element — it is entertainment. Today, display is no longer an innovative idea, but it is novel to apply it in a general aviation airport.

Airport as Display

“Display” in an airport allows people to see the things rarely seen by the public in an ordinary airport. It shows people the awe of flight, exposes how the system runs behind the scenes, and enhances human experience. Moreover, through the study of display, we can explore the educational role of an airport and help people obtain knowledge through the display, thus elevating aviation above mere transport.

On the surface, people may find that the aircrafts are the displayed objects, however when people explore further, they will realize that what is on display is the system — from arriving, to maintaining, to towing, to parking, and to departing. Each element in the sequence displays a particular aspect of aircraft and air travel. All together, people encounter the complete system.

Displaying

There are many ways to display objects. A basic one is through images. This method is widely used in displaying objects that are not appropriate for actual exhibition. Another one is physical exhibition, in which exhibits provide opportunities for visitors to see, to hear, or to smell. However, these two methods just give people unilateral communication; people cannot get a deep impression. However, a third method of displaying objects offers this, interaction. Exhibits can respond to people’s actions. It will seem like the visitors are having a personal experience with the exhibits.

In the thesis, all three methods are applied to give people the most impressive experiences. Images along the walkway show the public the history of aviation; the aircrafts which are on display give visitors the ability to see, hear, and smell; passengers can interact with the aircrafts, by touching them, operating them, and having the aircrafts work as luxury vehicles.

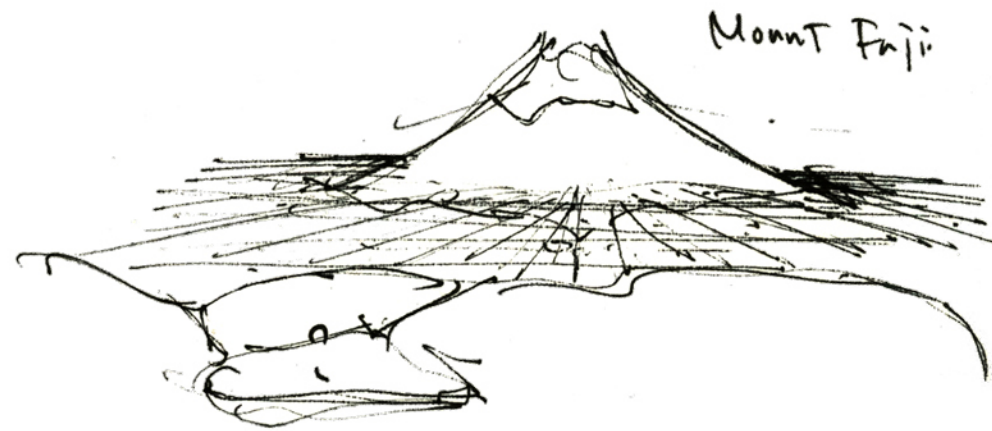
On the basis of these methods, the project explores the ways to display objects further. The idea is to let the public become the exhibit itself. When people visit the airport by an aircraft, either a private one or a chartered one, they are the exhibit in each others’ eyes. When they enter the building, their role changes. They are the visitors from this moment on. Not like a traditional museum, but here, the public is truly involved in and plays an active role in the display. People create the display for themselves. That means this airport will never be a one-time museum. The display is unpredictable, and always changing. No matter how many times people have come here, they will encounter and find out new things in their next visit.



A tour guide shows visitors a working space in the CNN Center.



A chef prepares a dessert in El Gaucho.



SITING THE DISPLAY

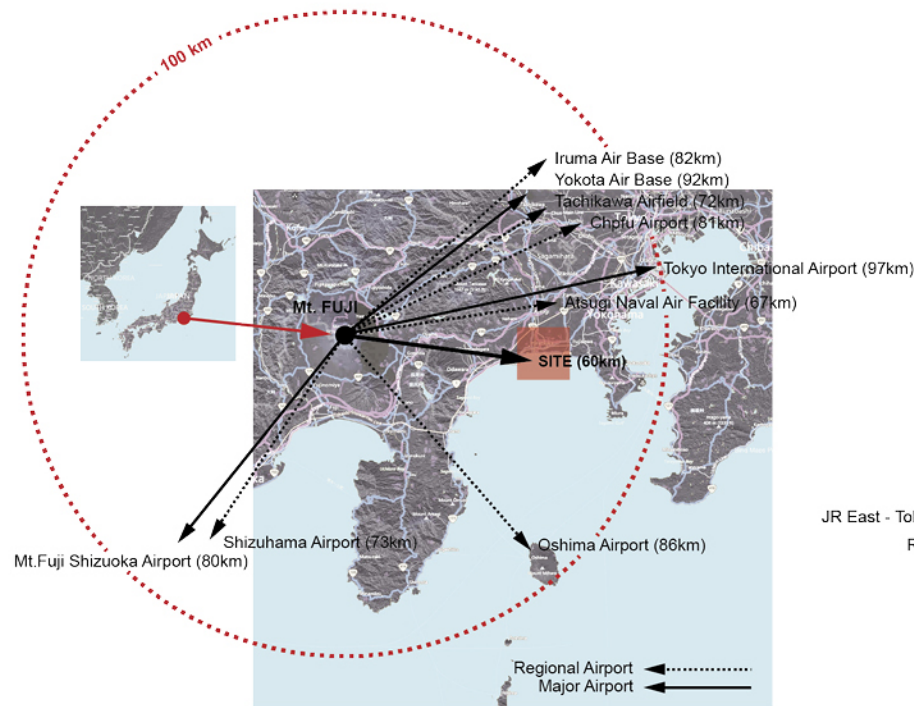
Site Conditions

The general aviation airport is located on a proposed artificial island in the middle of Sagami Bay, in Kanagawa Prefecture, Japan. The site is 37 miles away from Mt. Fuji, which makes it the closest airport for tourists to visit Mt. Fuji. More than 300,000 people visit Mt. Fuji every year. The tourist population is a group of people who have leisure time and seek entertainment. This condition supports the idea of designing a displayable airport at the site.

The project demands a four-lane, 4,500 ft-long bridge to connect the artificial island to the city Chigasaki and to the mainland. The bridge also makes the site accessible to the current transportation network.

The single runway is oriented NE-SW and can be used in both directions. The orientation is decided by the prevailing winds in this area.

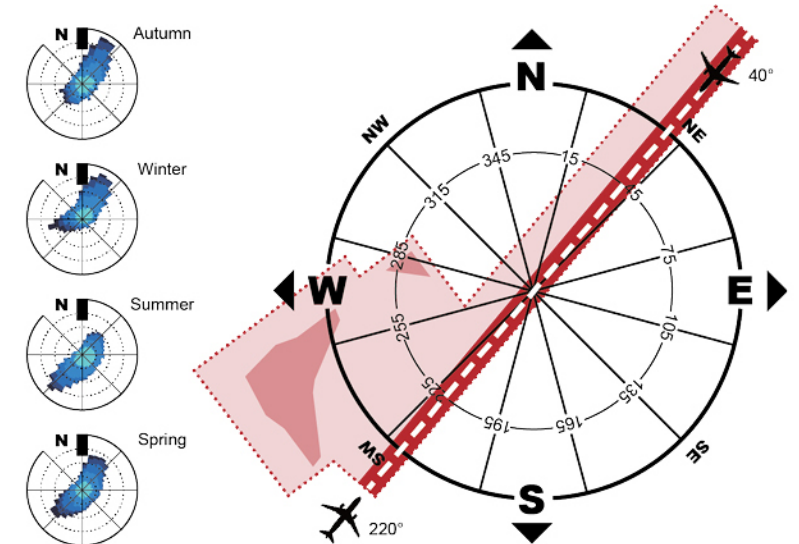
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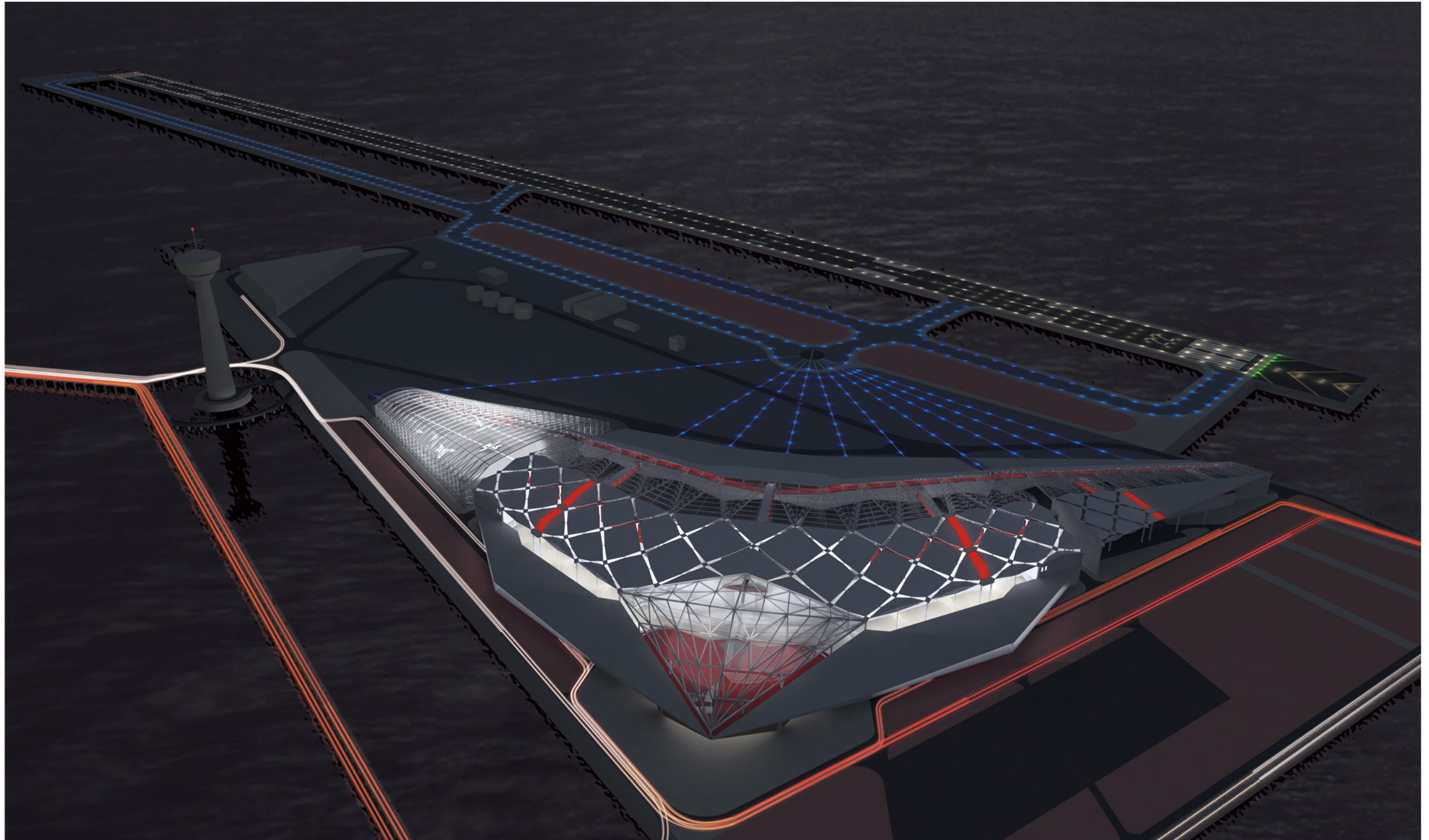
Currently, flight services for tourists traveling to Mt. Fuji are inconvenient.



A bridge extends from the current transportation network, connecting the site with the mainland.

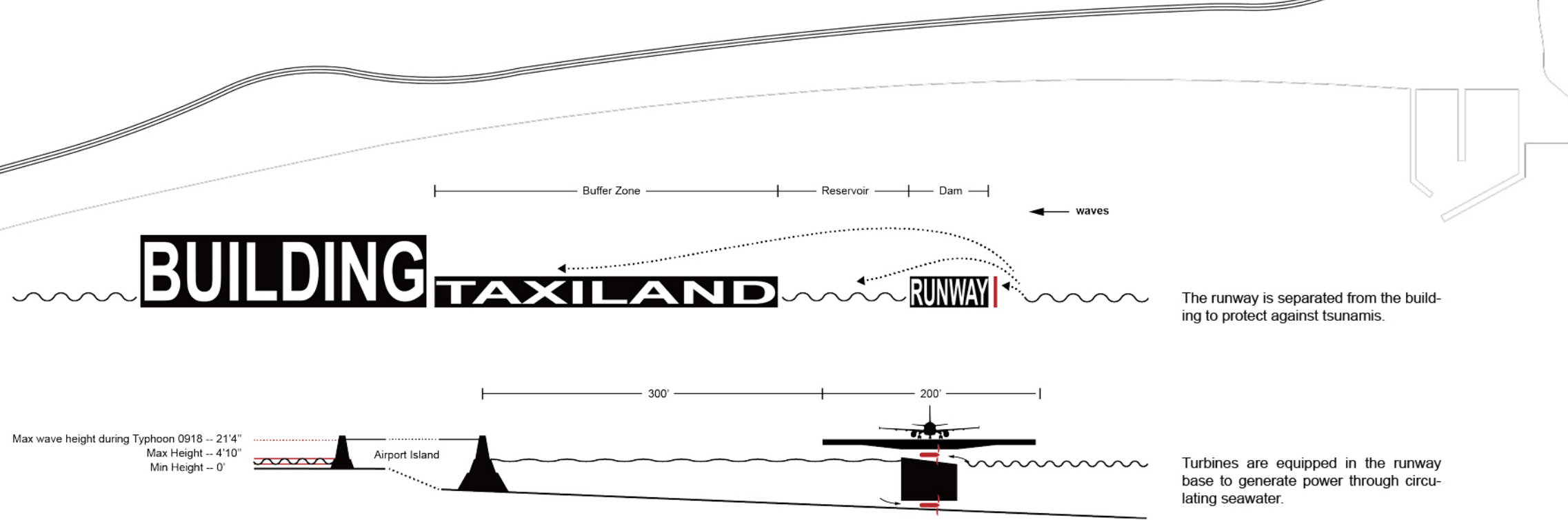


The prevailing winds are a major factor in determining runway directions.



A night scene of the island from the sky: In the background, the runway is outlined by the lights; In the foreground, interior lights penetrate from glass and skylights, illuminating the night sea.

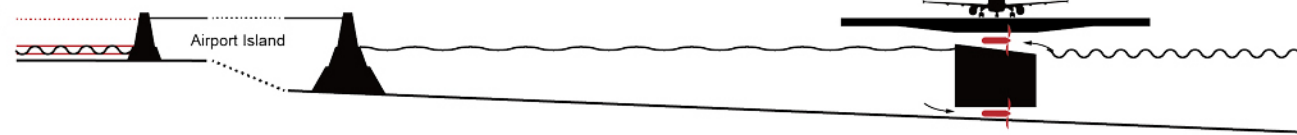
Tsunami Protection & Utilization of Seawater



The runway is separated from the building to protect against tsunamis.

Turbines are equipped in the runway base to generate power through circulating seawater.

Max wave height during Typhoon 0918 -- 21'4"
 Max Height -- 4'10"
 Min Height -- 0'

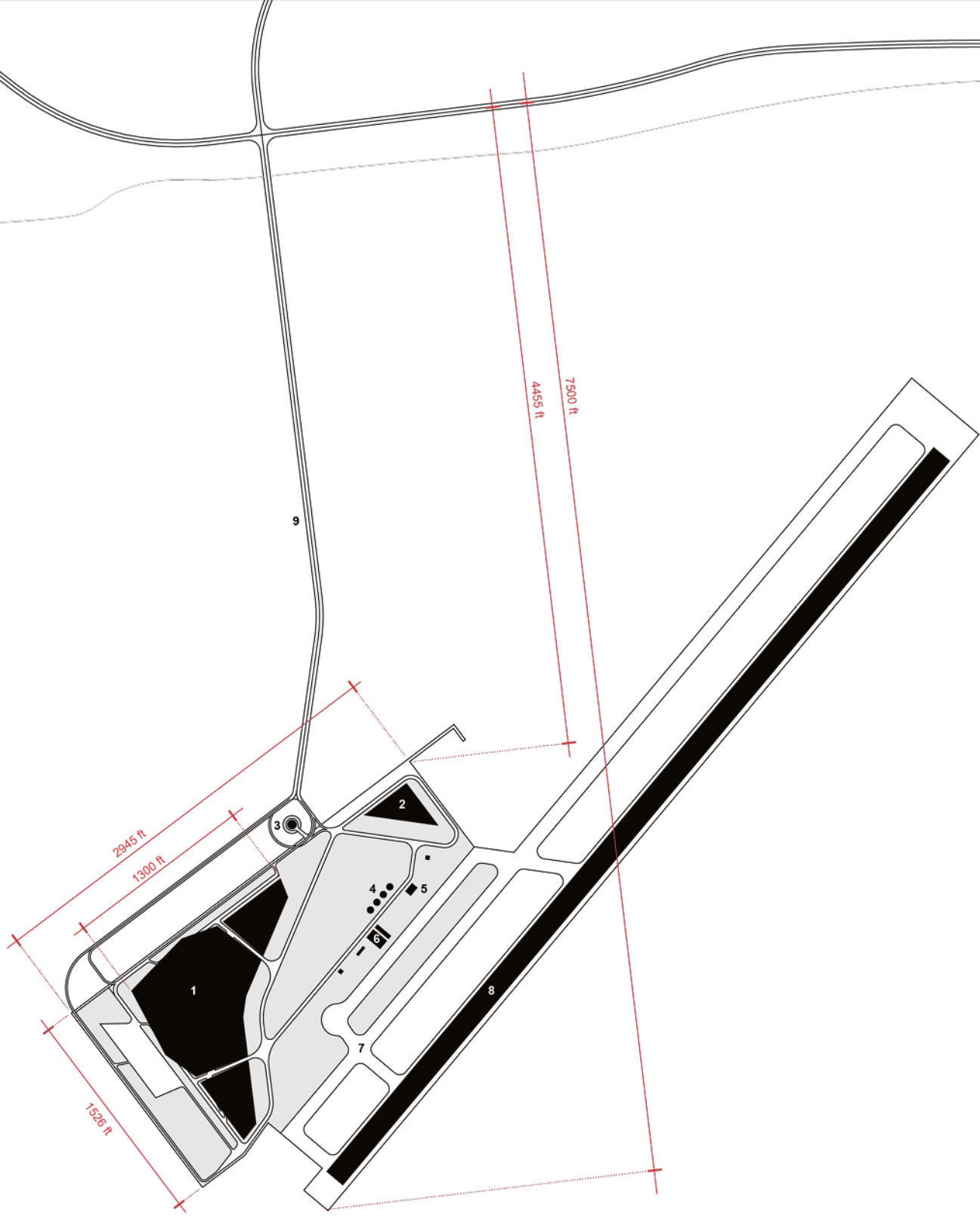


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The elevation of the island is 22 feet, which is determined by the recorded maximum wave height. There has been no tsunami recorded in this area, however, as a precaution, tsunami protection is included in the site layout. The runway is detached from the airport. Should waves come, the runway functions as a dam to the building. In extreme cases, the taxi area would work as a buffer zone to protect the building. Moreover, to make full use of this layout and natural resources, the runway dam and the reservoir in-between can also become a power station to serve the airport.

Site Section





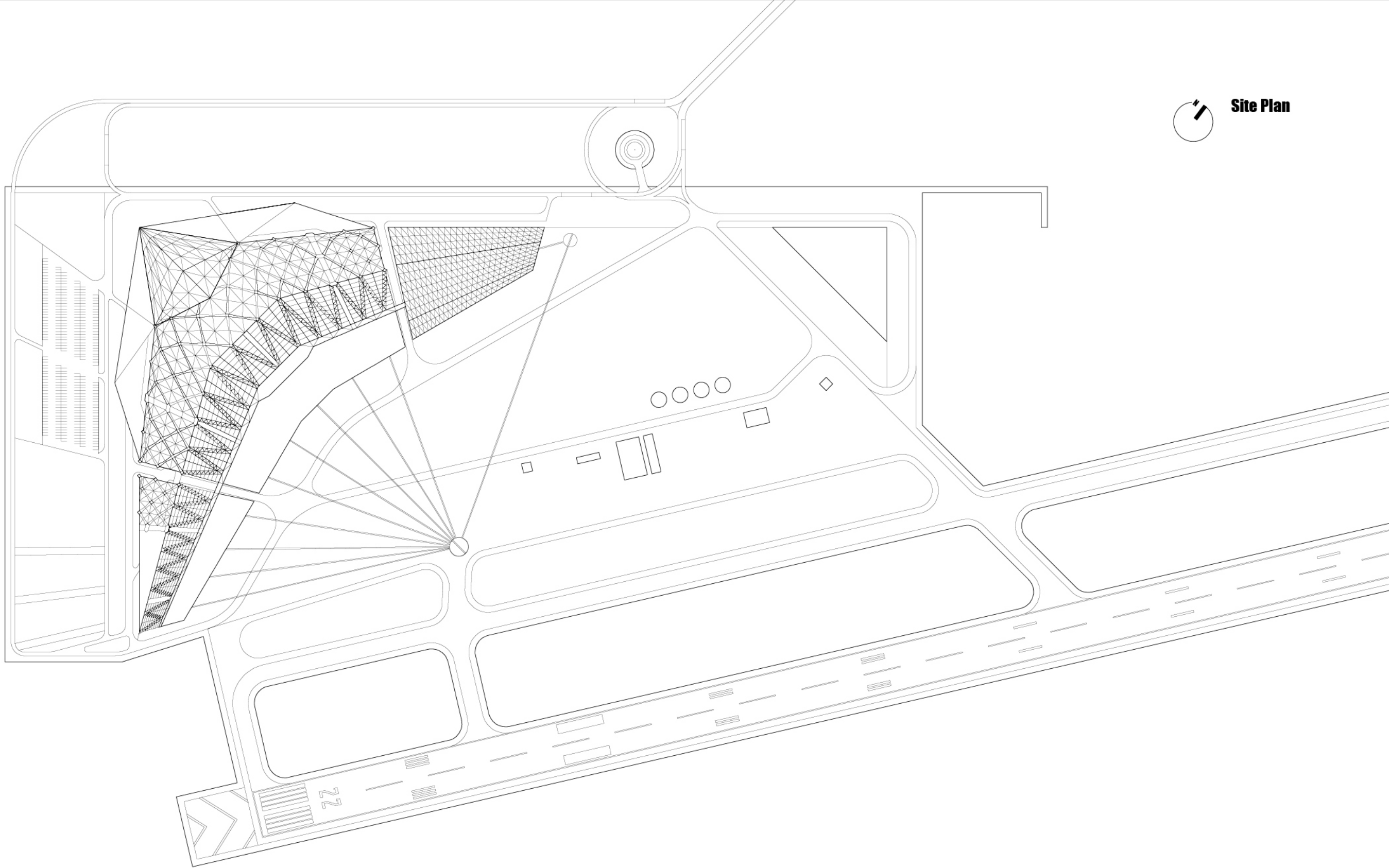
Site Layout

Airport Terminal	1
Dock	2
Control Tower	3
Fuel Farm	4
Fire Station	5
Ancillary Facility	6
Taxi area	7
Runway (150 ft x 6575 ft)	8
Bridge	9

EL 29'7"

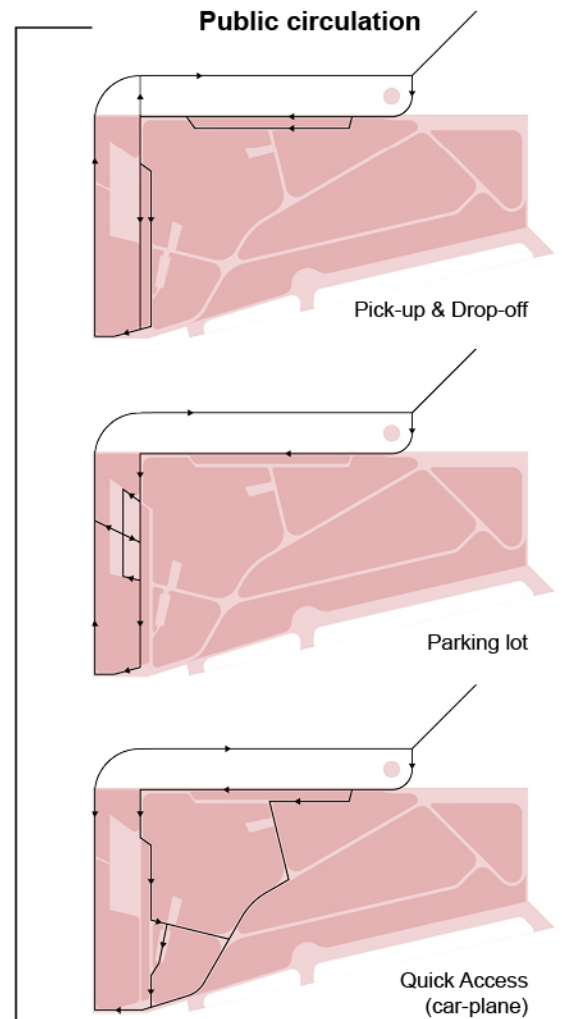
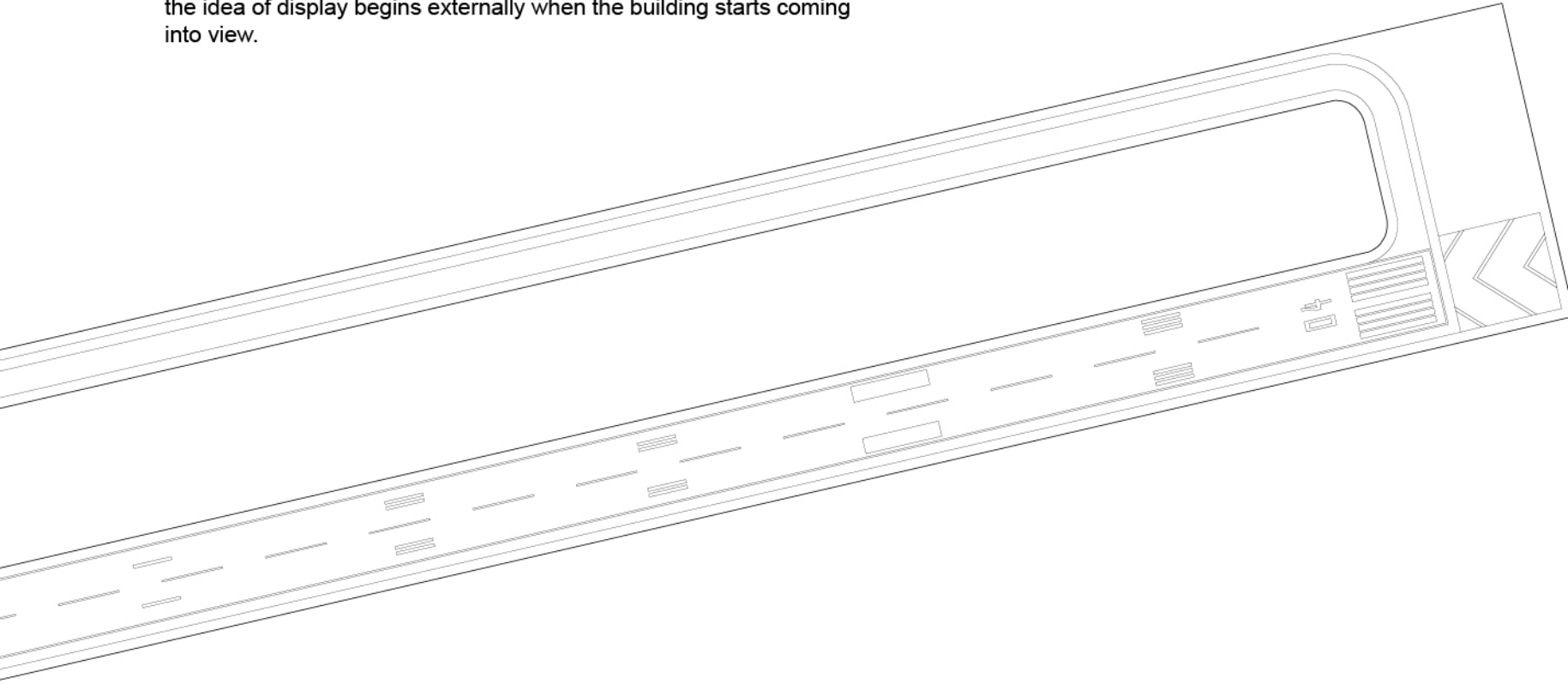


Site Plan

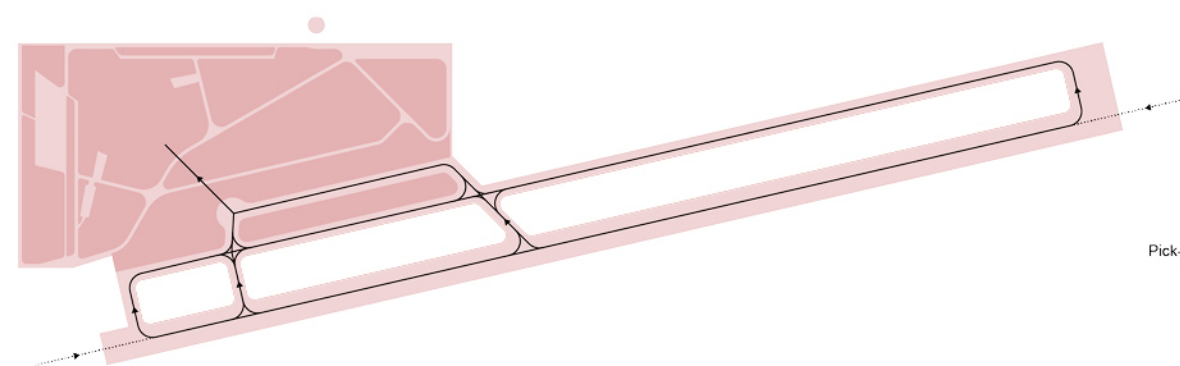


0 50 100 250 500 1000 feet

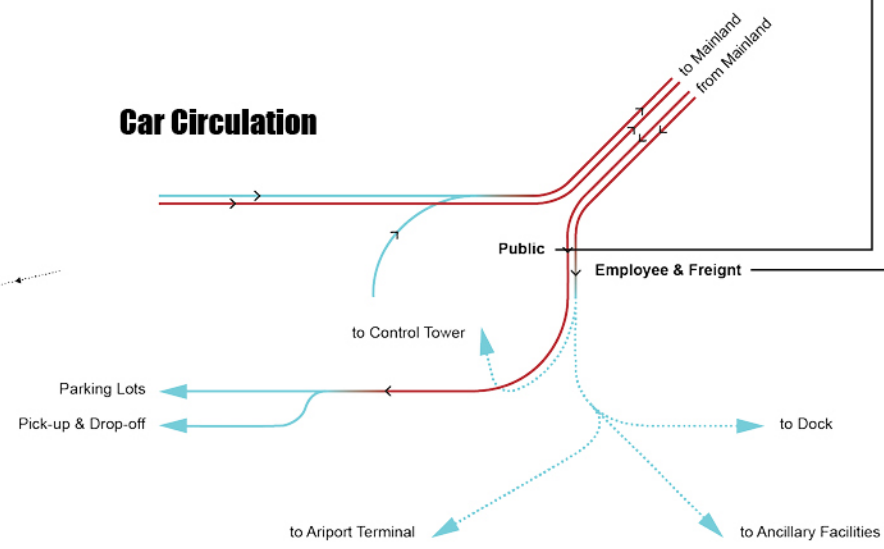
Visitors who come to the airport can be divided into two groups. One uses ground transportation and arrives from the mainland. The other group uses aircrafts and arrives from the sky. They have different routes, as well as views when approaching the building. While both routes are designed to pave the way for display inside the building, the idea of display begins externally when the building starts coming into view.



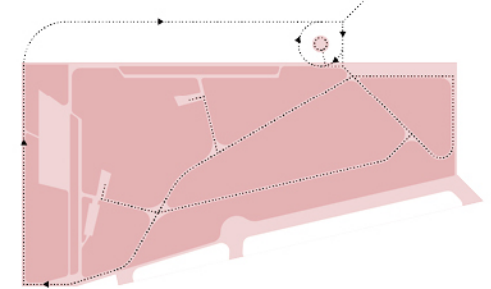
Aircraft Circulation



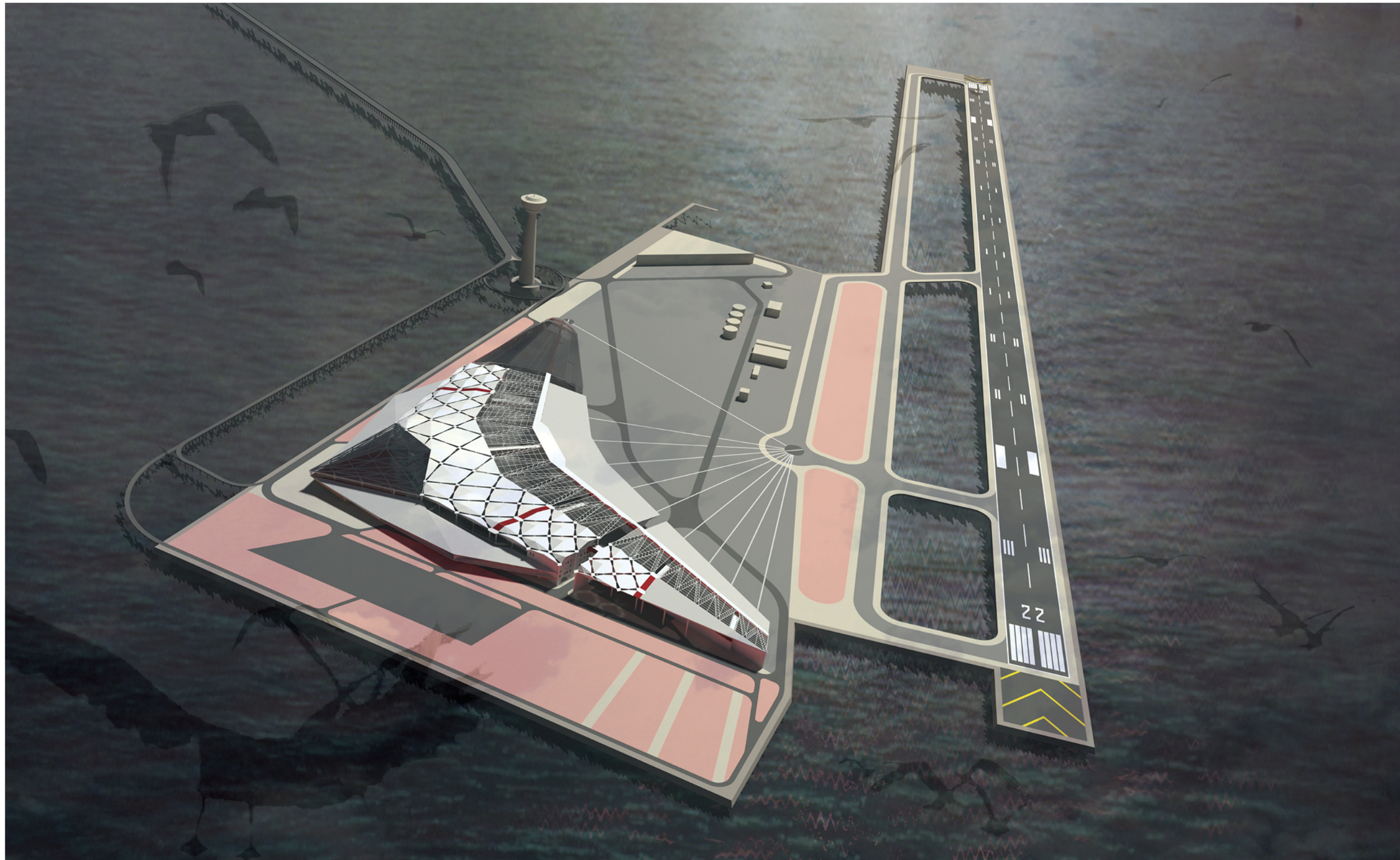
Car Circulation



Employee & Freight circulation

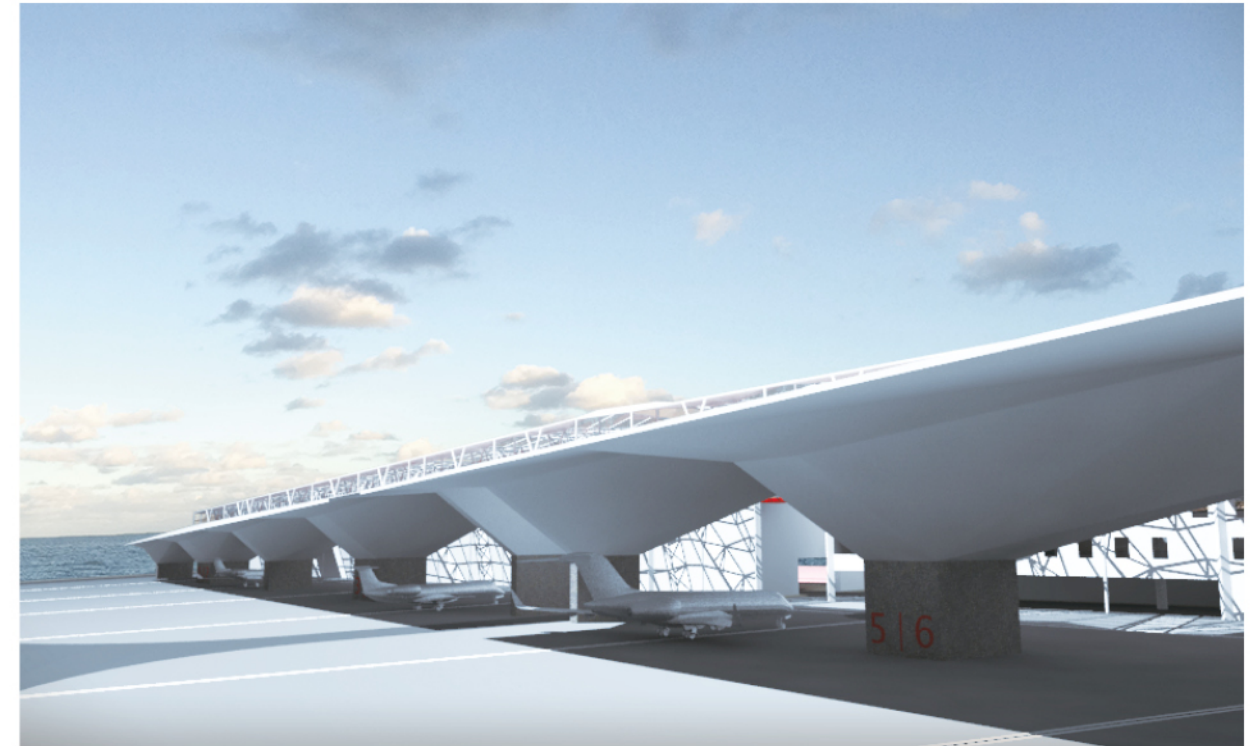


EL. 22'
EL. 34'



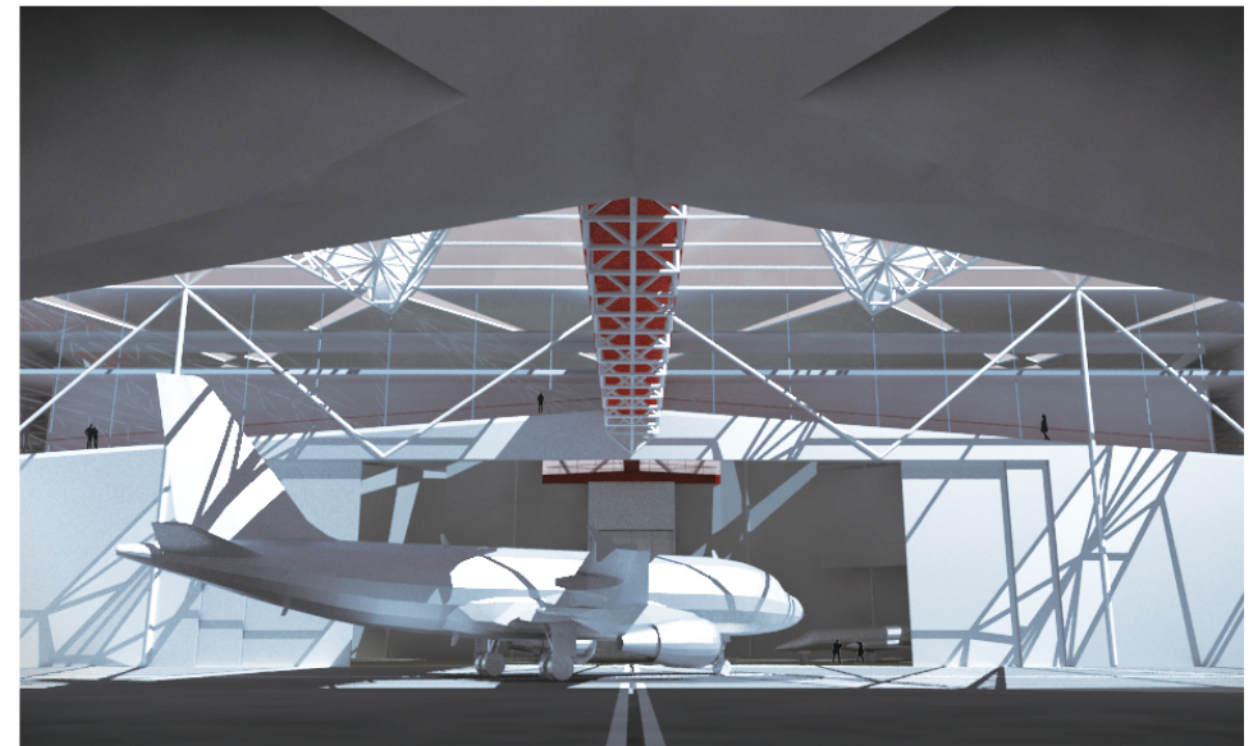
A Sequence of Views of Visitors Who Arrive By Aircraft

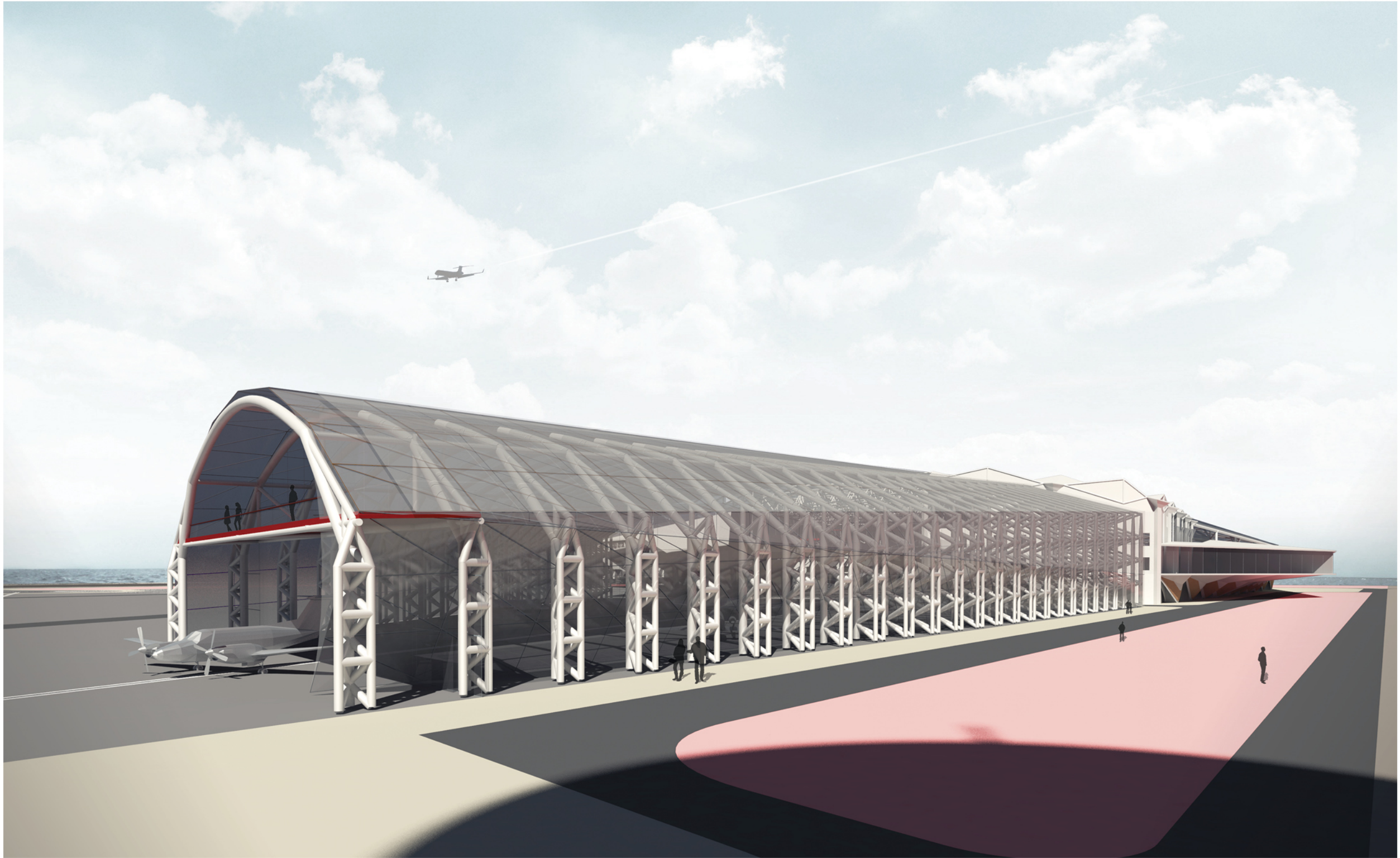
While being towed to the drop-off point, arriving passengers can see various parked aircrafts as static exhibits.



Looking from a distance, the triangle-shaped building parallels the form of an aircraft. Thus, the building that exhibits planes within is also an analogical display itself.

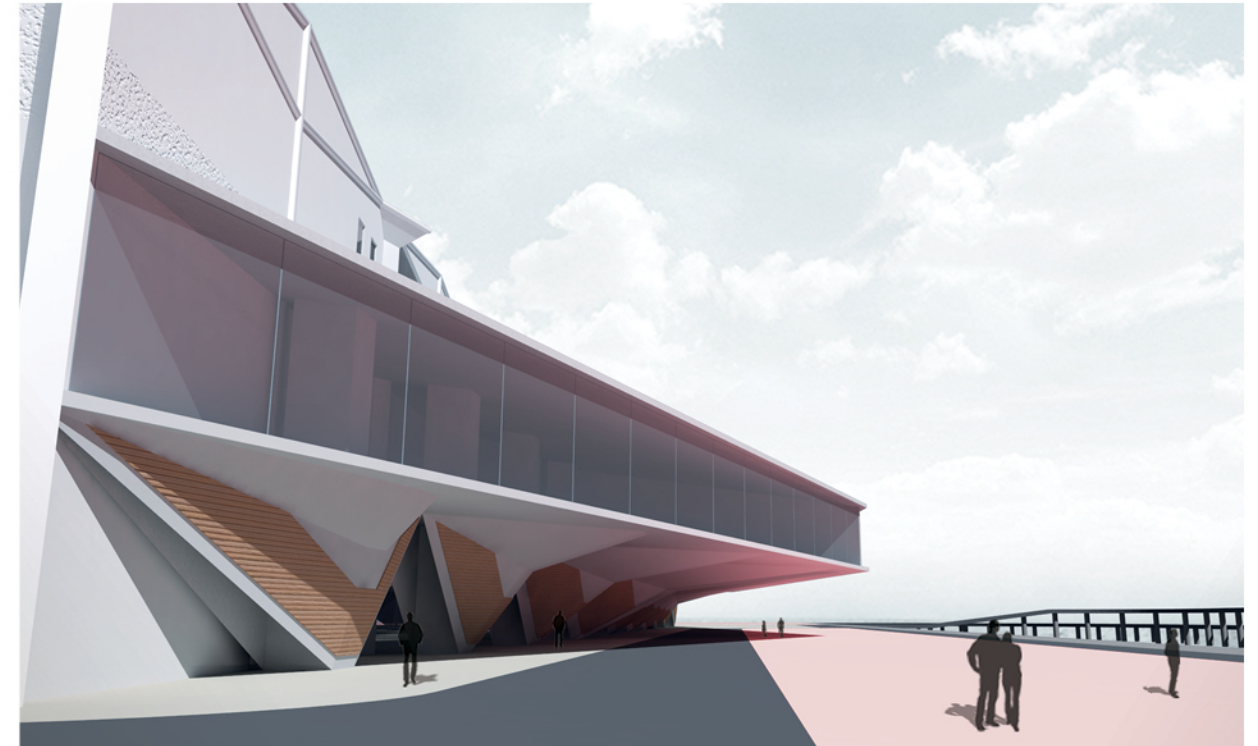
When getting off the aircraft at the rear entrance, the overwhelming plane-scale space gives passengers a sense of arrival.





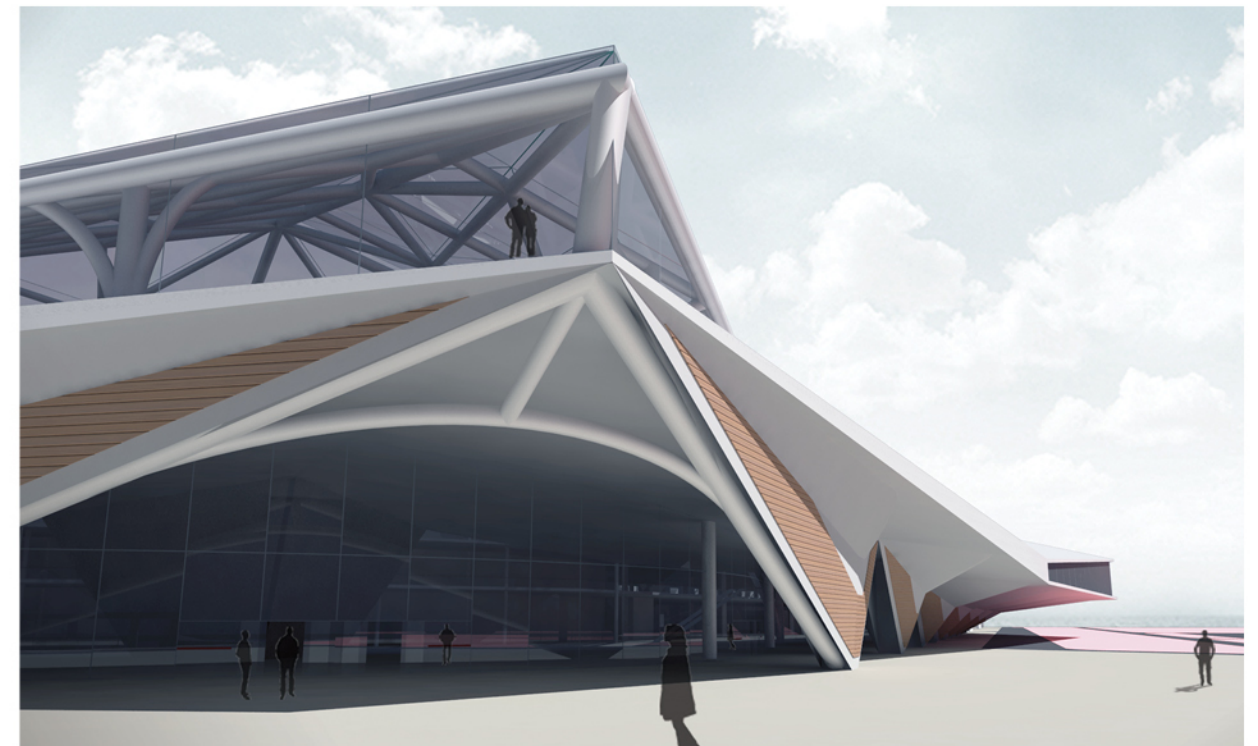
A Sequence of Views of Visitors Who Arrive By Car

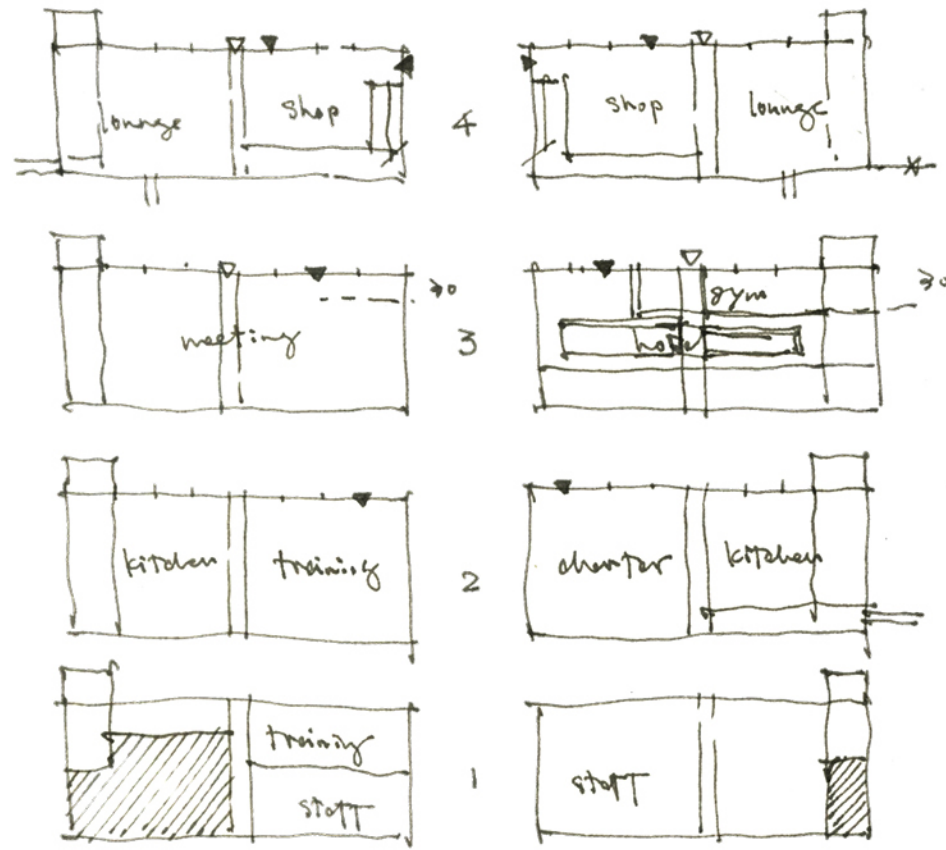
The repetitive and subtly changed cantilever structural units illustrate the rhythm in architecture.



As visitors get closer, they will have a passing view of the real exhibit, the aircrafts, from outside. The building and the aircrafts give the visitors a basic understanding of the internal display and arouse interest before they enter the building.

Wood panels help to adjust the building from plane scale to human scale.



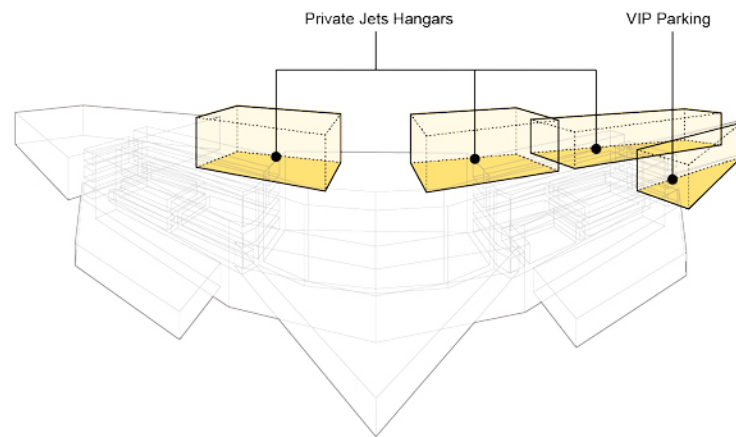


AN AIRPORT AND A MUSEUM

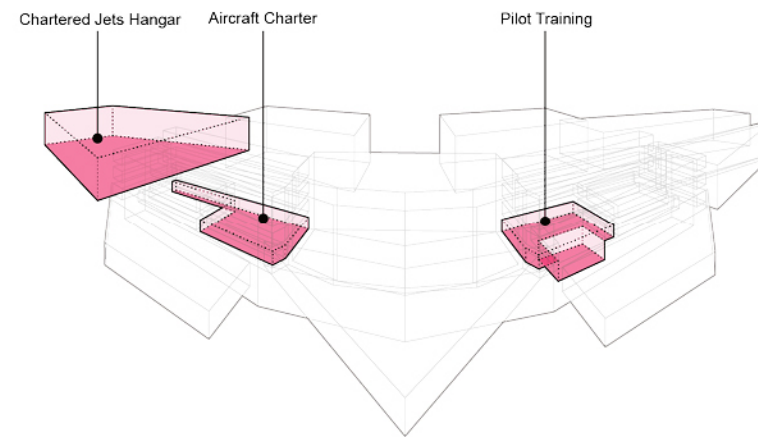
As a fully-functional airport, the building includes complex programs for flight-related and auxiliary services. Flight-related services are private aircraft arrival and departure services, aircraft charters, and pilot training. Auxiliary services provide spaces for food, shopping, accommodations, and conferences. Every program in the building supports the idea of display and makes the concept practical.

Diagrams of Spatial Programmatic Volumes

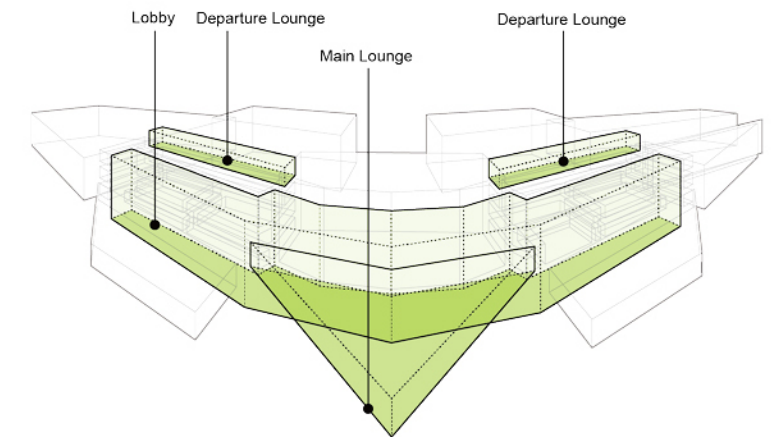
Private aircraft services



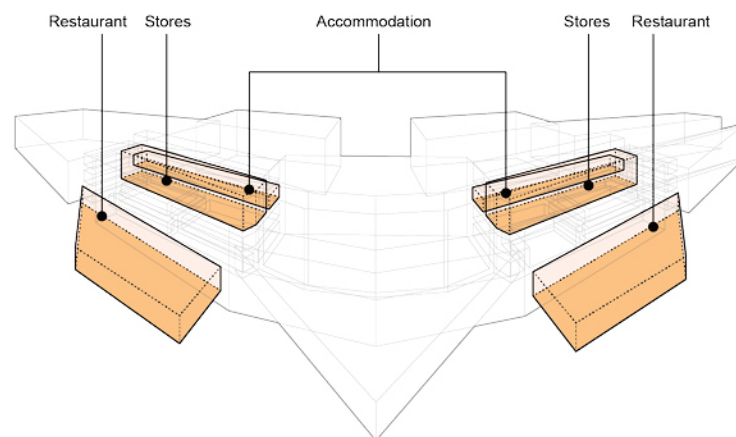
Flight charter and training



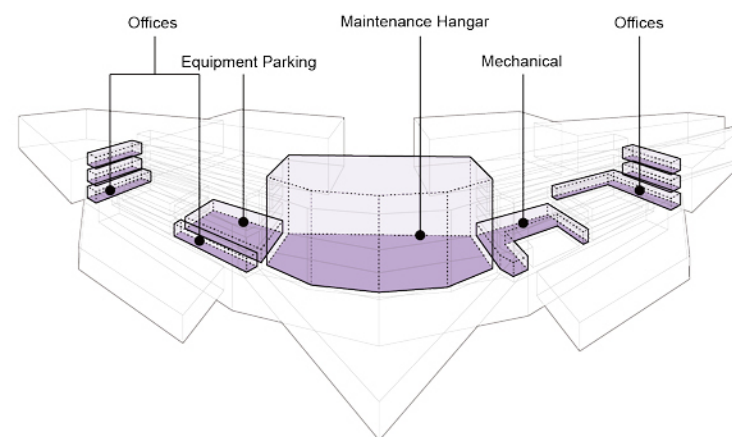
Lounge



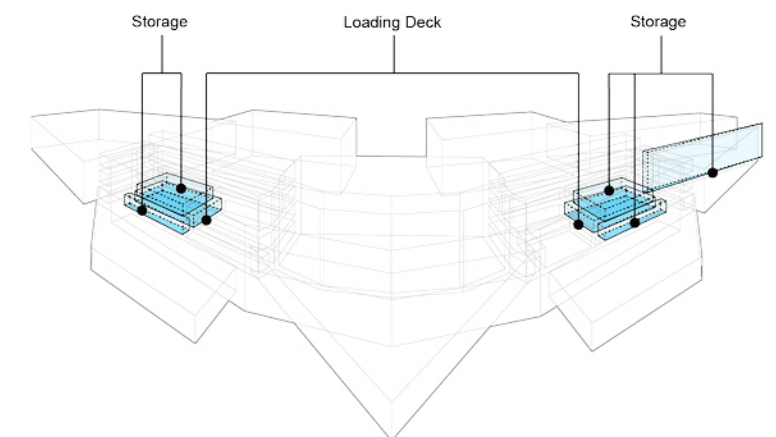
Auxiliary services

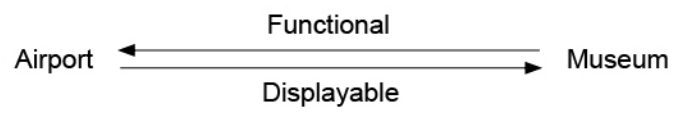


Employee

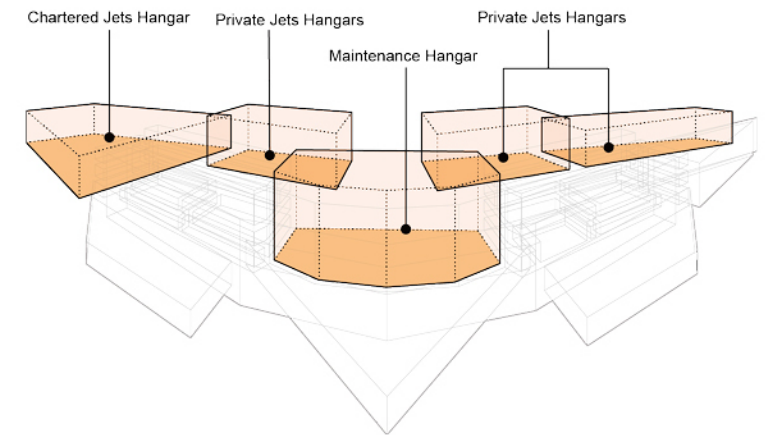


Freight

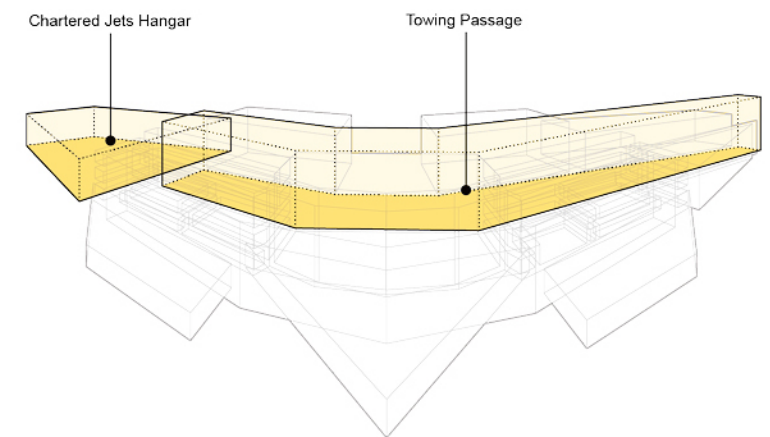




Static Display

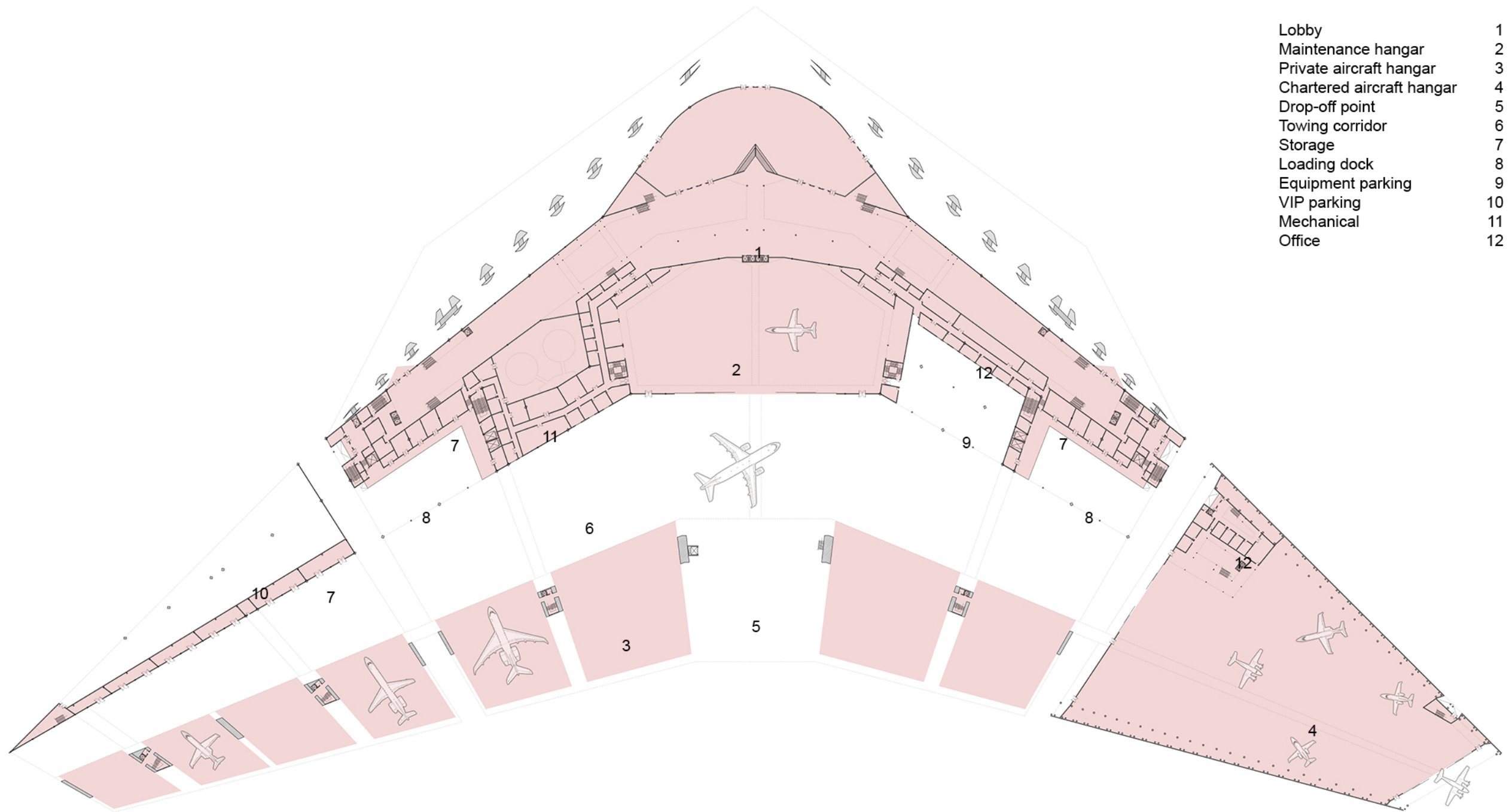


Dynamic Display



Entrance Level

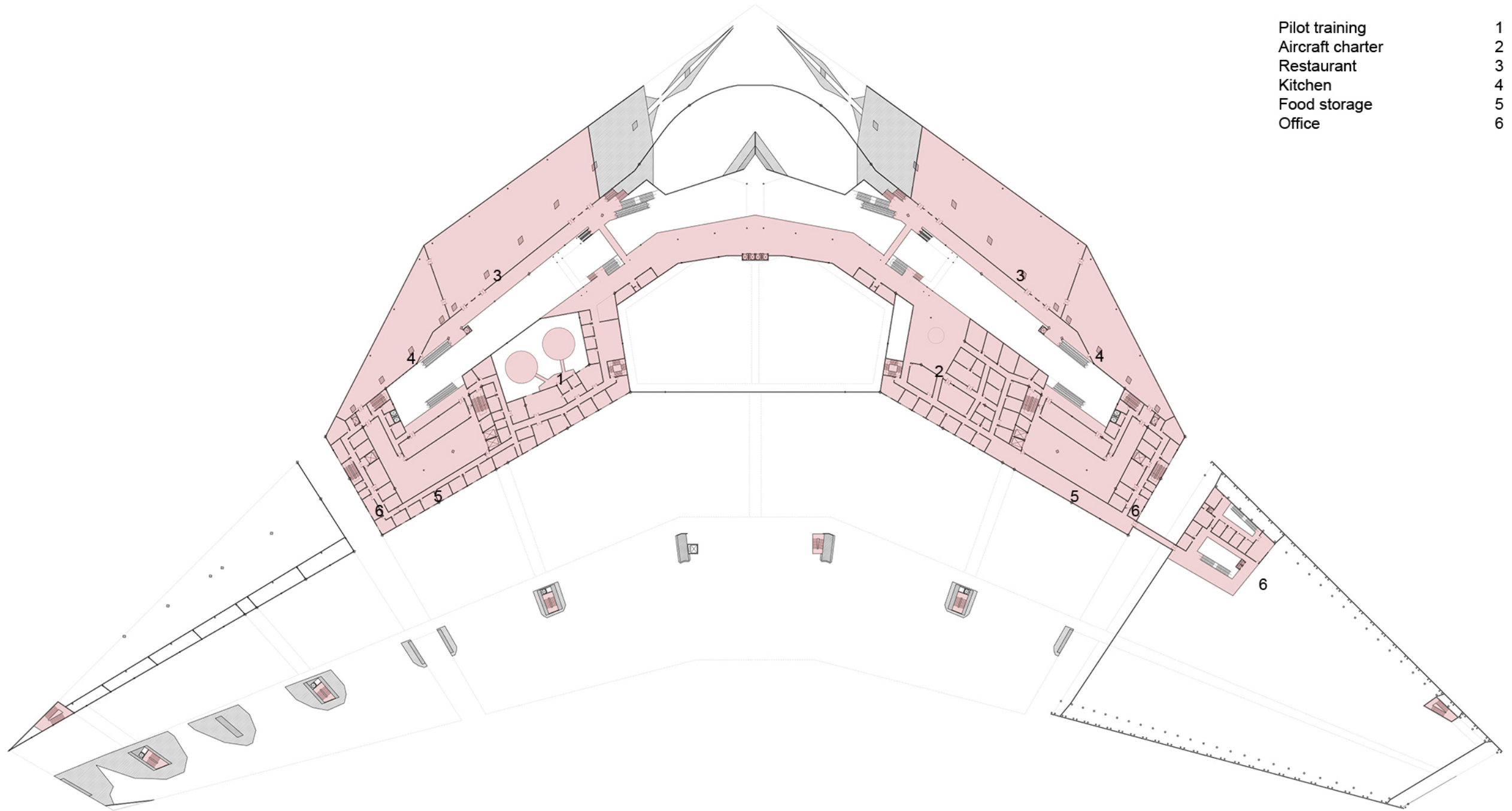
Lobby	1
Maintenance hangar	2
Private aircraft hangar	3
Chartered aircraft hangar	4
Drop-off point	5
Towing corridor	6
Storage	7
Loading dock	8
Equipment parking	9
VIP parking	10
Mechanical	11
Office	12



The maintenance hangar is placed in the center of the building. The aircraft towing corridor runs through the middle of the building and separates the terminal section from the hangar section. In order to adapt to different sized private aircrafts, there are eight multiple-dimensioned parking spots in the hangar section .

Flight Experience Level

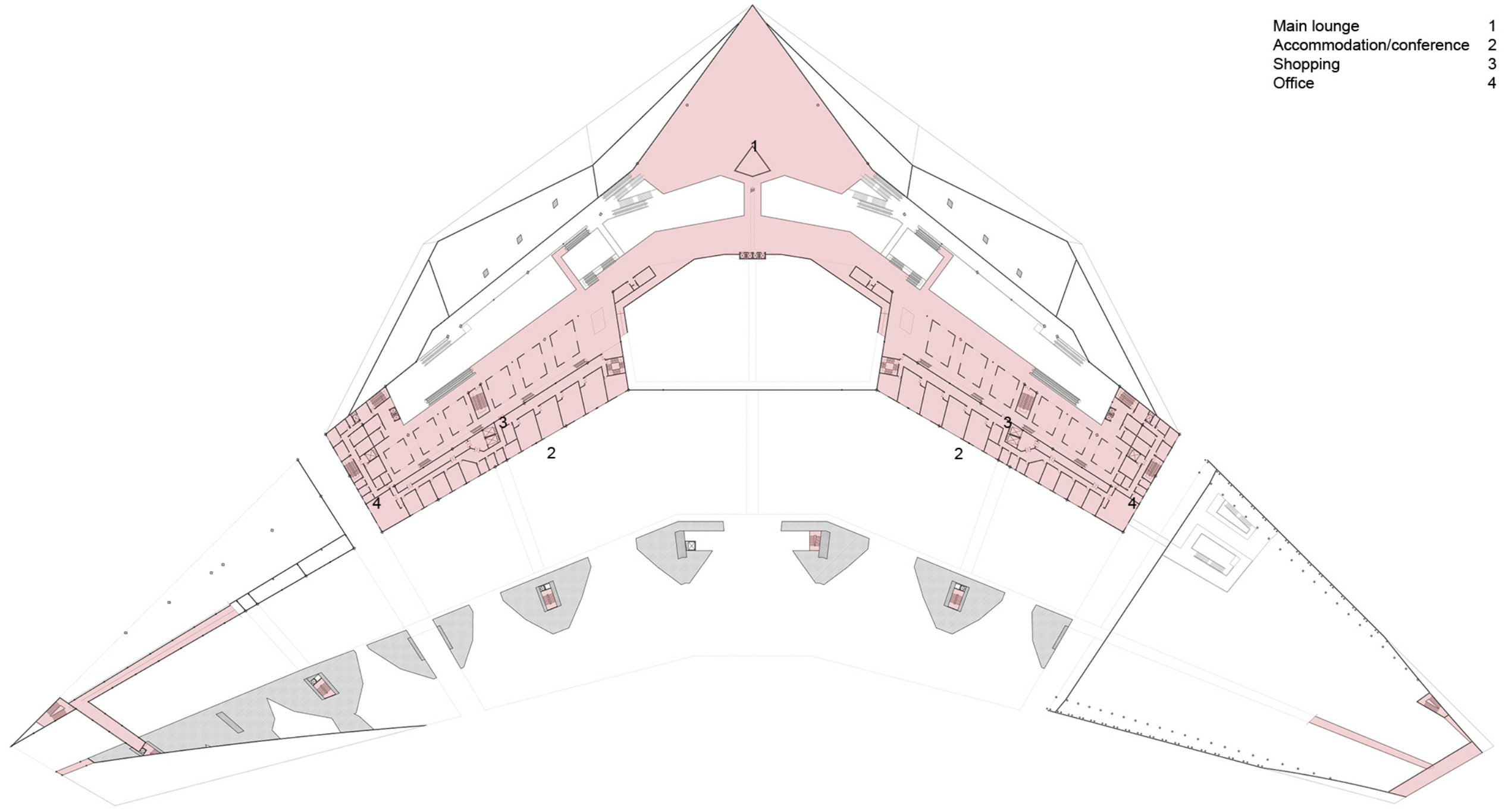
Pilot training	1
Aircraft charter	2
Restaurant	3
Kitchen	4
Food storage	5
Office	6



The airport provides services like pilot training and aircraft charter for visitors who do not own an aircraft but still want to have a flight experience.

Public Spaces Level

Main lounge	1
Accommodation/conference	2
Shopping	3
Office	4

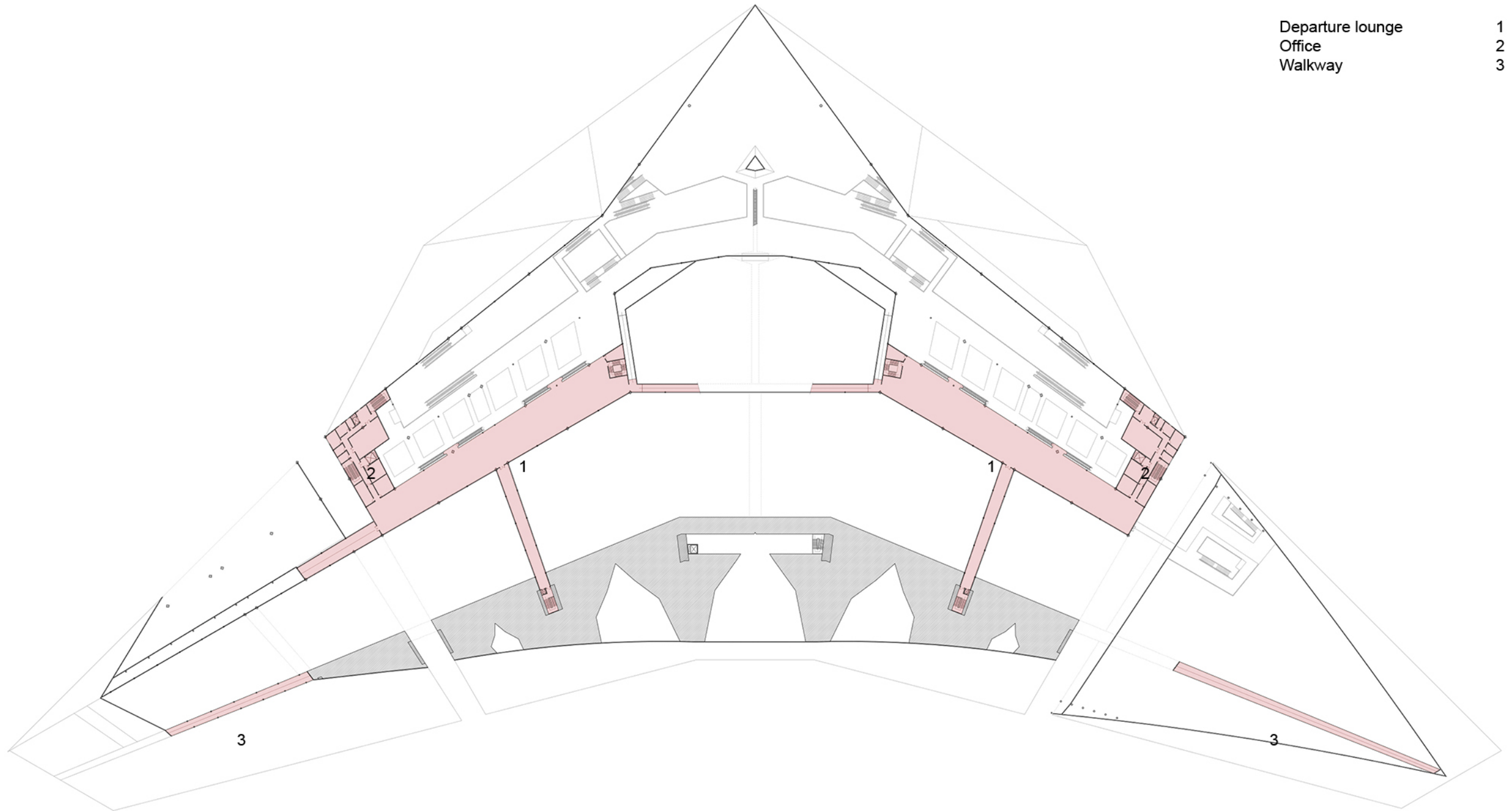


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On the third floor, there is a lounge space above the front entrance, facing Mt. Fuji. The outdoor walkway starts from two ends of the building. It is on top of the private hangars alongside the towing corridor, and gently slopes up to the central axis.

Passenger Departure Level

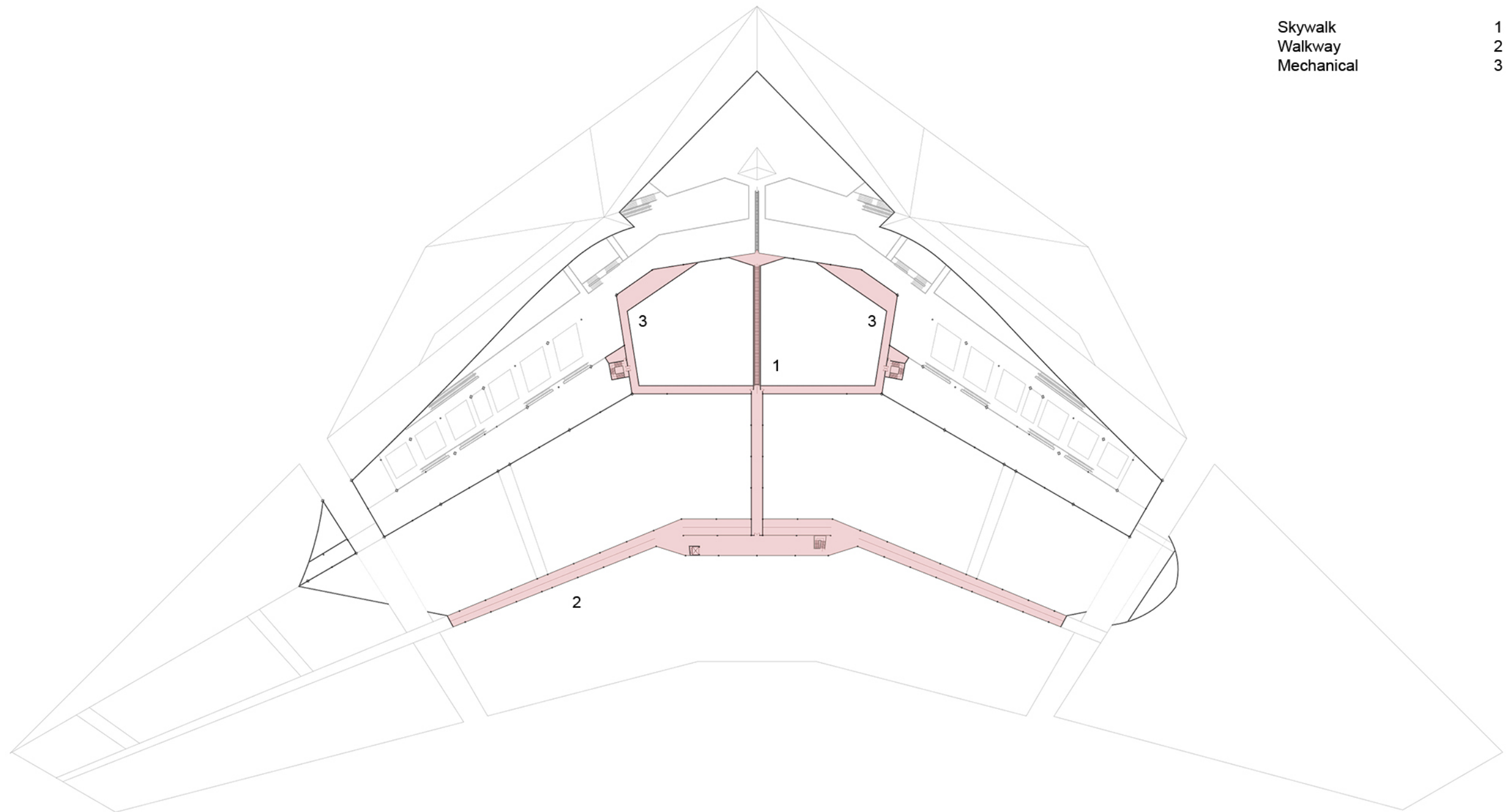
Departure lounge	1
Office	2
Walkway	3



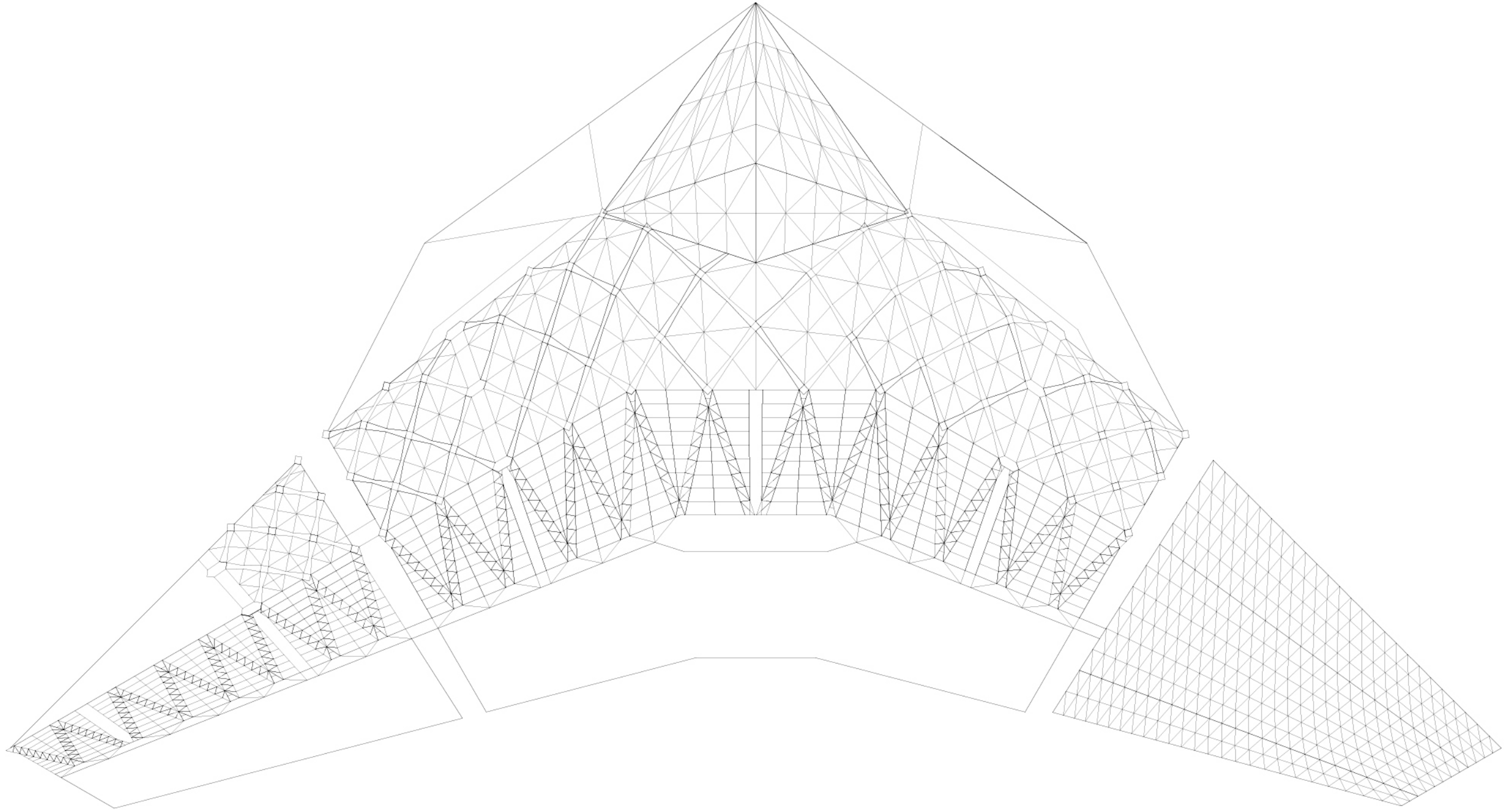
The terminal section and hangar section are connected by five bridges, which are at different levels of elevation. Some bridges lead passengers to their private hangars, while others lead visitors to the outdoor walkway.

Passenger Arriving Level

Skywalk	1
Walkway	2
Mechanical	3

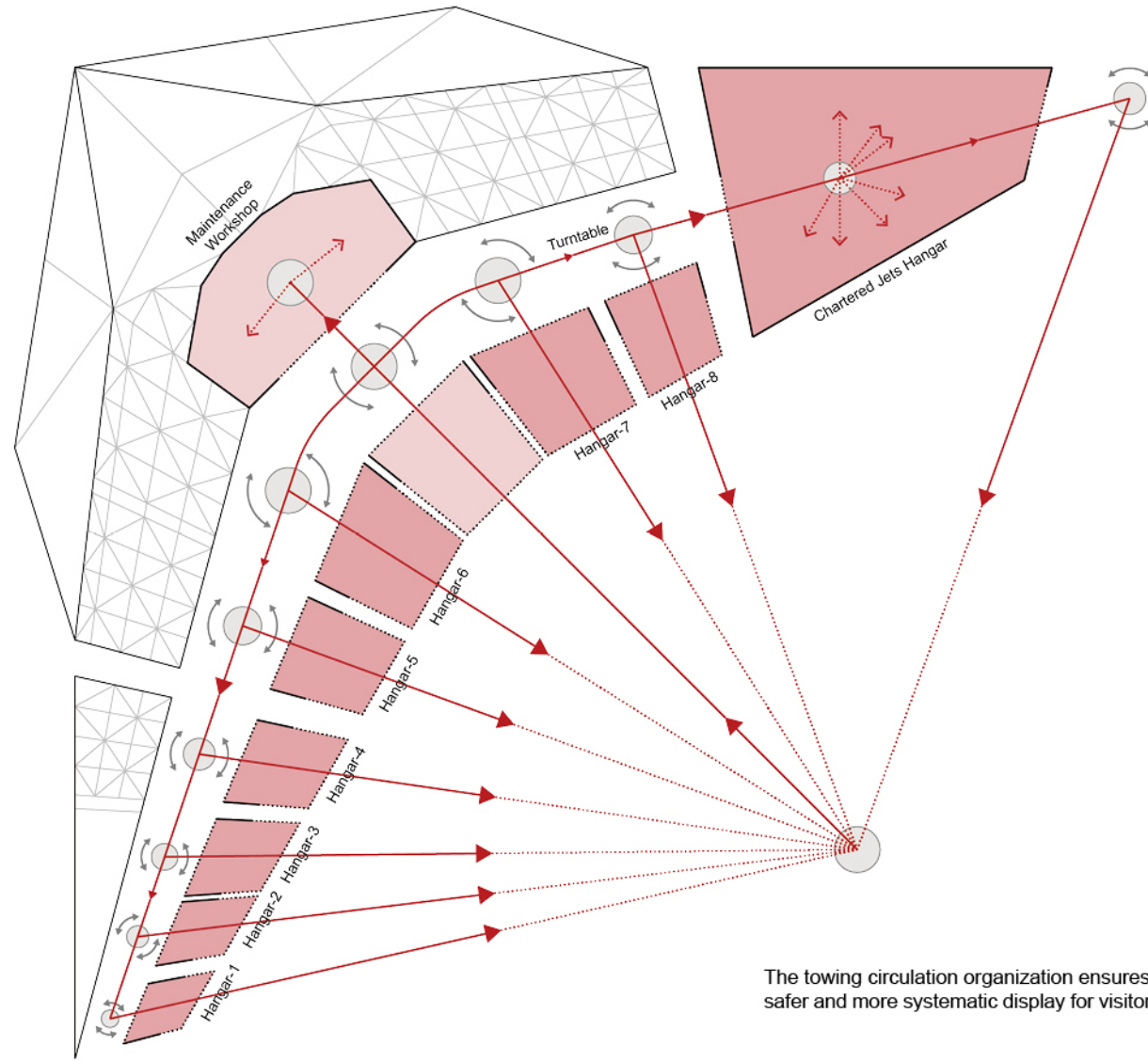


After getting off, passengers will take an elevator to the top level, which is also the highest point of the outdoor walkway. The bridge at the central axis will guide arriving passengers to the terminal section. A skywalk follows the bridge, leading people across the maintenance hangar.

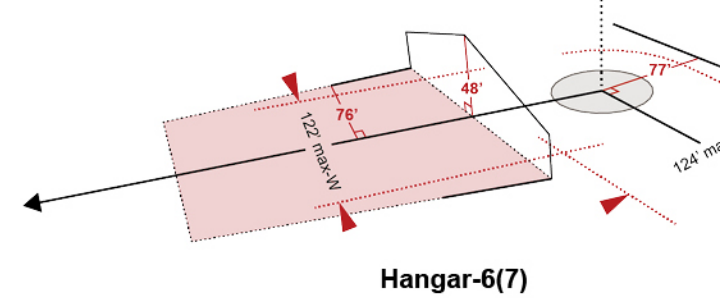
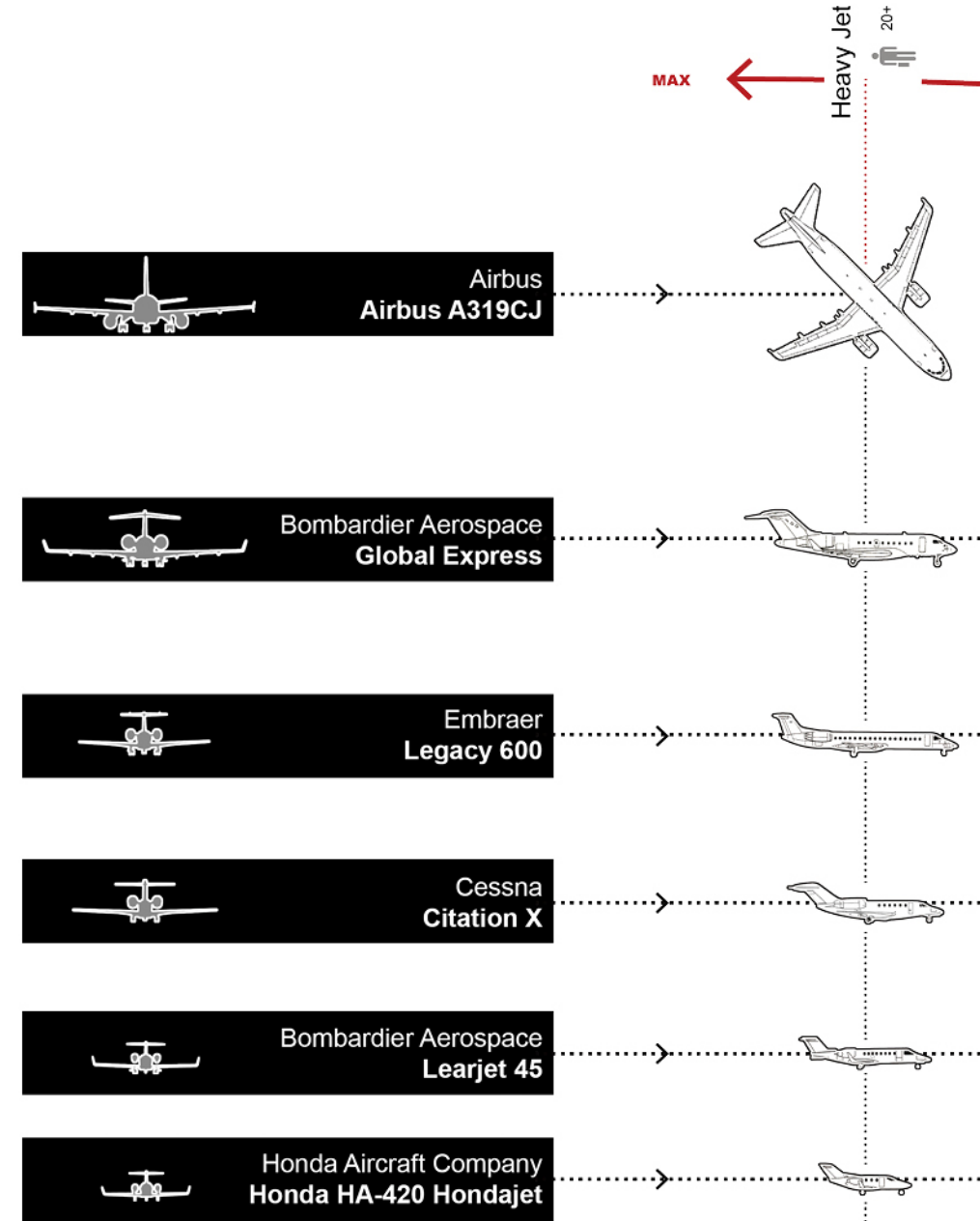


The roof plan exposes the structural system of the project. Different geometric patterns imply that various exhibit spaces are included inside the building.

Towing Circulation



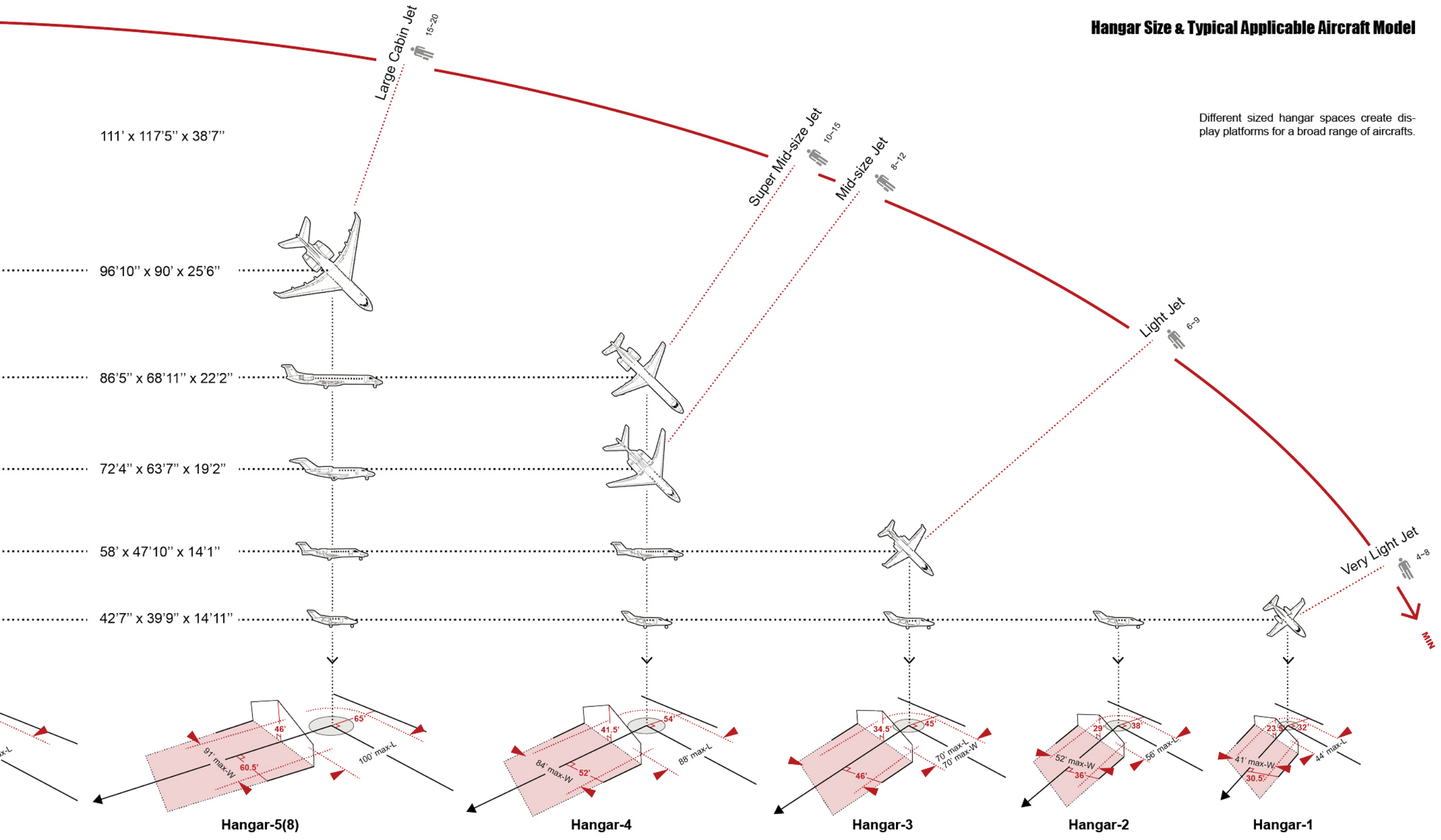
The towing circulation organization ensures a safer and more systematic display for visitors.

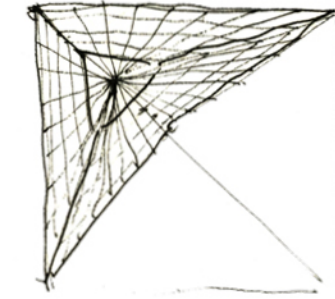
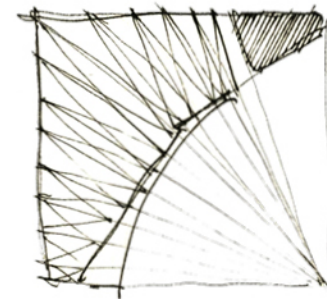
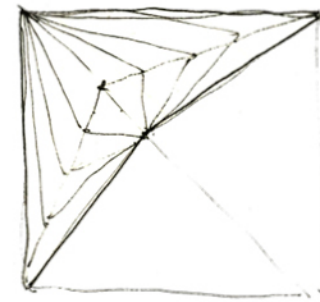
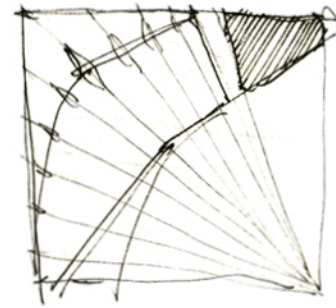
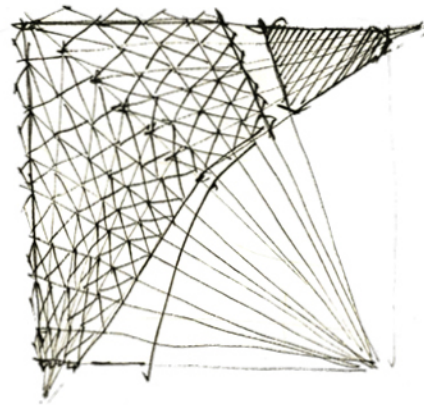


Hangar-6(7)

Hangar Size & Typical Applicable Aircraft Model

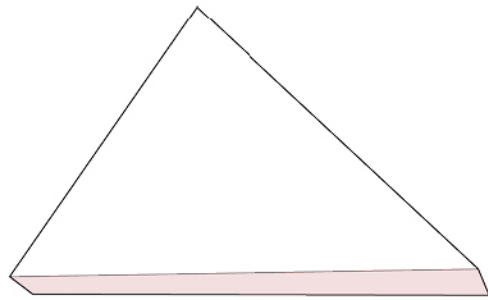
Different sized hangar spaces create display platforms for a broad range of aircraft.



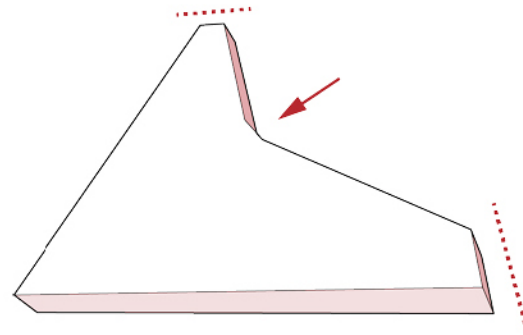


A PLANE-LIKE VOLUME

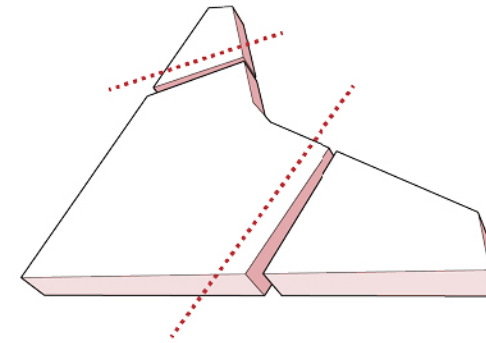
The massing starts as a simple geometric shape and ends as a complex form. In the process, the considerations of exhibit objects, exhibit spaces, and exhibit strategies play important roles.



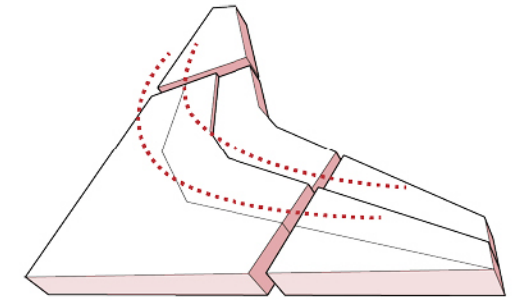
Step 0: starting from the triangle -- a shape that can be associated with aircraft.



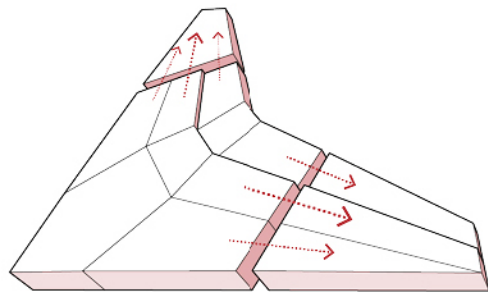
Step 1: highlighting the rear entrance by cutting and squeezing.



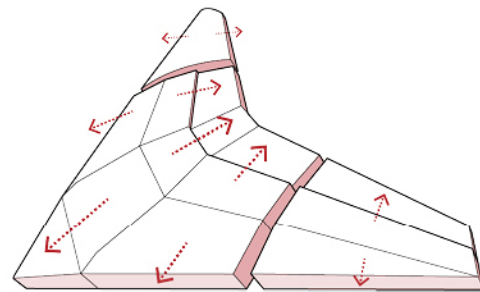
Step 2: dividing the volume to centralize functions and shorten longitudinal circulation.



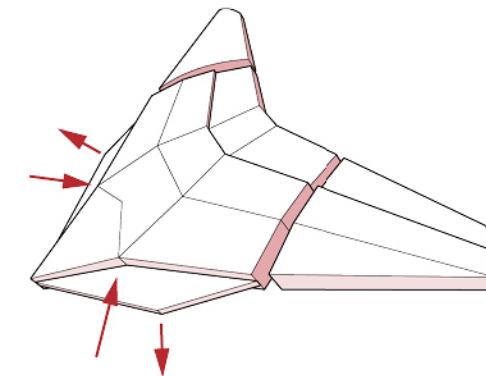
Step 3: subdividing the spaces: exhibit spaces as the inner layer, other functional spaces as the outer layer, and a visual channel in between.



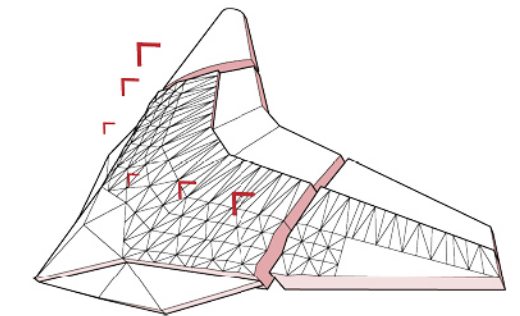
Step 4: using longitudinal slope to Accommodate to exhibit spaces that have different dimensions for displaying different sized aircrafts.



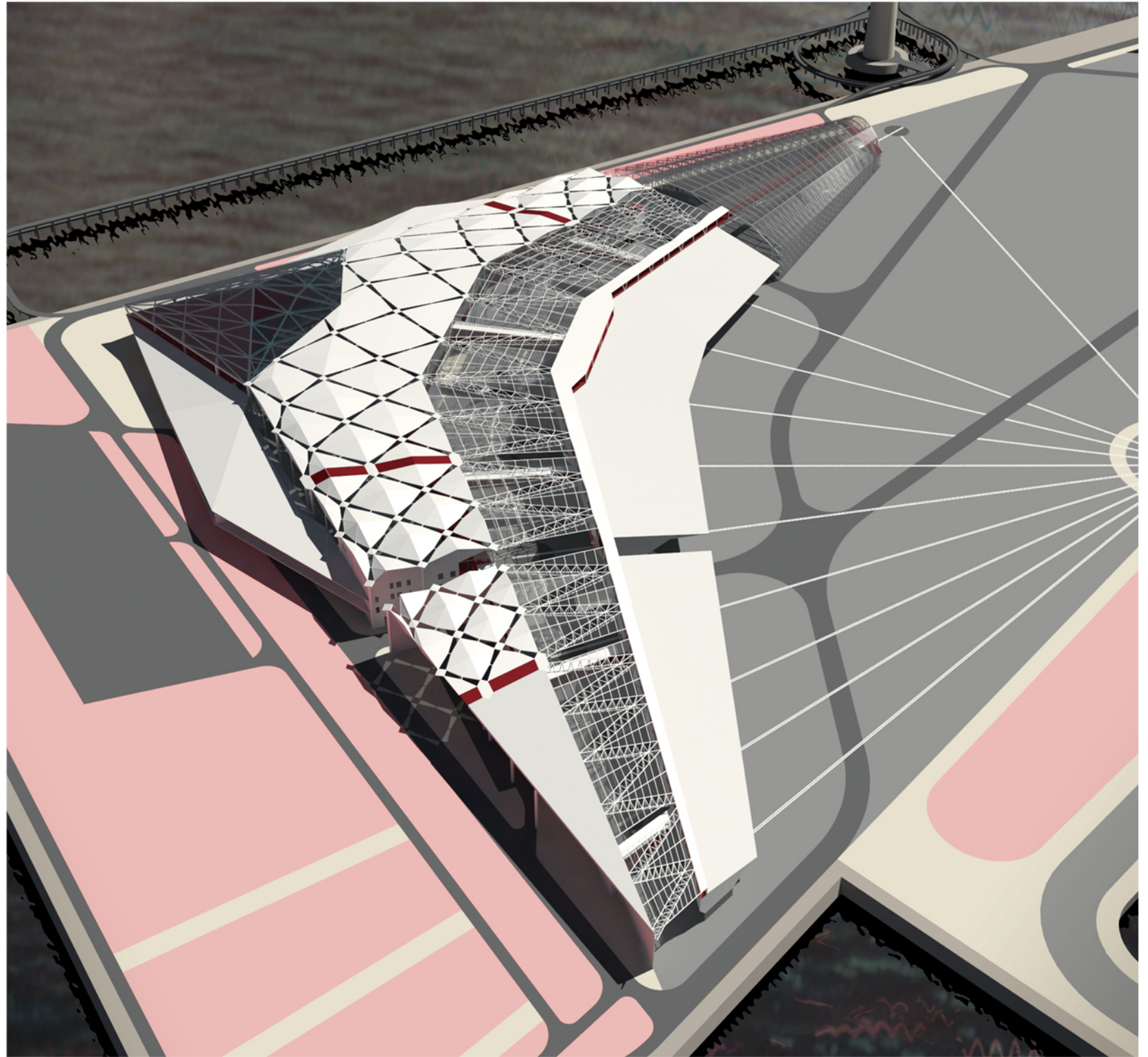
Step 5: applying transversal slope to smooth the skyline.



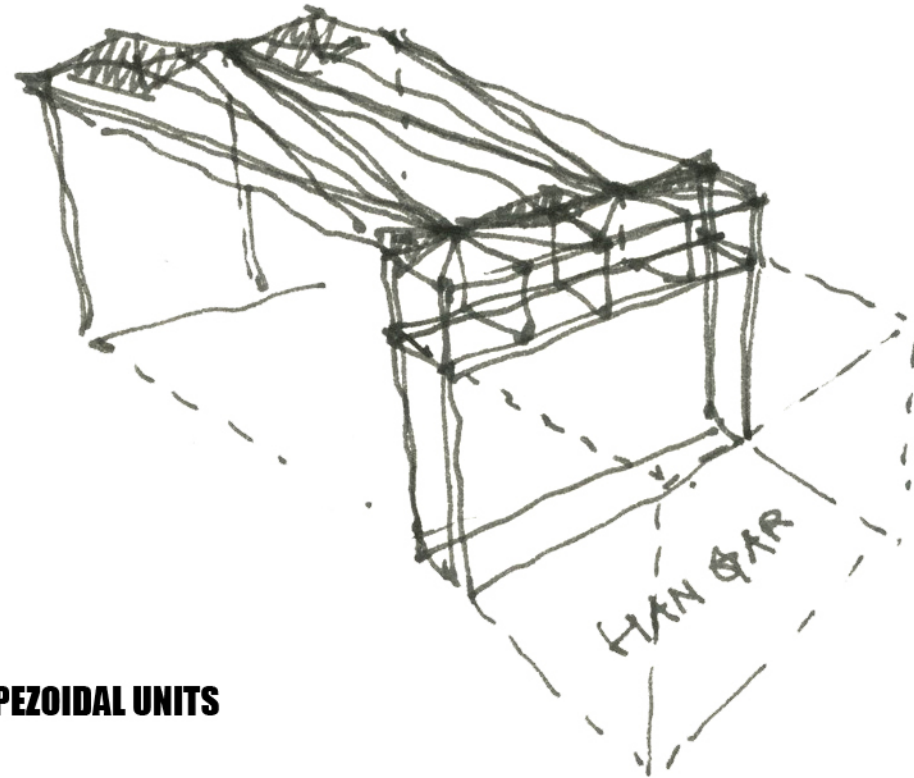
Step 6: highlighting the front entrance by pulling and squeezing.



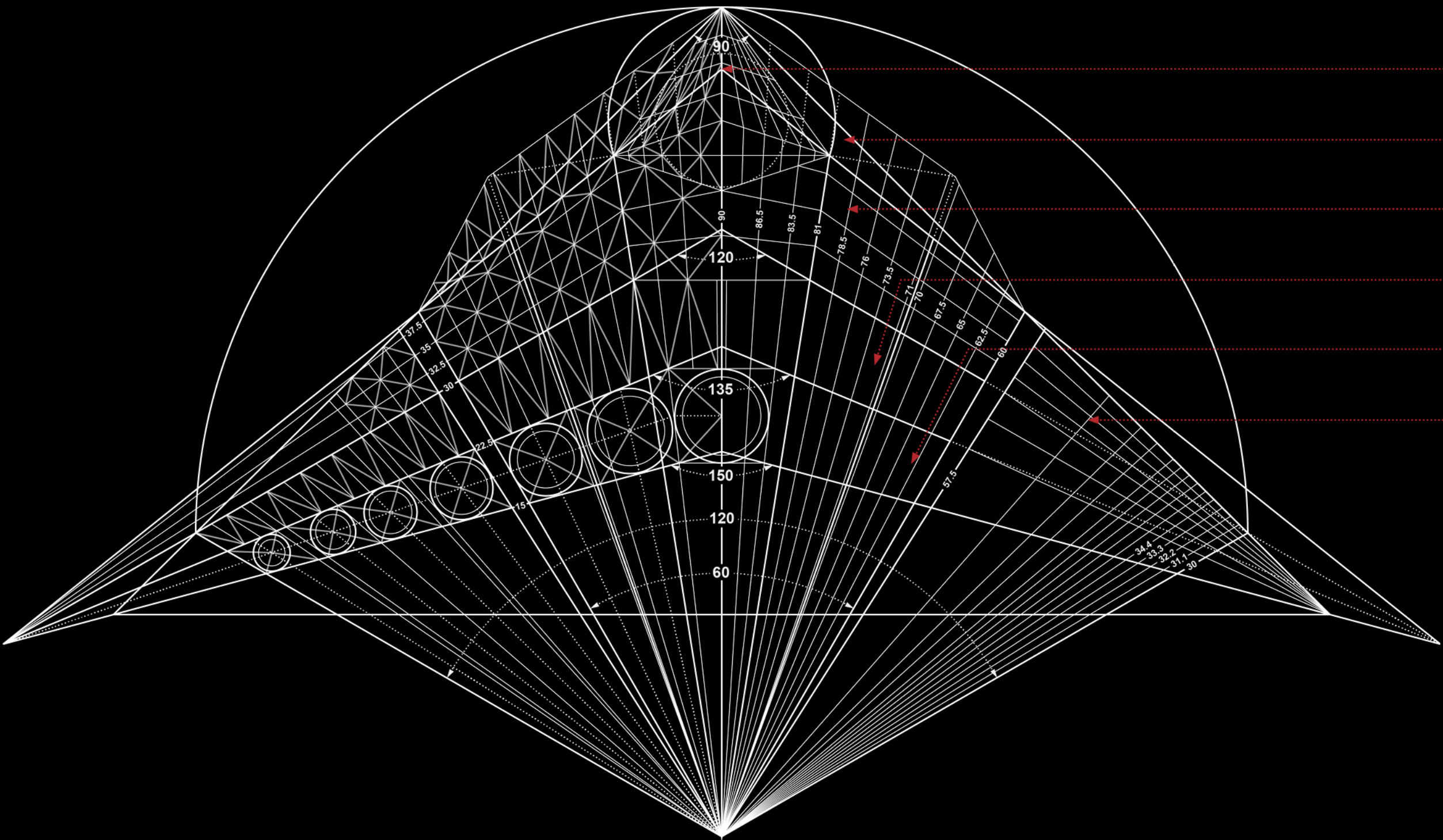
Step 7: folding the surfaces to add features to the project.

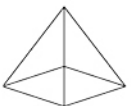

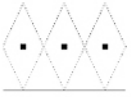
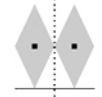
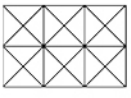
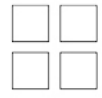



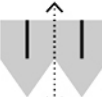
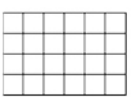



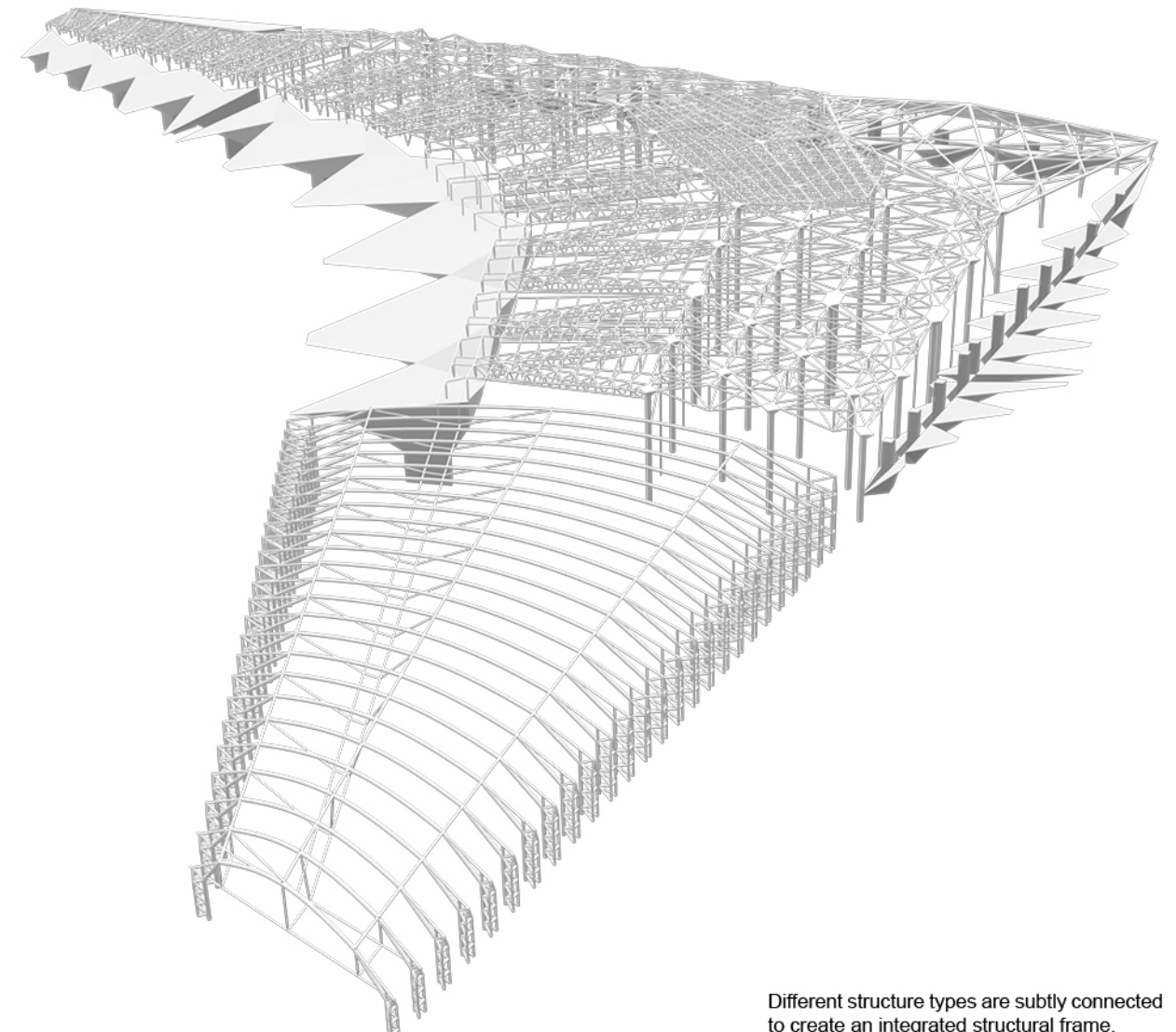
Final result of the manipulation



FLEXIBLE TRAPEZOIDAL UNITS

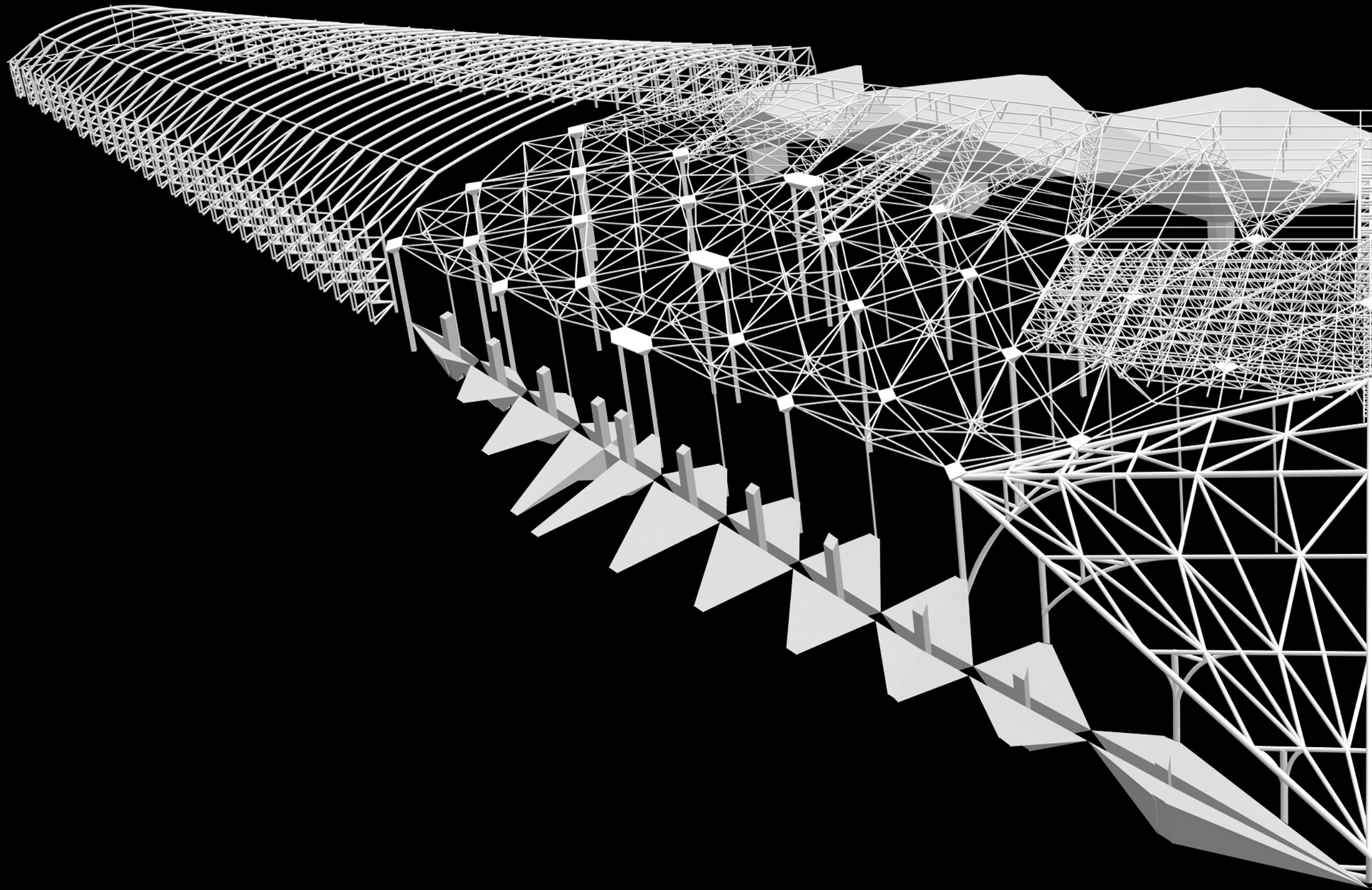


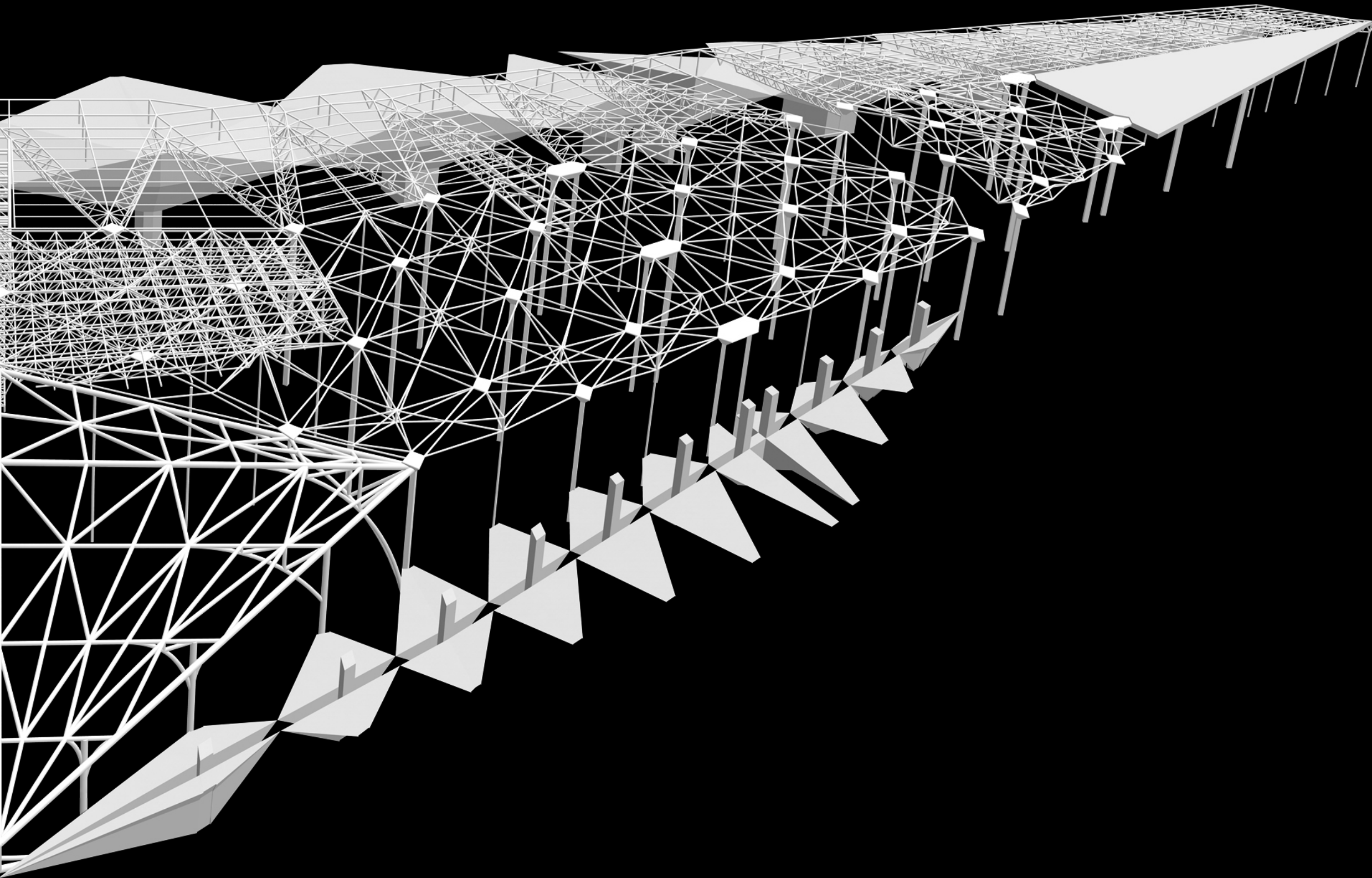
Structure type	Pattern	Feature	Function
1		 Entry	Entrance to the building
2		 Transition	Transition from outside to inside
3		 Sub-division	Independent functions
4		 Flow	Dynamic display
5		 Open	Individual display
6		 Integration	Integrated display



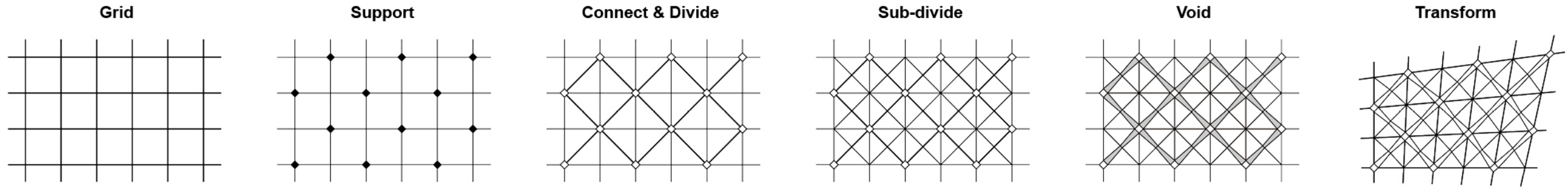
The airport has a complex structural system while the logic is clear and simple. The geometry which the structure is based on consists of 6 different geometric patterns. According to specific functions — static display, dynamic display, or others — a variety patterns are chosen to complement different functions throughout the airport. Flexibility and transformability allow the structure to accommodate the dimension and spatial property changes in exhibit spaces. It also creates smooth transitions from one space to another.

Different structure types are subtly connected to create an integrated structural frame.

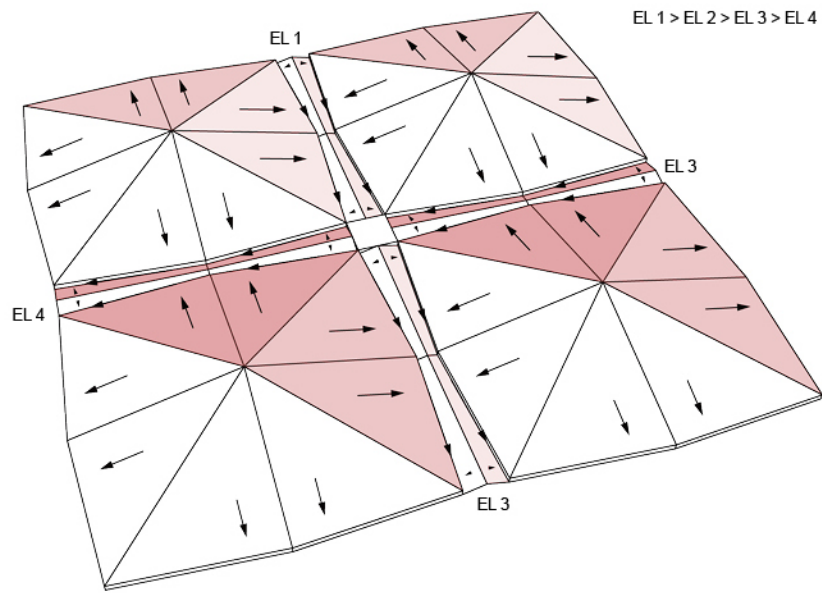




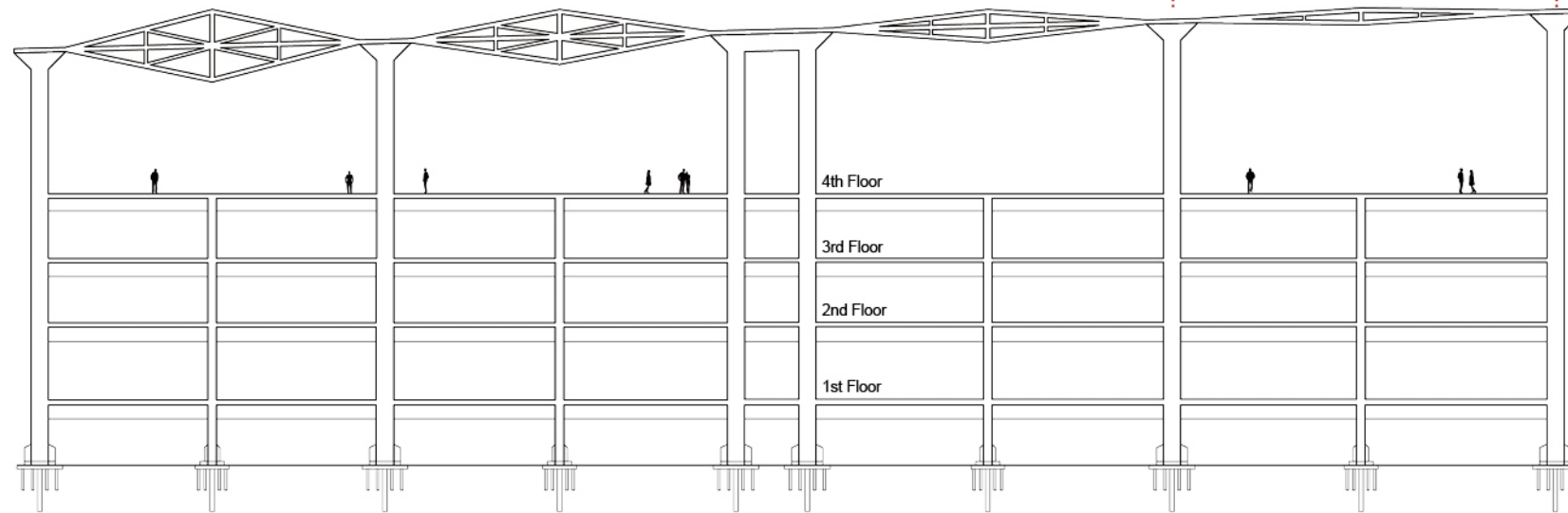
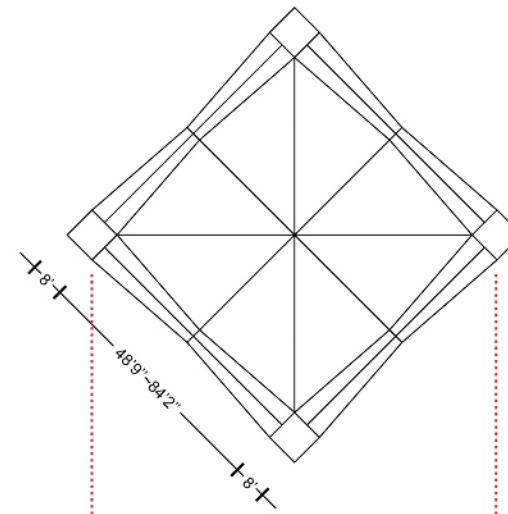
The diamond-shaped roof units cover the terminal part. The structural design starts from an orthogonal grid which results in different sized quadrilaterals. The skylights that are placed on each edge of the diamond units imply the functional division inside the space.



The special-to-generic design process shows flexibility of the structure.

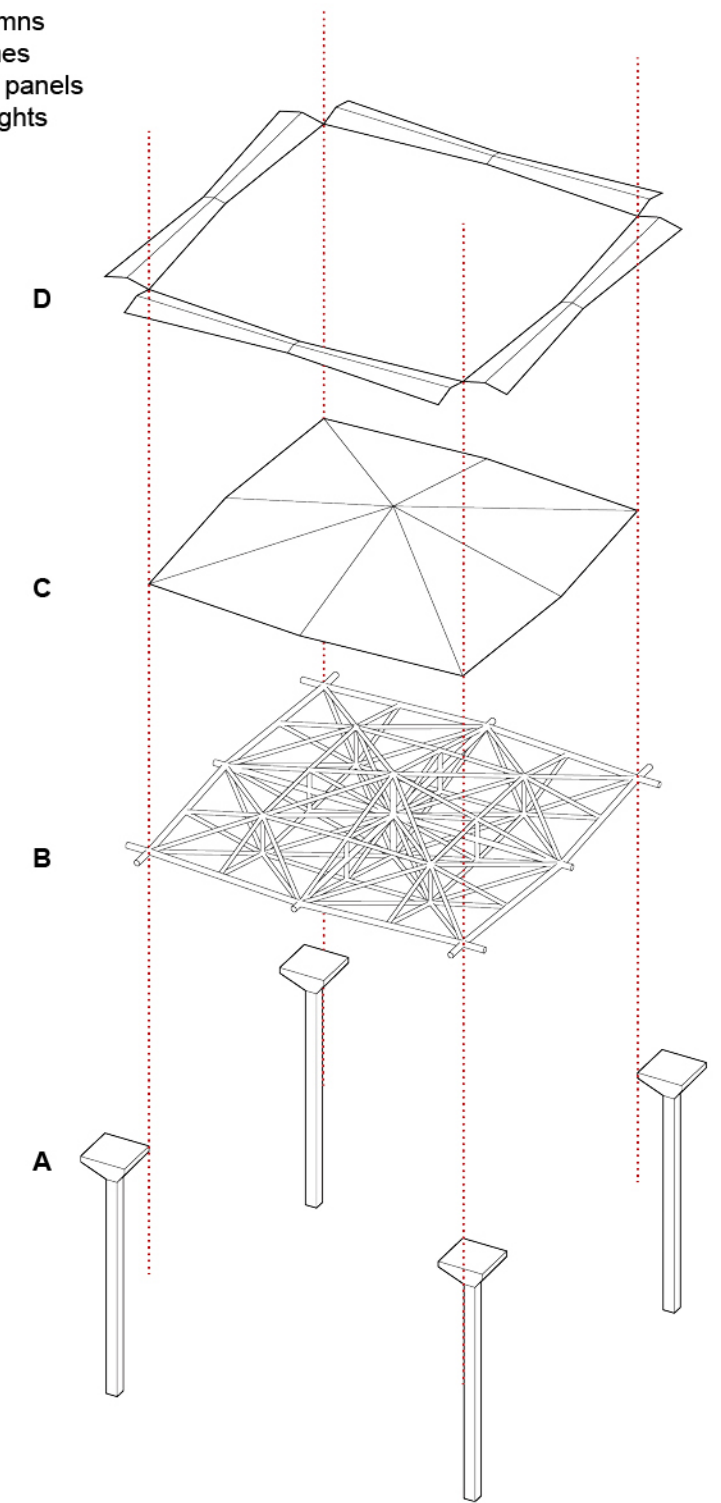


The folded roof surfaces help to drain rainwater.



The various slopes create changing interior space.

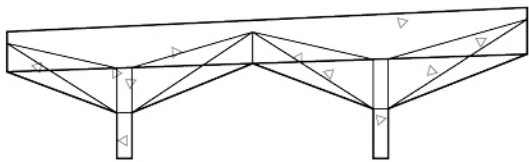
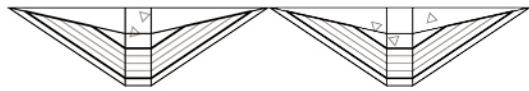
- A. Columns
- B. Frames
- C. Roof panels
- D. Skylights



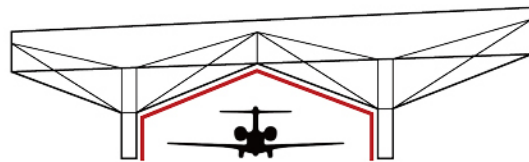
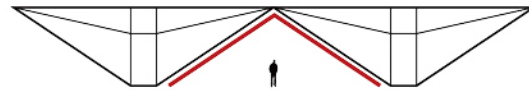
Structural layers from supports to enclosures

The structural design of the front and rear parts of the building is a study on integrated structure and different spatial scales. On the surface, they share many similarities — concrete material, folded surfaces and cantilever structure. However, many design distinctions make them different overall. The front part serves as a transition space from the outside to the inside. The repetitive while changing form creates a rhythm and leads visitors into the building. However, the rear part serves as an exhibit space for private aircraft. Its scale is based on the different dimensions of the exhibited objects. These distinctions make the two parts different in size, material, support structure, and so on.

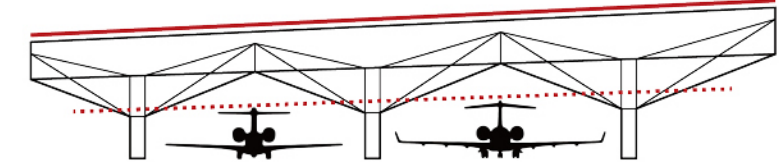
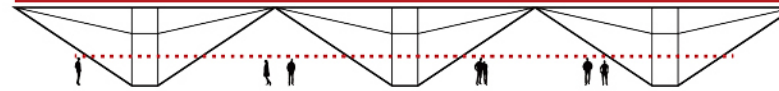
Material



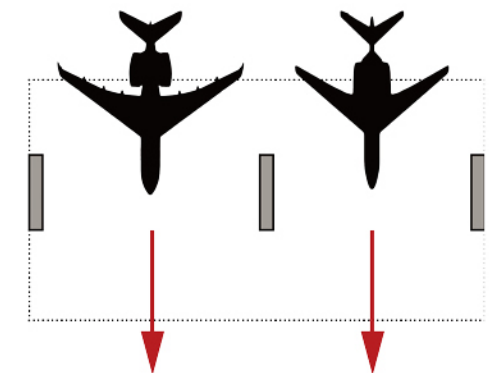
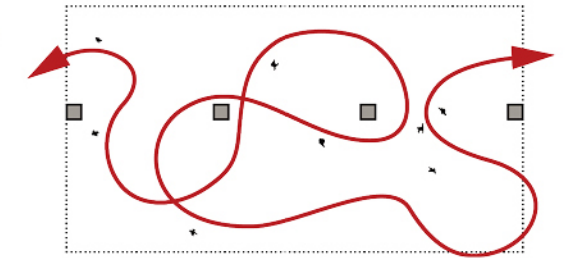
Opening



Slope



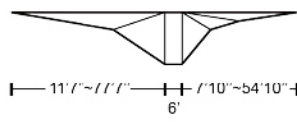
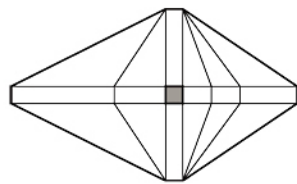
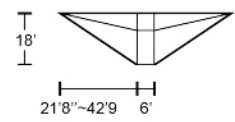
Structural support



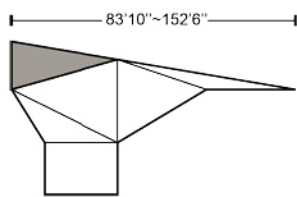
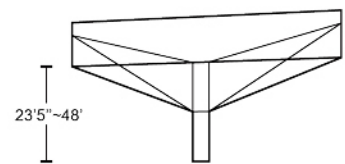
Distinctions between the similar structure types of 2 and 5.

Dimensions

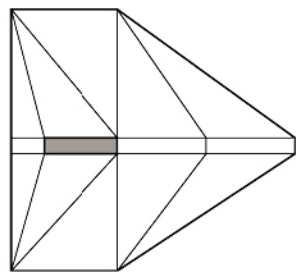
R=0.13~0.24



42'~79'3" 7'~11'

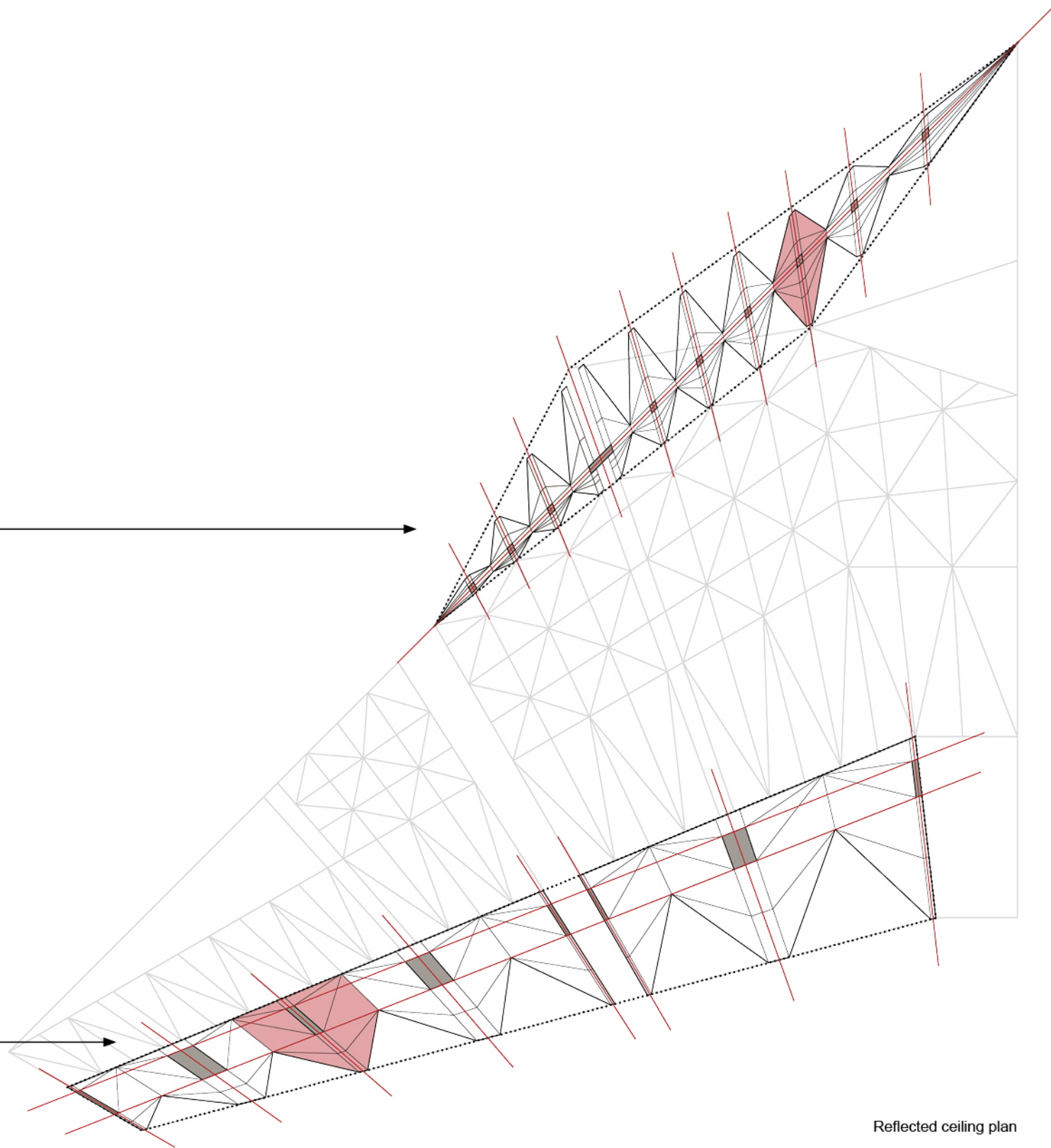


R=0.13~0.15

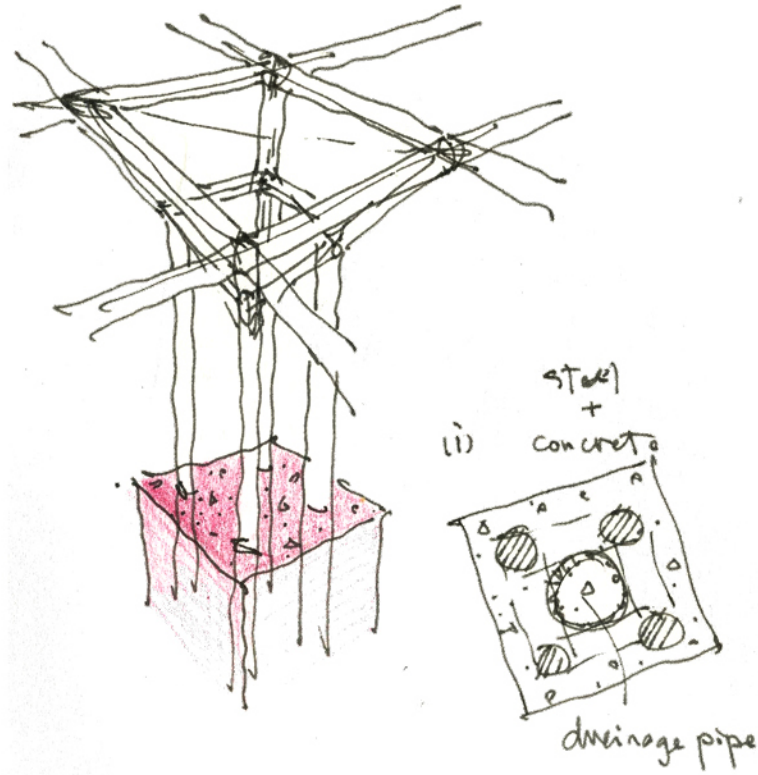


Structure type 2

Structure type 5

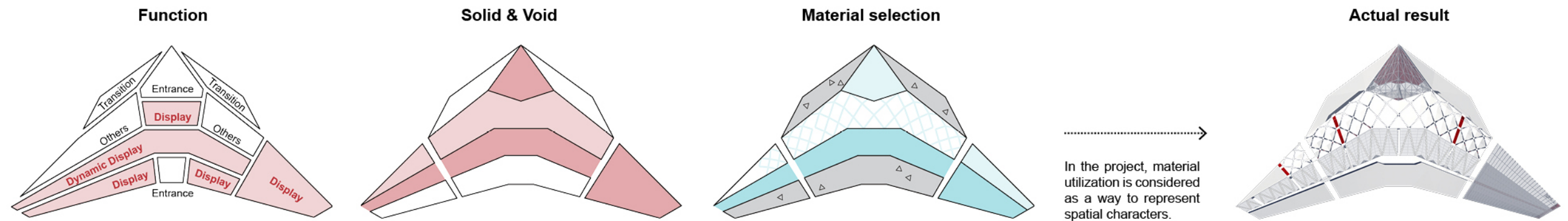
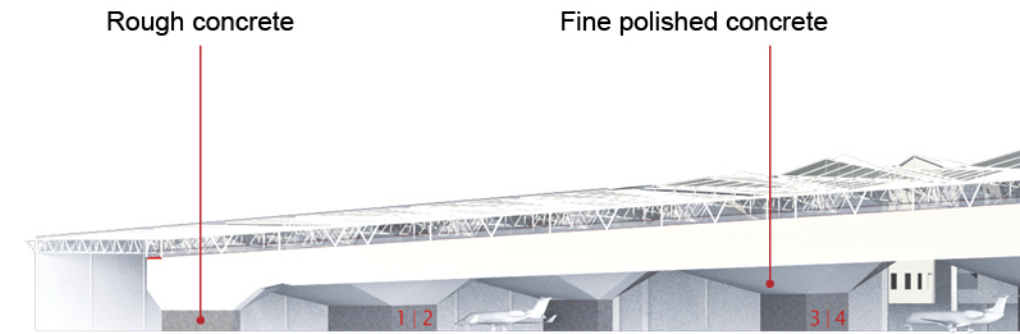
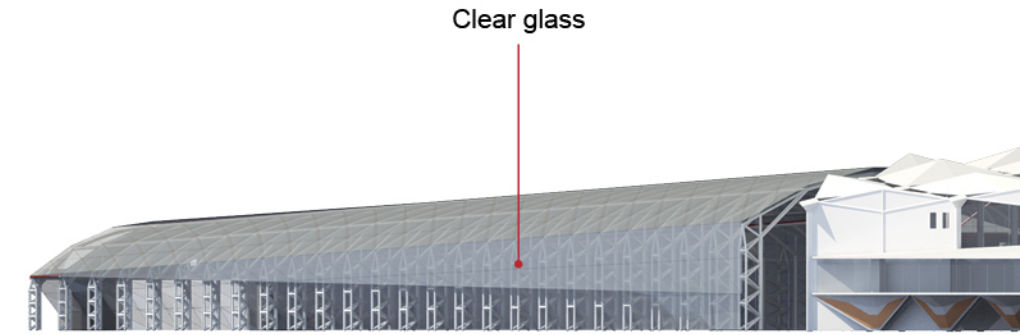


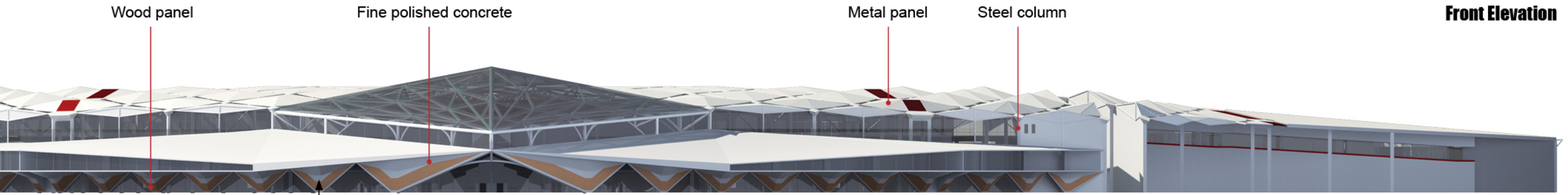
Reflected ceiling plan



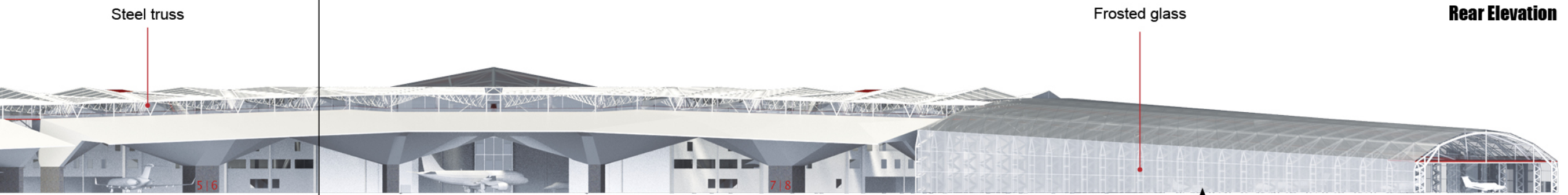
A COMPOSITION OF WOOD, CONCRETE, STEEL AND GLASS

As a large building project, the airport requires steel frames to create large-span spaces. Off-white metal panels cover the main part of the building, creating an attractive shiny appearance when seen from a distance. Clear glass and frosted glass are used alternately, based on the consideration of spatial visibility. The glass chartered aircraft hangar, which is placed at the north end of the building, breaks the tediousness of the symmetrical design. The dynamic exhibit space is also a place covered by glass, dividing the building into three parts. When sunlight falls on the frames of the dynamic exhibit space and casts wave-like shadows on the towing passage, it implies motion. The concrete cantilever structure creates hangar spaces for private aircrafts, matching the feeling of displaying static industrial objects. Wood is applied to the front entrance which makes the large building engage the human scale and tactility.

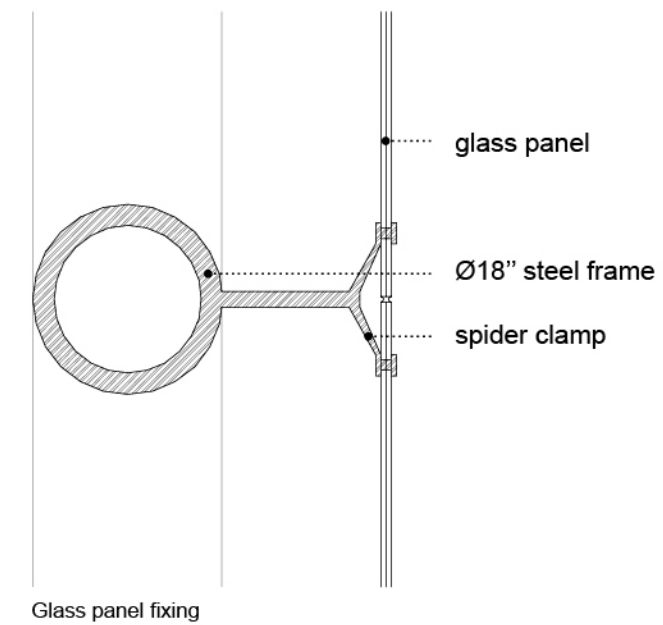
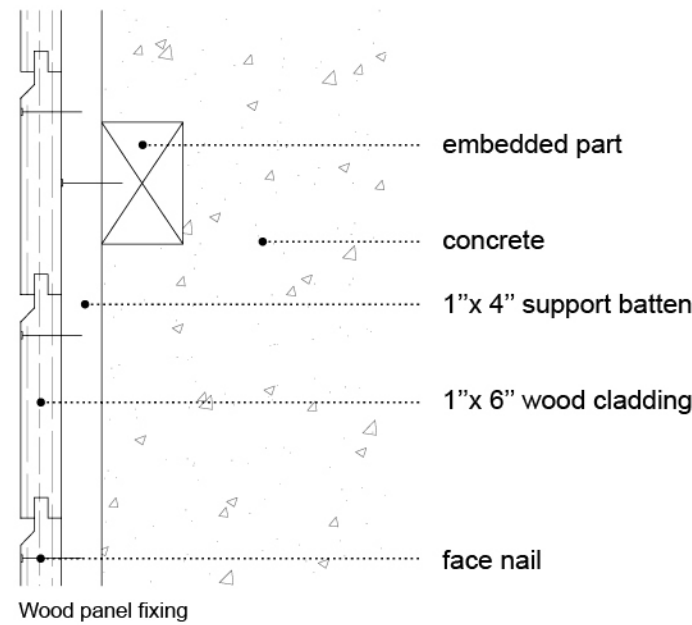




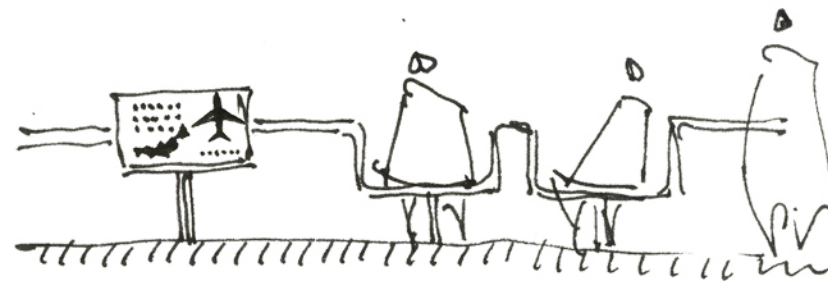
Front Elevation



Rear Elevation



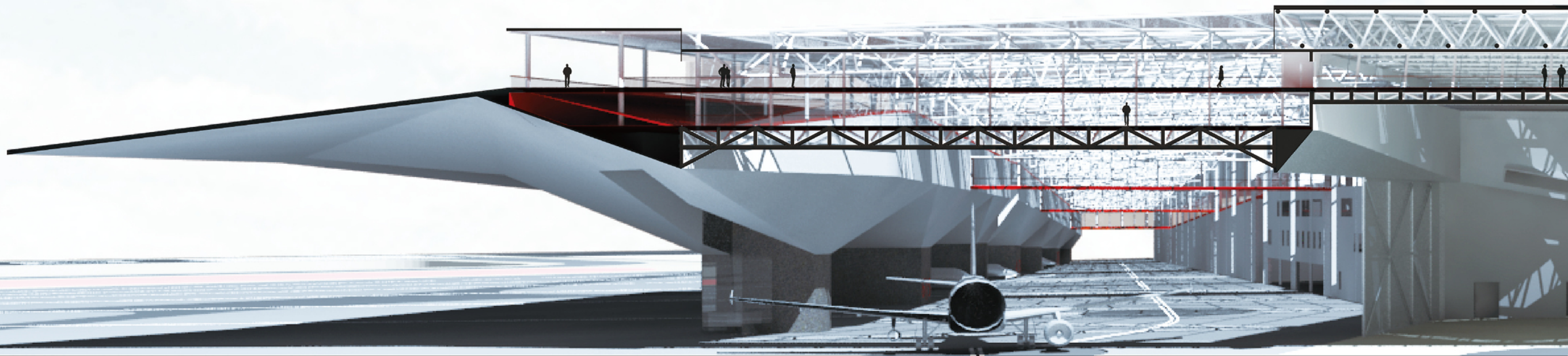
Details



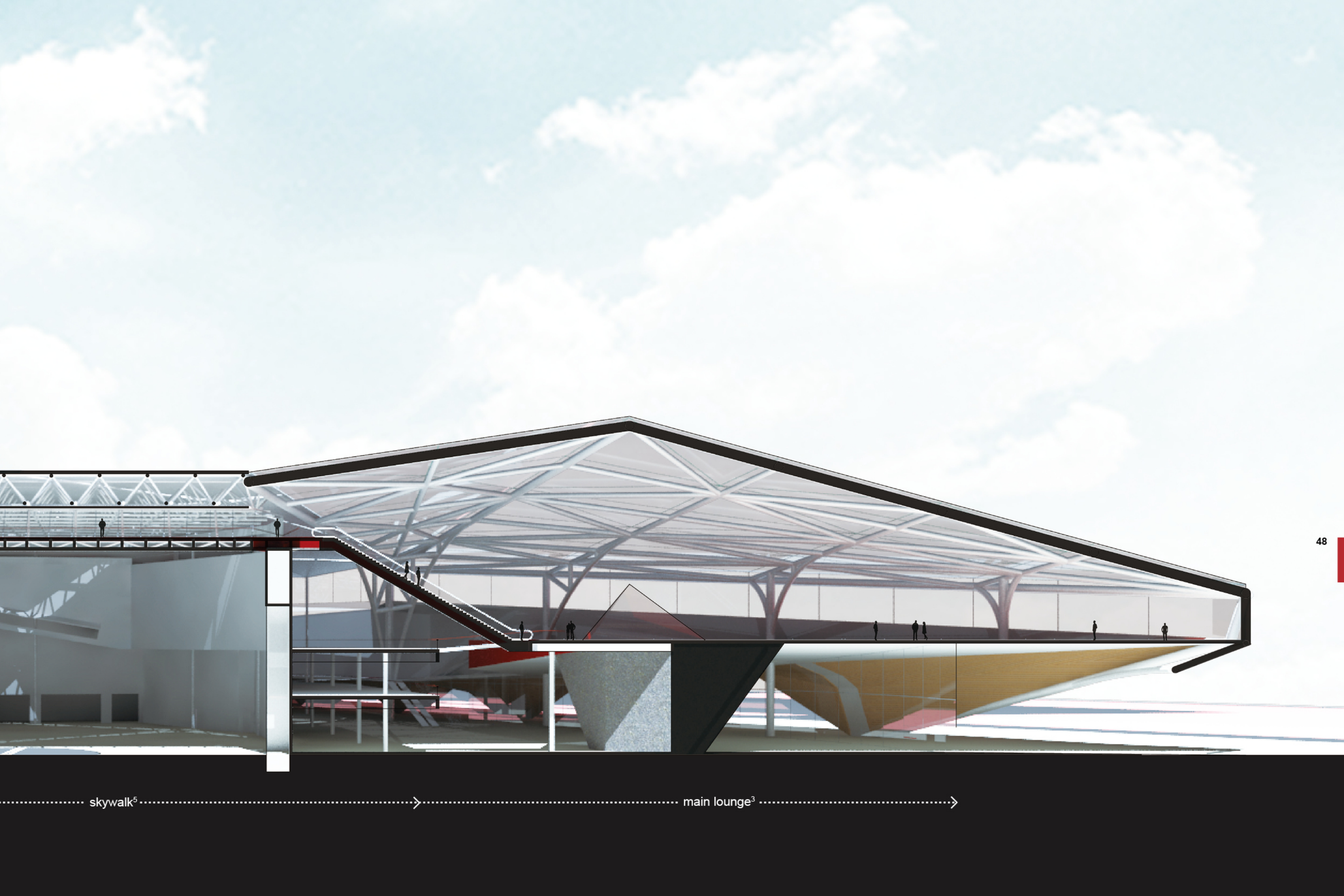
MOMENTS IN THE JOURNEY OF EXPLORATION

Arriving Passenger Circulation

47



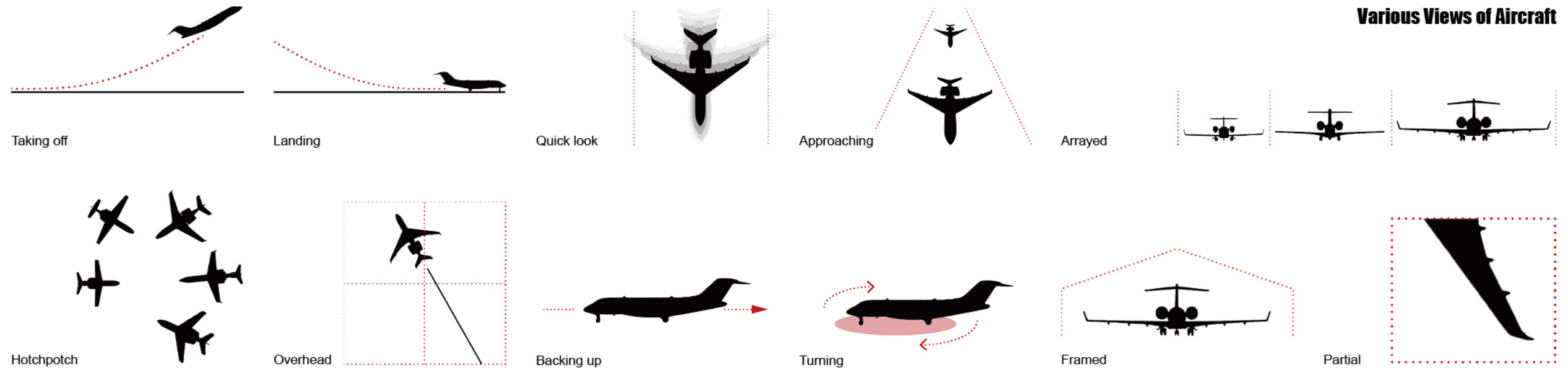
drop-off point¹>..... outdoor walkway⁵>..... bridge⁵>.....



skywalk⁵

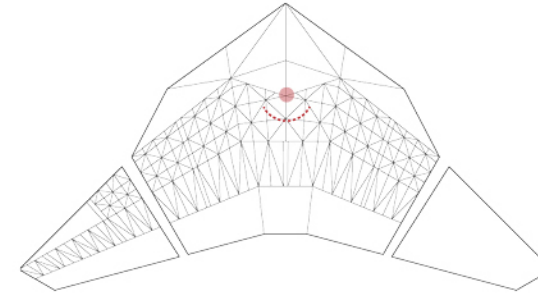
main lounge³

Circulation is organized to connect all important moments in the display. The organization is designed to provide opportunities for visitors to see different views of aircraft — in static or in motion, at a distance or up close, and give visitors impressive experiences while in the airport.



Various Views of Aircraft

A View From Inside The Central Elevator

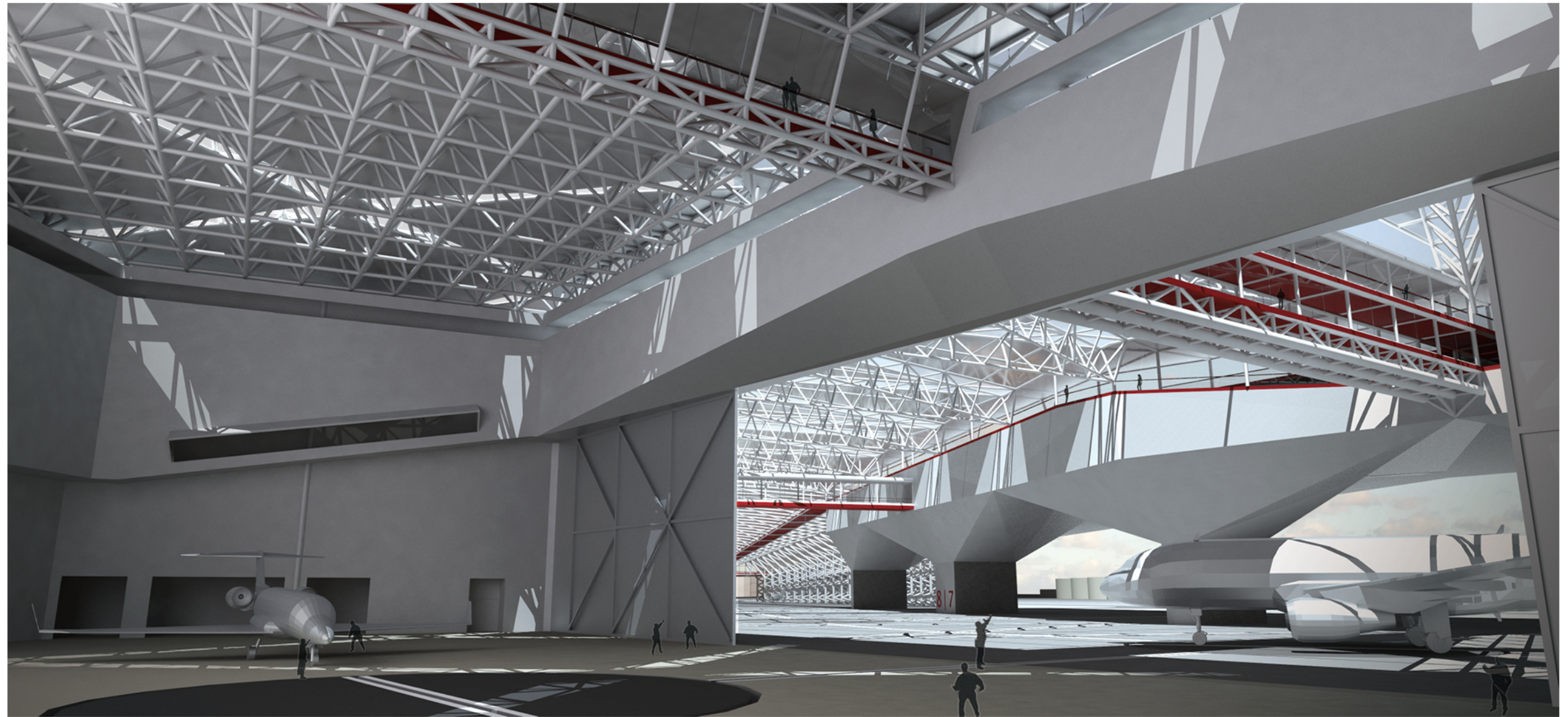
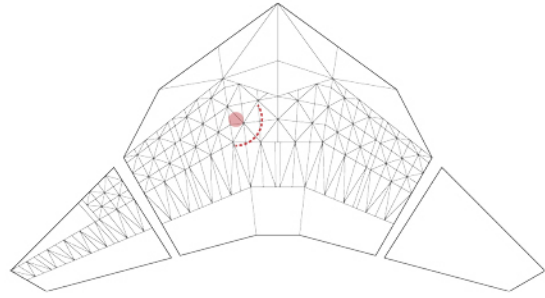


The journey of exploration starts officially when visitors step into the building. They may find nothing relevant to “display” initially. Yet later, when moving around in the building, they will find some clues: They will get a quick glance of the maintenance hangar while taking the central elevators; They will see aircrafts flying overhead when resting in the main lounge; They will have a look at the partial maintenance hangar when walking on the ramp that leads them to the fourth floor.

Unexpectedly, visitors will reach the climax of the exploration: a whole corridor for aircraft towing is displayed right before visitors' eyes. The corridor runs through the building and separates the building into terminal part and hangar part. Private aircrafts are parked on the opposite side. Each one is a distinctive exhibit in itself. When strolling on the roof walkway, which is on top of the hangar spaces along the towing passage, a panoramic view of the taxi area and the runway are exposed. So far, visitors will have witnessed the complete system that works for aircraft and air travel — from arriving, to maintaining, to towing, to parking, and last, to departing.

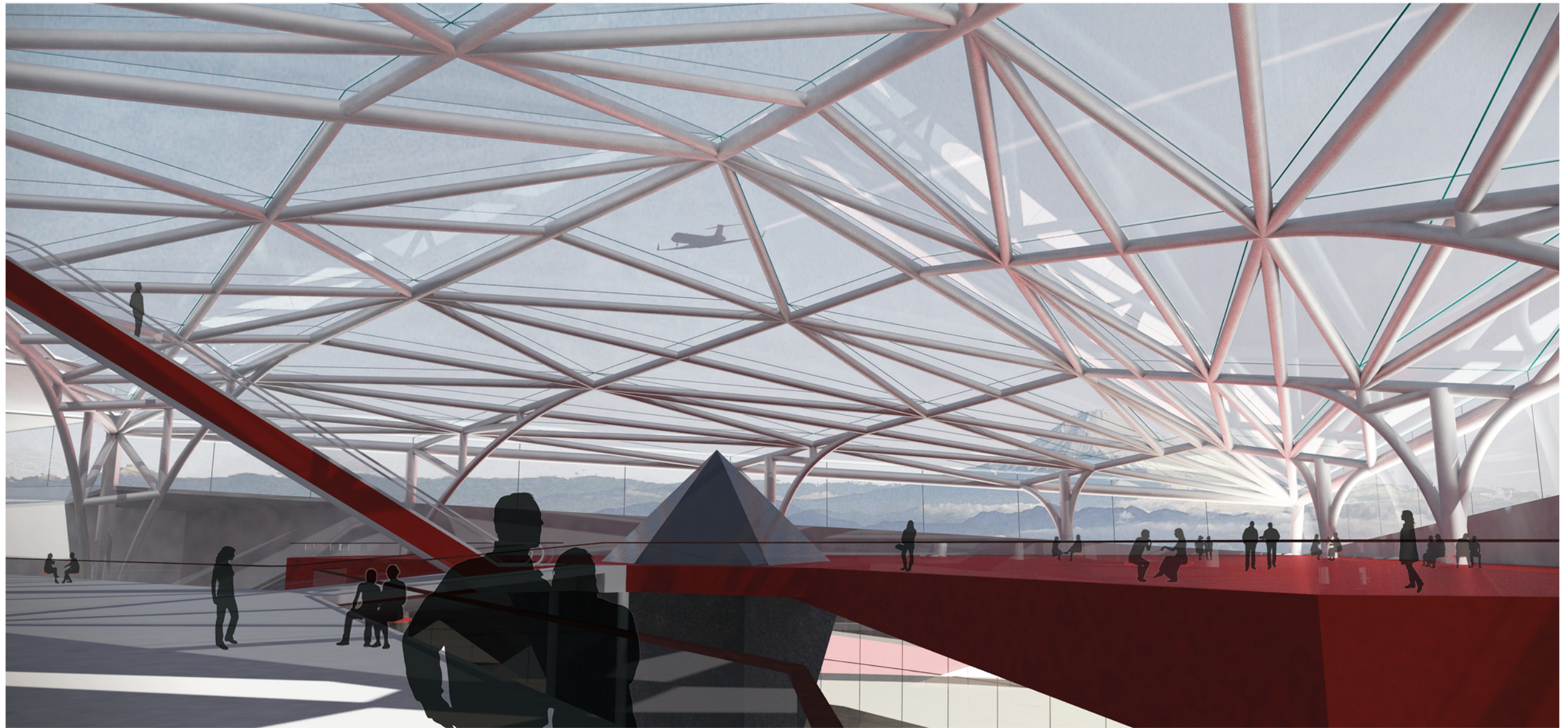
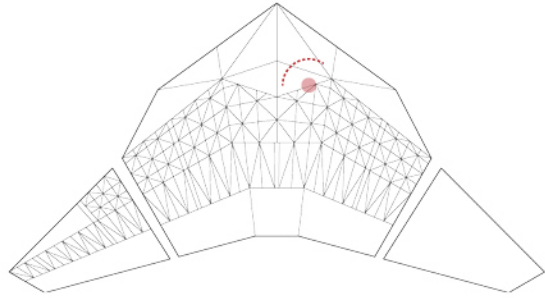
Visitors can have a quick glance of the maintenance hangar.

A View From Inside The Maintenance Hangar



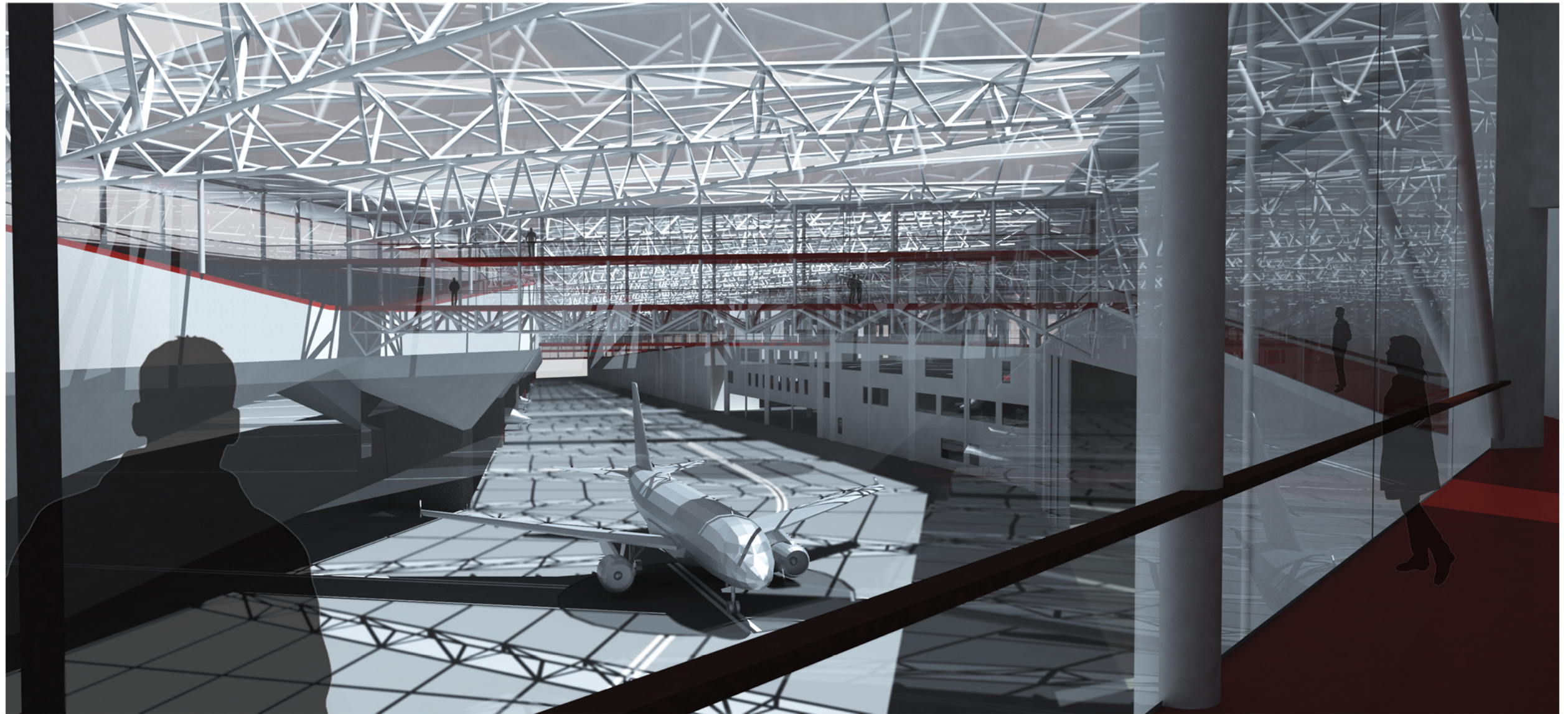
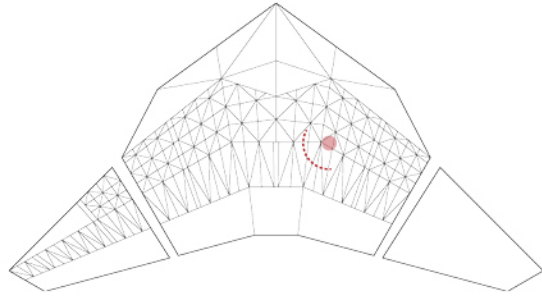
Continuing from the bridge, arriving passengers enter the building via a skywalk.

A View of The Main Lounge

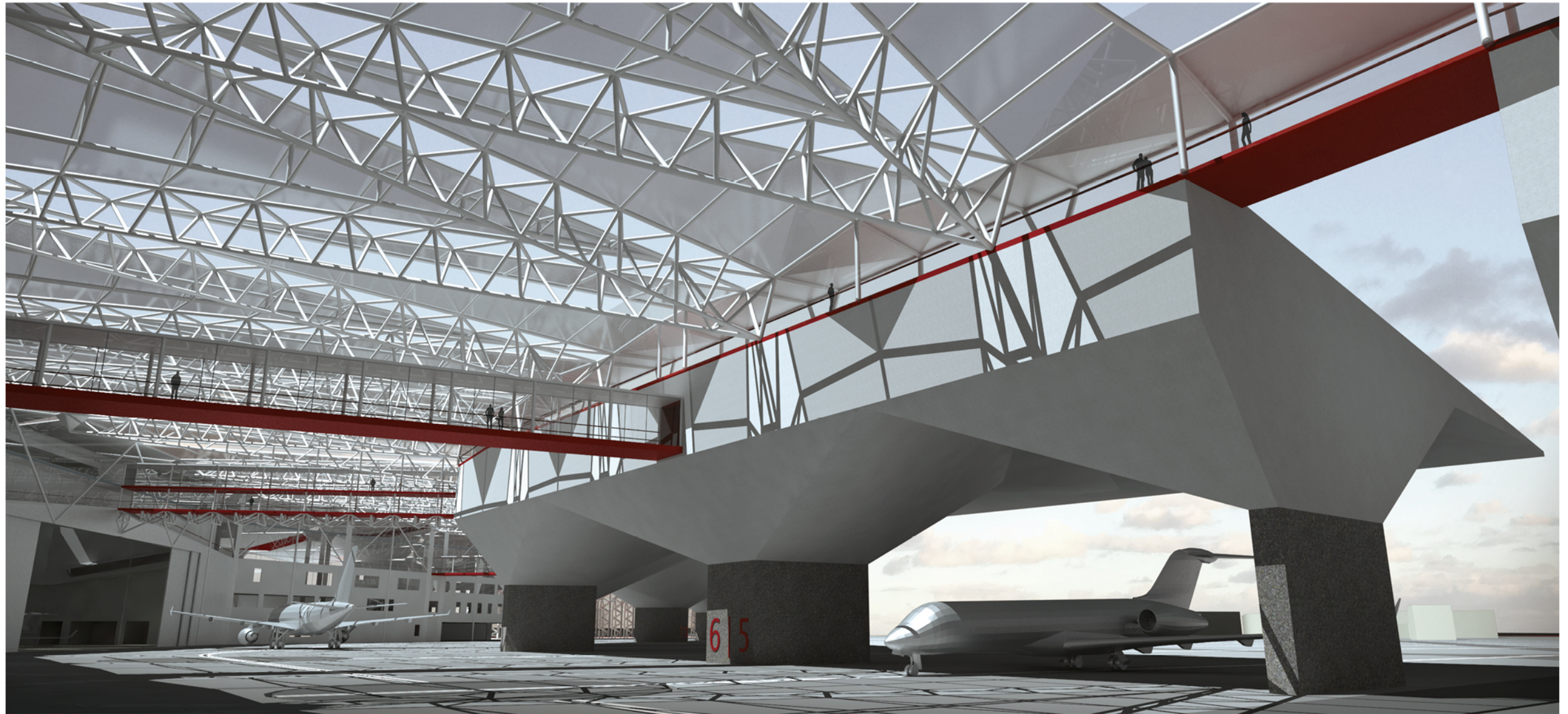
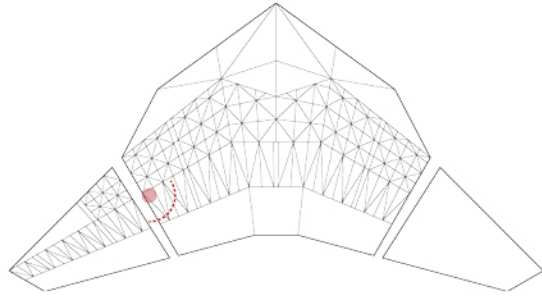


Aircrafts fly overhead.

A View From The Departure Lounge



The whole corridor for aircraft towing is displayed.



The outdoor walkway is atop the private hangars and follows the towing corridor.



Visitors have a panoramic view of the taxi area and the runway from the outdoor walkway.



I started the thesis from the decision to take on the challenge of designing an airport. However, the thought of display did not come up at the beginning of the study. Instead, I had several great yet fragmented ideas: I planned to draw the public's attention to aircraft; I planned to show them the aircraft-related activities that have seldom been exposed in a common airport; I planned to give them a memorable experience while they stayed. In the airport, I planned to have an exposed towing passageway, open private hangars, and a visible maintenance hangar. Through selection and expansion of these ideas, I realized that what I did was put the airport on display. This awareness helped me to focus the thesis on the specific consideration of "display" and deepened the study in this clear direction. Under the frame of "display," the project was developed with interconnecting and interlocking ideas, and the design process became more holistic and articulated.

Curiosity is human nature. We are interested in the things we rarely see and eager to know how the behind-the-scenes system works. The idea of display may be applied in any kind of functional project. The thesis is an attempt to practice this idea, and the thesis shows one possibility of display as an airport. Without the context of an airport, "display" can also be an important attribute added to other functional projects like schools, hospitals, and even dry cleaners.

Although specific exhibit spaces and exhibit strategies will be different among distinct projects, the basic principles and approaches will stay the same. That is what I learned through the study. To display a sequence of functional spaces, the first thing to understand is the spatial character. A specific functional space will result in a specific display strategy. Then, it is important to find out how the system works and what the relationships among the functions are. The finding will affect the circulation of the functions as well as the circulation of the public.

No matter what the specific project is, the goals of designing functional spaces on display are always the same: to show the public the functional spaces, give them impressive experiences, and help them obtain knowledge through the display.

REFLECTION

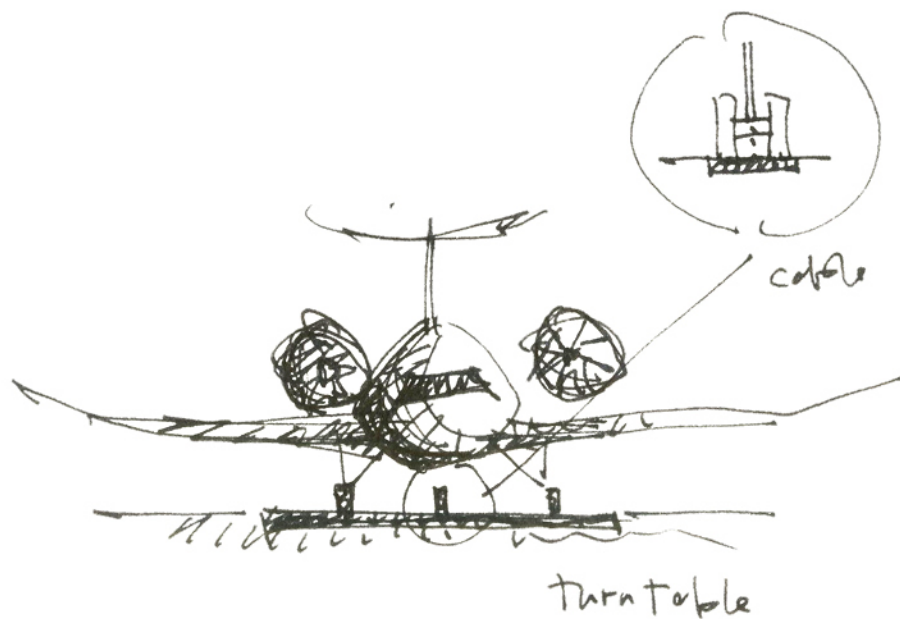


Image Credit

Page 7. CNN Center. <http://images.budgettravel.com/2010012103588CNN.jpg>

Page 7. El Gaucho. http://cdn2-b.examiner.com/sites/default/files/styles/image_content_width/hash/db/ca/dbcab94f2de12d090f249ae72cd40282.JPG?itok=IN6Rt_KL

Page 10. Sitemaps. <http://www.worldmapfinder.com/BingMaps>

Page 10. Wind statistics. <http://www.surf-forecast.com/breaks/Chigasaki-Jetty>

Page 62-63. 3 views of aircraft. <http://www.aerospaceweb.org/aircraft/jetliner/>, <http://www.the-blueprints.com>, <http://www.skybrary.aero>

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