KHAN JAHAN ALI AIRPORT
KHULNA

BY

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ABSTRACT

This report aims to presents the significance of a new airport at the west-southern part of Bangladesh where fast travel become a requirement. As Airways become the fastest way to connect cities, airports become an important hub for transporting. An airport performs as a transportation hub for the city which crucially acts as the most important structure for socio-economic aspects. While thinking of Khulna, one of the major divisional city of west-southern Bangladesh, inaccessibly from other major cities has been a serious issue. Because of the geographic location of Khulna division and Padma river accessibility are highly interrupted. As lacking of proper road network, the west-southern part is remained undeveloped for many years. But now, completion of new Padma Bridge will open a notable opportunity of socio-economic growth. Addition to that, Mongla sea port, which is one of the two sea port in Bangladesh creates window for larger economic activity. Also, Sundarban, the largest Mangrove forest in the world is located on the most southern part of Khulna division which needs proper exposure for tourism. To stimulate the socio-economic and touristic revelation and keep pace with 21st century air traffic government have proposed a new domestic airport in Khulna. Government visions of the new airport is to make positive impact on economy, social development, the lives of welling of the people in west- southern part and also generate an exposure of Sundarbans.

CONTENT

1 INTRODUTION

According to the current age, Airport become one of the most crucial structure of the civilization. As the civilization develop through knowledge, world is getting smaller to people. Knowledge become the ultimate source of power and accessibility turns to its main base. People start to travel extensive amount of distance and the requirement of fast transportation becomes inevitable. Form the beginning of mankind, people tried to innovate different transport technology for fast travelling. As now, Air traffic happen to be the fastest way for transportation, airport earns its significance rapidly. Strategically it become the most significant building in the world. Airport exemplifies the progress, freedom, trade and desires of a country. (Hugh Pearman, 2004)

Airport is basically the portal for modern world. It acts as the gateway for people which stands to become the place of arrival or departure through air traffic. It functions as the primary communication for traveler while arriving into a specified city. Air terminal performs vital role on representing the culture introduction. “Airports are a national symbol, therefore no expense is spared to make sure mine is better than yours," says architect Ron Steiner, an airport expert with the international architecture firm Gensler. A conventional airport is not only a passage which led people to one transport mode to another, but also portray the identity of life living there. Though only culture and beauty never clarify airport as it is one of the most highly functional building which must be extremely considered.

This thesis paper presents a brief history of airport evolution, some identified case studies which have notable similarities with the context, brief overview of technical aspects which must be considered while designing a modern airport, the project development phase and concept generation, schematic diagrams, site analysis and considerations which requires to design a modern airport.

1.1 Project Introduction

Khulna being the second port city and a highly potential economic zone, doesn't have an airport. To stimulate the situation Bangladesh Government is planning to build an airport in a total land of 690 acres. Bangladesh executive Committee of the National Economic Council (ECNEC) approved the Khan Jahan Ali Airport construction project at May, 2015. Runway of the airport are derived as 3253m long and 300m wide. This will a domestic airport to support the west-southern part of the country and create an exposure of Sundarbans. Project is in the development stage and the completion date are estimated as the beginning of 2021 (Civil Aviation Authority Bangladesh).

1.2 Project Specification

The new airport at Khulna will be gateway to the west southern part of the country. The site is located in a strategic position where two important district city Khulna (33km) and Bagerhat (29km) are very close from the site. With that, the Mongla sea port and access to the Sundarbans is only 20 km away. These airport will create significant economic impact on these sites.

Name of the project: Khan Jahan Ali Airport

Client: Civil Aviation Authority of Bangladesh

Site Location: Khulna-Mongla Highway, Khulna.

Site Area: 514 acre of land (including buffer zone, future expansion area and air funneling zone)

Founded by: government of Bangladesh

Budget: BDT 5.4 billion (estimated by CAAB, 2016)

Date of completion: beginning of 2021

1.3 Functions and programs required for the project

The proposed project of Khan Jahan Ali airport, Khulna have some specified program list mentioned by CAAB which are essential for establishing a functional domestic airport. As airport is a structure which contains severe programs that are mandatory to keep an active airport, these programs are thoroughly substantial. These programs are _

- A terminal building with separated arrival and departure passenger flow.
- A control tower
- A 3253 meter runway
- An apron with minimum 4 aircraft gateway
- Administrative section of CAAB
- Cafeteria and restaurant
- Minimum 400 car parking

- Public toilet
- Prayer room

Addition to that, the presumed number of passenger will be 500,000 annually by CAAB.

1.4 Problem statement

With the geographic location of Padma River, the west-southern part of the country become highly inaccessible. The only bridge to connect with the rest of the country is Jamuna Bridge. Through this way, it takes more than 10 hours to reach west-southern part from the capital by road transport. Inaccessibly leads to these areas lower development.

1.5 Aims and objectives

The aim of this project is to design a fully completely airport which serves as a properly functional modern airport with comfortable airport building. It will include contextual orientation system for effective identification of the structure from air, introductory presentation of the largest mangrove forest and create an experience on the minds of passengers which they will never forget. Proper passenger's distribution for different flight, aesthetically pleasuring surrounding, freshly breathable space and visibility of activity will perform the building as a celebrating and connecting space. The airport will act as a platform for symbolizing the culture of west southern part and boost socio-economic growth.

1.6 Rationale of the project

Construction of the new domestic airport will enable easier accessibility for people form any other Parts of Bangladesh to the cities of these areas. There are 3 International airports and 6 Domestic airports in Bangladesh. The closest domestic airport form Mongla sea port is Jessore Airport which is 130 km away and takes almost 4 hours of travel time by road. There is no other fast transport ways to access Sundarbans and its surrounding areas.

The Khan Jahan Ali airport will allow a better communication form the rest of the country to the southern part of Khulna division. The people will these are will be facilitate to fast transport and connection with the world will be easier. Also, the largest Mangrove forest will get a significant exposure to tourists.

With that, airport itself generate a considerable economic and social impact of the surrounding sectors. It enhance the lifestyle of individuals, products and administration of the surrounding regions and create a boost to the nation. An airport draw the attraction business and leisure visitors which also promote tourism in the surrounding. It create opportunity for people to start new business with hotels, shops, restaurants and other facilities which generate support for tourists.

2 LITERATURE REVIEW

2.1 Definition of Airport

Airport is a functional structure which serves as a transportation hub for air traffic. The primary concept of all transport hub is to be a transit point or space which serves people to lead them from one transportation medium to another. As for airport, any one or both of the transport vehicle is aircraft. According to the definition of airport from the Cambridge Advanced Learner's Dictionary & Thesaurus, Airport is "A place where aircraft regularly take off and land, with buildings for passengers to wait" (Cambridge Dictionary, 2015). Basically airport is an aerodrome where aircrafts arrive, park, refuel and depart with its extended facilities of transporting people. The major functions of an airport are adequate store space for maintain and refuel aircrafts, a control tower to navigate air traffic, a landing area with minimum of an active runway for the plane to take off, single or multiple terminal for people to transit and utility facilities. For an International airport, there are some additional facilities for customs and passport control.

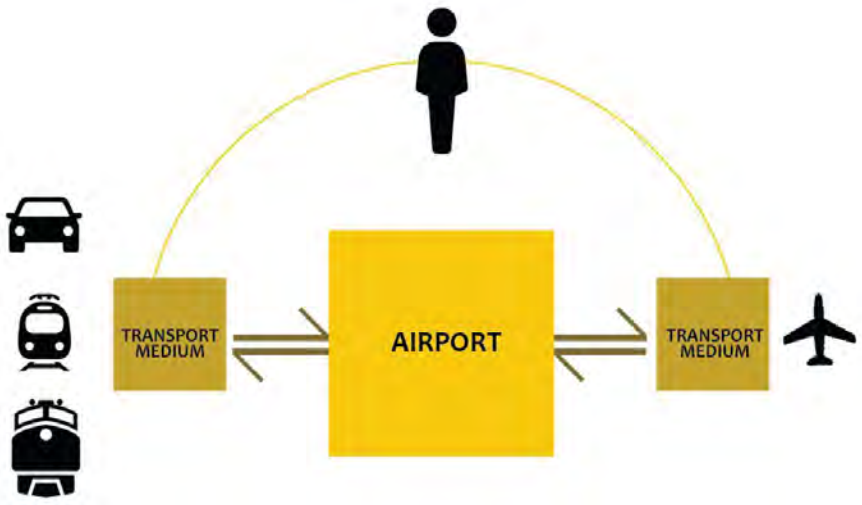


Figure: Definition of airport as a transport hub
(Source: Author)

2.2 History and Evolution of Airports

At the early age of aircraft the takeoff and landing sites were grassy fields. Though that landing sites the aircraft could approach from any angle that provide favorable wind direction. From that, a slight improvement was developed with dirt-only field, which eliminated the friction from grass. As this conditions only functioned properly when the field is dry, later, plane concrete surface were begin to use for landings and take off. (Avjob, 2016),

After the First World War the requirement of International air service generated. The very first airport was built in 1915 after aircraft started to use for commercial use in transportation. (Robert E. Caves, 2007) The London Croydon Airport was first made to create protection against Zeppelin raids of First World War. Later on, additional wooden air traffic control and customs building were included to stimulate the functions of airfield. At that time, the airport was only served for the economically benefited group of people, but, architecture history of airports began from that moment. (John, D. 2008)

Figure: London Croydon Airport, 1915
(Source: http://www.controltowers.co.uk/c/croydon.htm)

From that period of time, different companies started to build more airports to transport people globally through airways. Soon London requires more spaces for new aircrafts which required to land or take off at the same time. The requirement of a transitional space also came up as people from different vehicular arrive or leave through aircrafts.

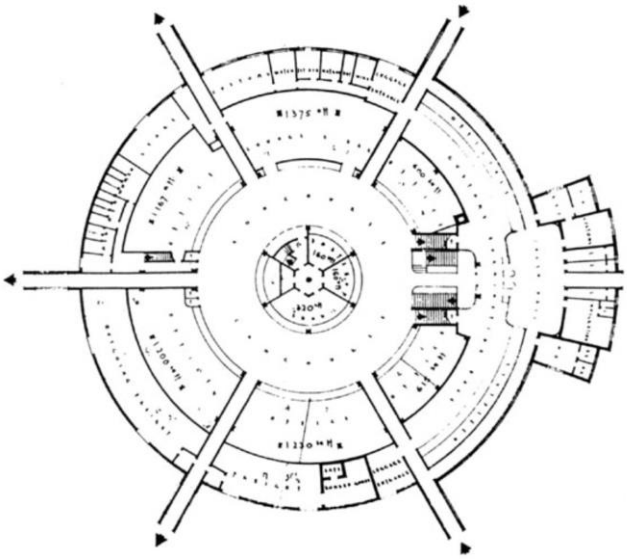


Figure: London Gatwick airport ground floor plan
(Source: http://www.british-caledonian.com/Gatwick_Airport_-_The_History_P2.html)

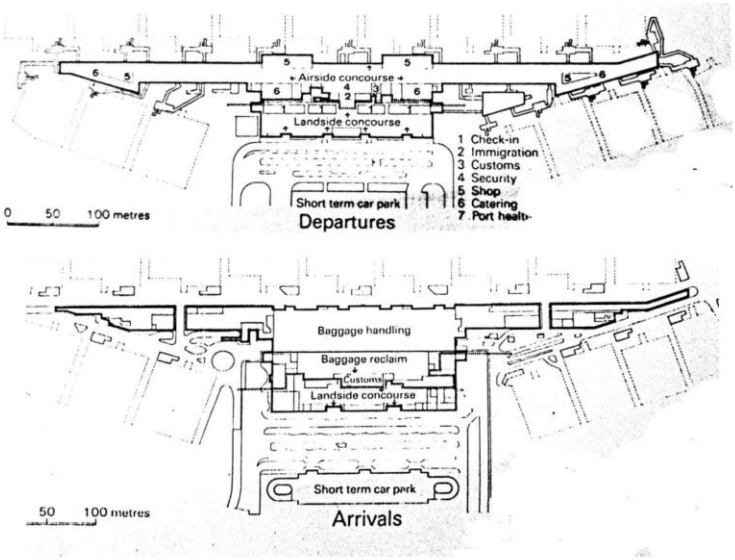


Figure: London Heathrow airport Terminal 4
(Source: Christopher J. Blow (1998), Airport Terminal, 2nd Edition)

So, in 1935 Mark Jackman designed the first airport terminal building which serve as the intermediate space for people at London Gatwick. (Williams, A. 1986).

With the advancement of technology, propeller drives aircrafts were replaced by Jet or fuel based aircrafts and a new bigger airport was in need at London. Architect Scott Brownrigg and Turner started a new arrangement of terminal in Landon Heathrow Airport where linear transit route were developed. Additional functions of the airport was placed accordingly. (Williams, A. 1986)

Through times, as per requirements, airport grows into new concepts which led to different orientation aspects and interesting forms with varieties of functions. People started to use airways for first traffic and global transportation reach its top stage and airport terminals includes various activities with its fundamental functions. Shopping mall, accommodation, park, food court etc. are extending modern days airport portraits. The Hong Kong International Airport designed by Sir Norman Foster is one of the significant example of today's airport. The concept of a huge structure and functional flow under a single roof in airport acts as city commercial space. With the purpose of only a transitional space of transportation, now a days, airport became a platform for presentation.

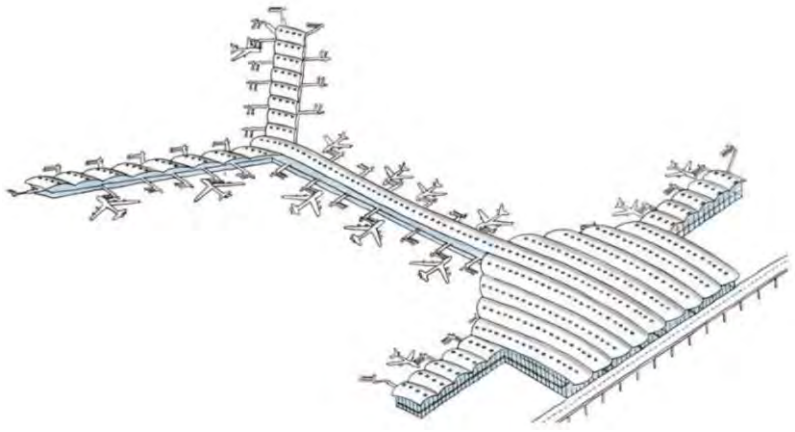


Figure: Hong Kong International Airport
(Source: Foster & Partners)

2.3 Basics of Air-terminal Arrangement

According to US Federal Aviation Administration, 5 primary components are featured in a modern airport. These are _

* The landing area with minimum one runway
* The parking and service spaces required for aircrafts
* The technically supporting amenities for maintaining and refueling aircrafts
* The flight gates through which people get in or out from an aircraft
* The Passenger waiting area or terminals (Christopher J. Blow 1998)

Other necessary components which assist the primary components to serve appropriately are:

* The Control tower to navigate air traffic and work as a landmark for inbound aircrafts
* A fire station for emergency situations
* Access drives for aircrafts
* Adequate space for car parking
* Other buildings

These components are crucial parts of a modern airport complex and their arrangement are with other component severely affect the functionality of an airport.

2.4 Airport Arrangement

A regular airport can be divided functionally into 3 major sections, which are,

* Air side

* Terminal building

* Land side

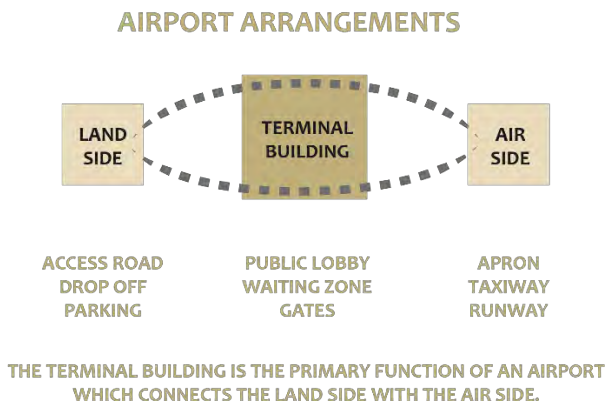


Figure: Airport arrangement diagram
(Source: Author)

2.4.1 Air side

Where all the activity which related to aircrafts moving, landing and taking off. 3 parts of airside are

* **Apron**; where aircraft park for loading through gateway from the terminal

* **Taxiway**; through which aircraft move around

* **Runway**; which used for landing or taking off

*

2.4.2 Terminal

It is the main structure of an airport where passenger get in or out from land side to connect with the air side (Christopher Blow 2005). Within this there are all type of security checking including customs for international airports. Also most of the services and leisure activity are placed in here.

* **Public lobby**; connected to all activities and services
* **Waiting zone;** for passengers before their flight
* **Gates**; connects with aircraft

2.4.3 Land side

Areas which connects from the vehicular route.

* **access road;** access from main road
* **Drop off;** adequate space from people to come from every land type transport service
* **parking;** adequate space for parking of any motorize vehicle

2.5 Air side functional analysis

With the building design and space quality there is a crucial part in designing airport, which is the functional design of the air side. There are absolute requirements for airside designing which cannot be ignored as these ensure aircraft trafficking and safety. Apron, Taxiway and Runway have vital divisional spaces which have different function to run the air side.

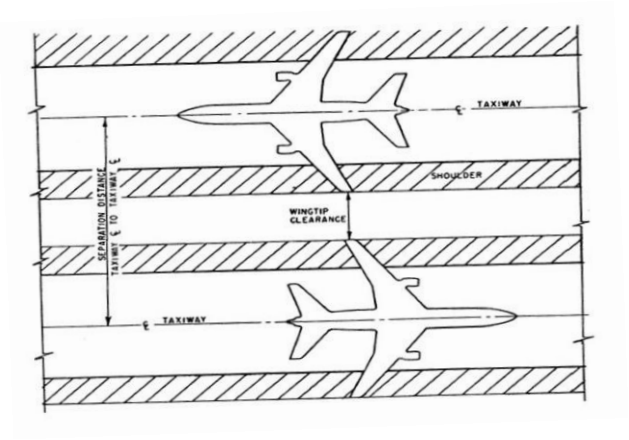
2.5.1 Holding bays and bypasses

Bypasses is a identified space of an airport in which aircraft stand ground until the runway is prepared to use for taking off. Holding bay or Bypasses is a crucial function to those

airports where air traffic flow is significantly high. These allows to work the air side in more efficient way.(Douglas Disinger, 2010)

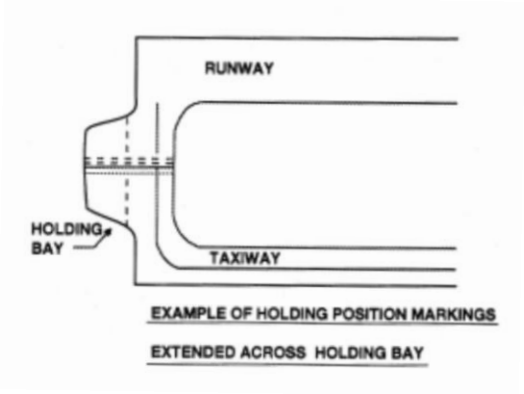
There are different types of bypasses-

- **Dual taxiways:** A detour taxiway which is typically placed parallel to taxiway. As these can be places parallel to another taxiway, it takes minimum cost to build but, will make the circulation significantly efficient.



Source: https://slideplayer.com/slide/1705001/

- **Holding bays:** An additional defined area in between runway and taxiway which is functioned to held, bypass or provide enough surface space for movement of aircraft.



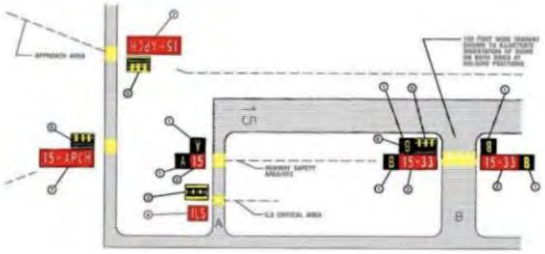
Source: US airfield Standards

- **Duel runway entrances:** To enhance efficiency of an airport sometime it provide double entry to a single runway. In these cases runway connects with the taxiway in 2

different ways which will reduce aircraft taxing time. It is highly recommended to utilize double entrance with double taxiways.

Source:

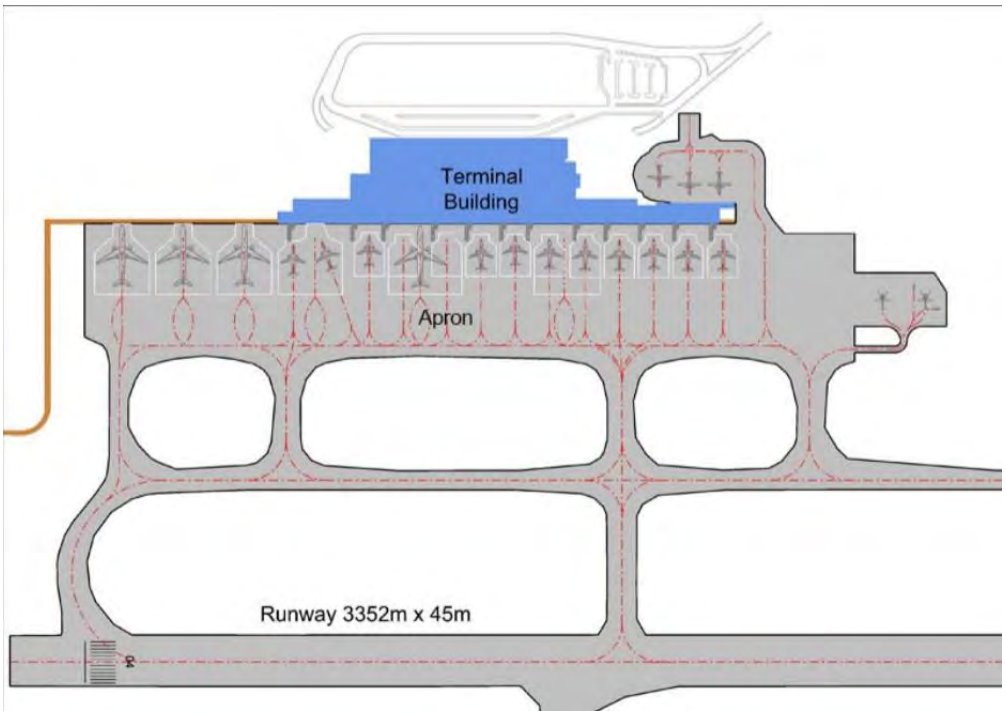
US airfield Standards



2.5.2 Apron

Apron is the specified area in the airport which aircrafts use for parking, loading or unloading, refueling and boarding. On apron, aircrafts are connects with the terminal building through multiple gates for boarding passengers. An appropriate arrangement of apron increase sufficiency of an airport. Designed aircraft circulation with lighted direction And proper placement of aircrafts services reduced aircraft holding time. (Douglas Disinger

2010)



Source: Apron planning and Design Guidebook

Most of the time, it is analyzed that, the form of the airport terminal building defines from the concept of Apron. As in airport, Apron takes the highest amount of area, the arrangement of apron simply dictates the form of that airport. Commonly there are several concepts of arrangement of apron which are practiced worldwide.

- **Simple Apron:** This arrangement set up for small sized airports where there is not much air traffic flow. It is the basic concept of apron where airport simply park according to the frontage of the terminal building.

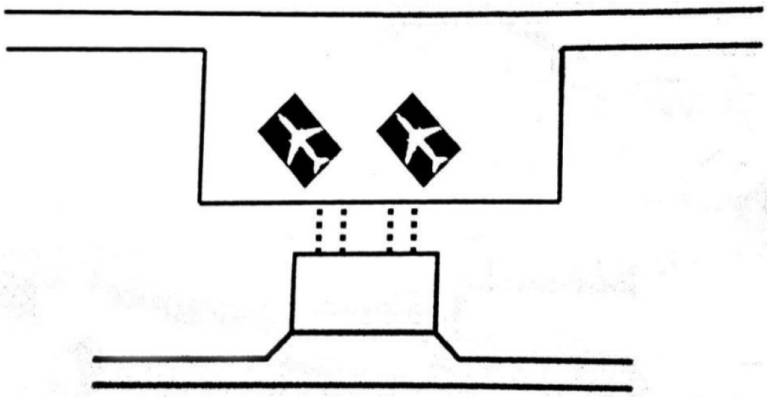


Figure: Simple Apron
source: ICAO Doc 9157 part 2

- **Linear Apron:** Simple apron concept is developed into linear concept from the need of heavy air traffic. In linear Apron aircraft are placed linearly at edge of the terminal building. With these concept most of the time the form of the airport turns more linear at the air side.

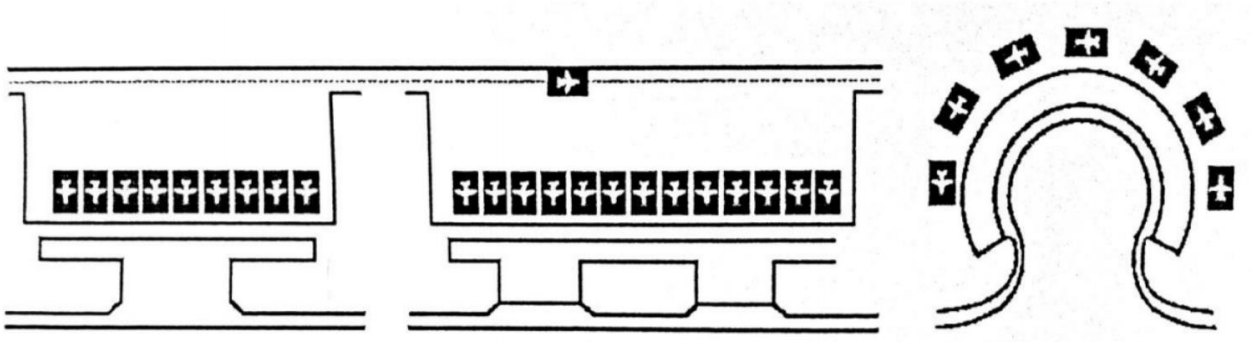


Figure: Linear Apron
source: ICAO Doc 9157 part 2

- **Open Concept:** With this, aircrafts are parked in one or more than one row on the air side of the building. In this way aircrafts are not connected with the terminal building through the gates and it takes some kind of vehicle to take the passenger near the aircrafts. Milan Linate airport is an example for open concept apron.

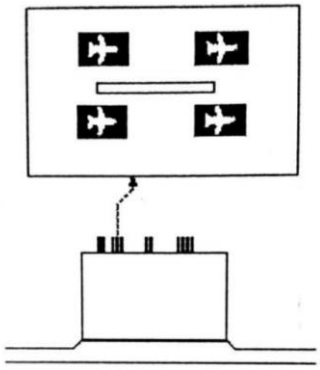


Figure: Open concept Apron
source: ICAO Doc 9157 part 2

- **Pier Concept:** In pier concept, aircrafts can be placed front by front of each other with in rows. A single linear entry comes from the terminal building opens multiple gates for aircrafts. This concept mostly use for immediate expansion of any airport. With this concept airport can easily handle more aircrafts at a time than any other time of aviation history.

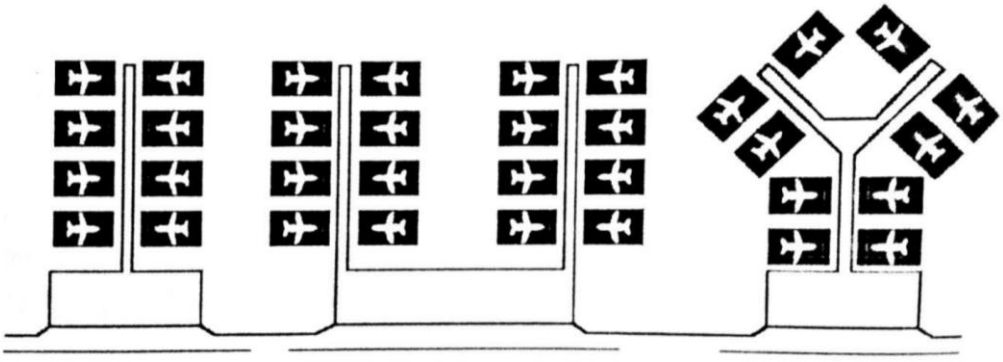


Figure: Pier concept Apron source: ICAO Doc 9157 part 2

- **Satellite Concept:** In this concept the gateway of terminal are placed in a significant distance from the main building and connected through underground tunnels, Satellite become and Individual building where apron can be arrange from every side of that building.

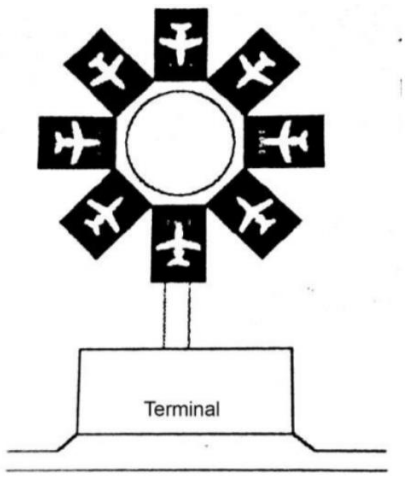


Figure: Satellite concept Apron
source: ICAO Doc 9157 part 2

- **Hybrid Concept:** When an airport contains apron with multiple concepts from above are called hybrid concept. London Heathrow airport is a perfect example for this concept.

2.5.3 Passenger Loading Methods

As airport acts as a structure for connecting people with air traffic, Airports functional flow varies with the different methodology for passenger loading. There are several existing ways of passenger loading method which are briefly mentioned below.

* A Jet Bridge loading: The Bridge is connected with the terminal building. People come through the bridge and board directly into the aircraft.
* Movable Steps: A type of Stairs which is movable towards the aircrafts like escalator. Connects with the aircraft when boarding. People came to apron through the vehicle.
* Passenger transporter: By bus or train passenger brought to the aircraft for boarding
* Aircraft contained steps: some aircraft, mostly private aircrafts contains step which can open up for boarding passengers. (Harrison, A 2015)

2.5.4 Runway

The most crucial functional space for an airport is its runway. It is the identified space which only use for landing and taking off. The runway must be designed in a way where it can be easily identified for the aircraft even in a worst possible weather condition. (Air safety institute, 2012) A runway and taxiways are placed by considering other major components of airport which are connected through aircraft, such as terminal building, freight zones, Apron airport services and also aircraft parking zone. The amount of runway of an airport defined by the quantity of flights come and goes in an hour. Generally a runway can accommodate 50 to 65 flights per hour. (Harrison, A 2015)

There are 3 types of runway, which are -

- Single runway
- Parallel runway
- Open - V - runway

If any airport contains parallel runways there must minimum of 500 meter distance between two runways. In Bangladesh the typical wind flow is from south to north with no

cross wind headings. In this condition the alignment of a runway must be in 90 degrees of the axis or more precisely 92.5 degrees. This amount varies due to geographic location. Generally a runway of 4000m or 13123 ft. is adequate for any type of aircraft. With that, globally, the most used runway wide is identified as 80m or 250ft. (Harrison, A 2015) it is not the absolute number and varies airport to airport but can be used as standard. Taxing distance is a critical issue for an airport as long navigating separations protract flying times, builds fuel utilization and lead to delays (Robert, 2007).

2.6 Dimensions

2.6.1 Aircraft Dimensions

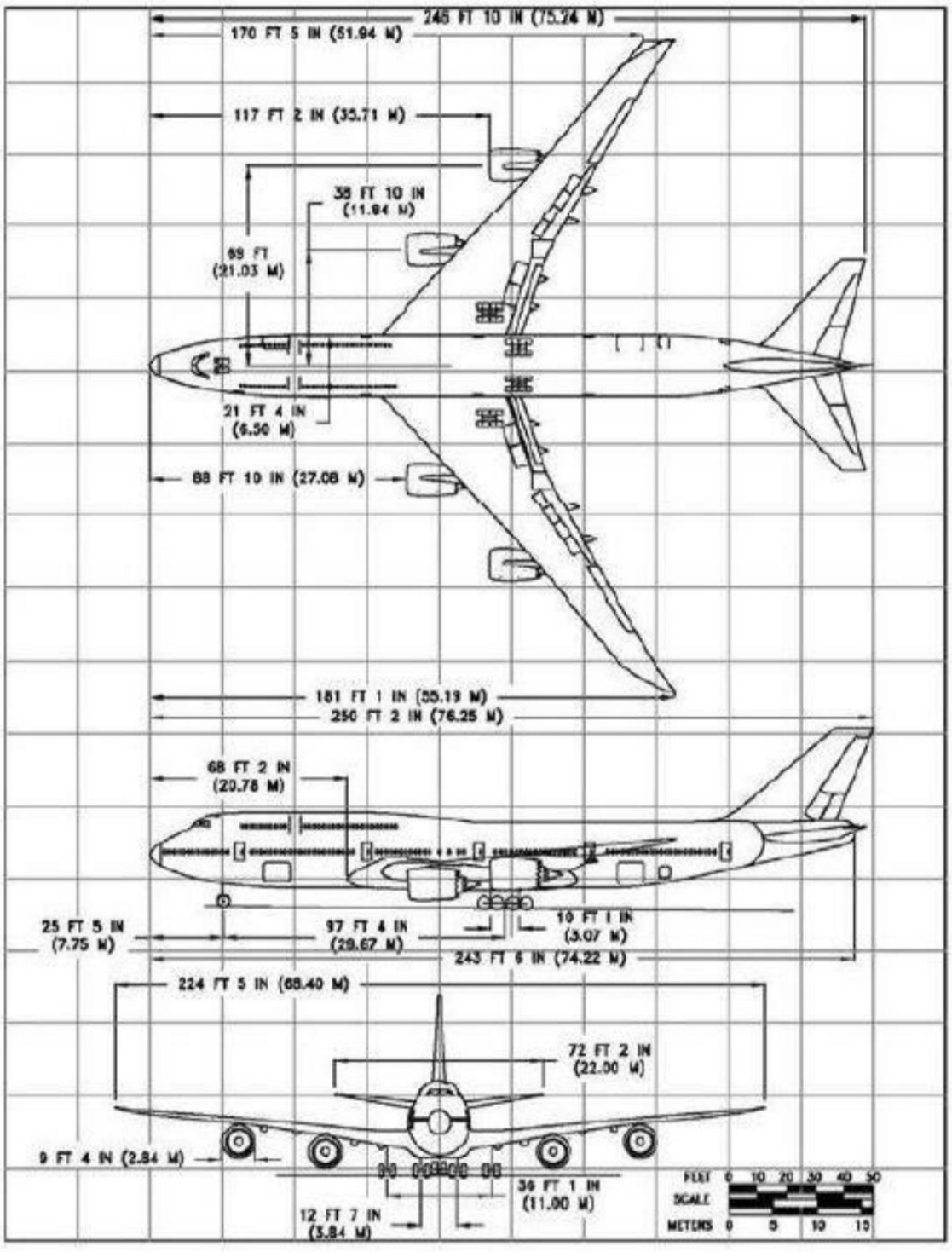


Figure: Boeing 747-400 (Source: Boeing Manufacturers)

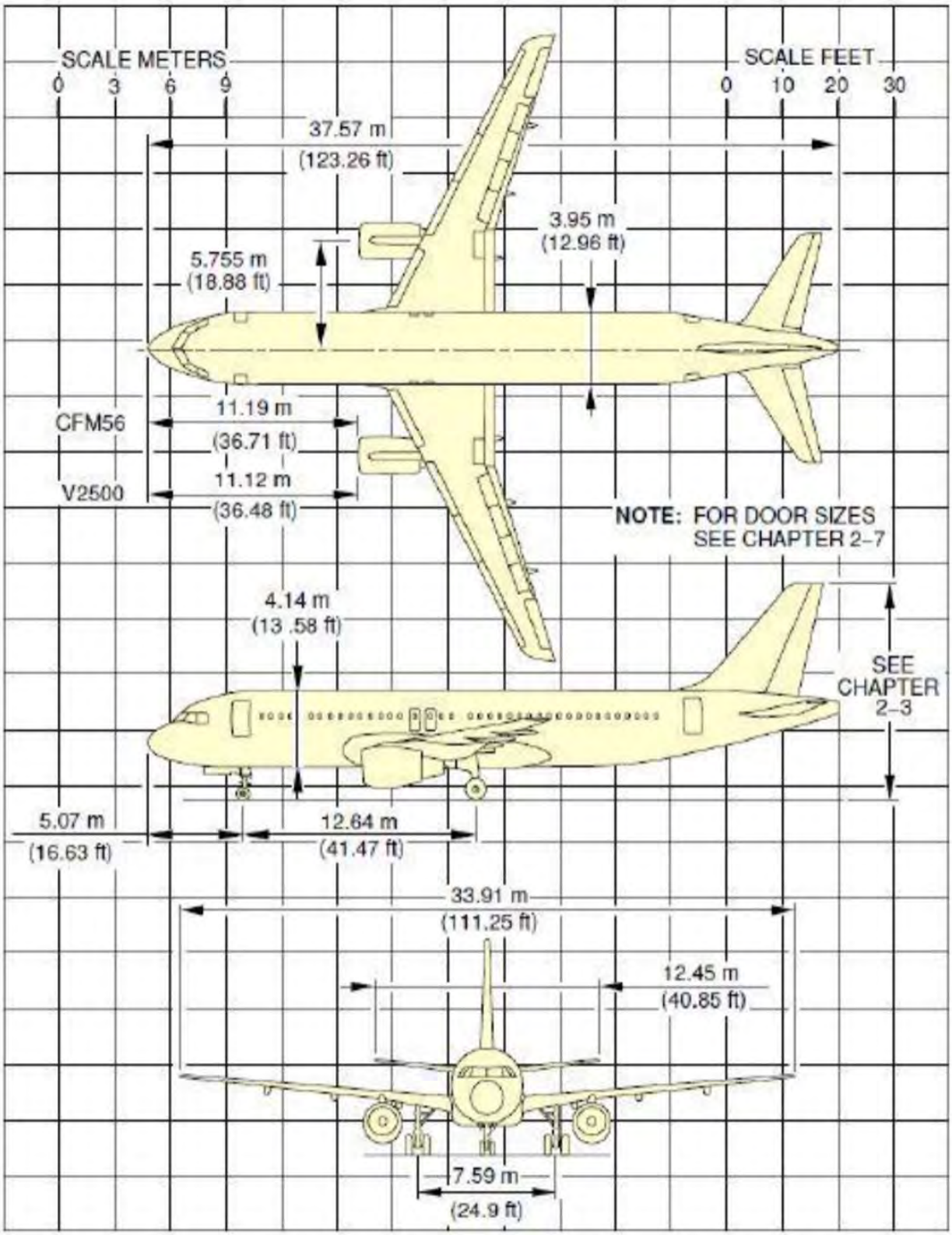
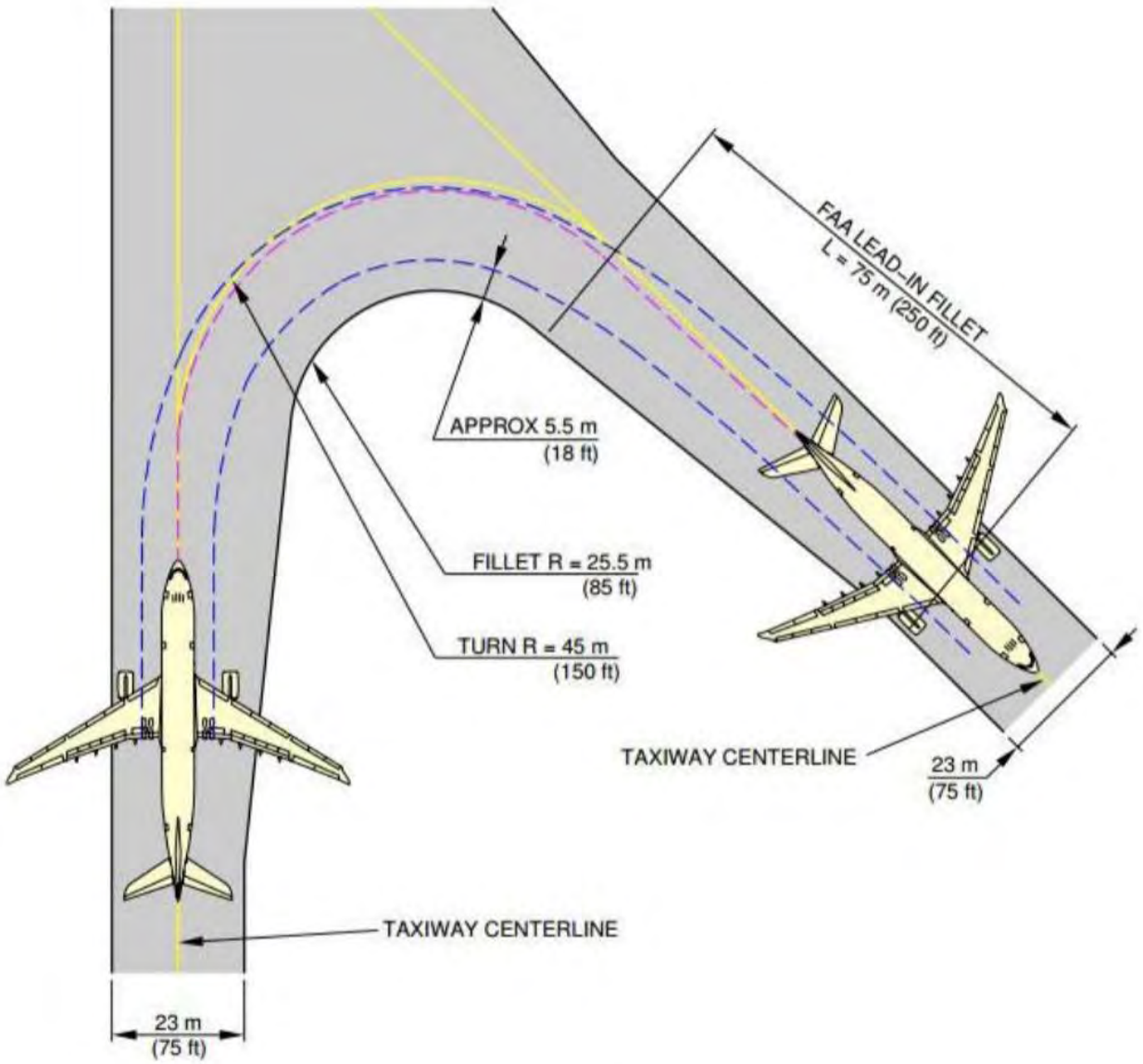


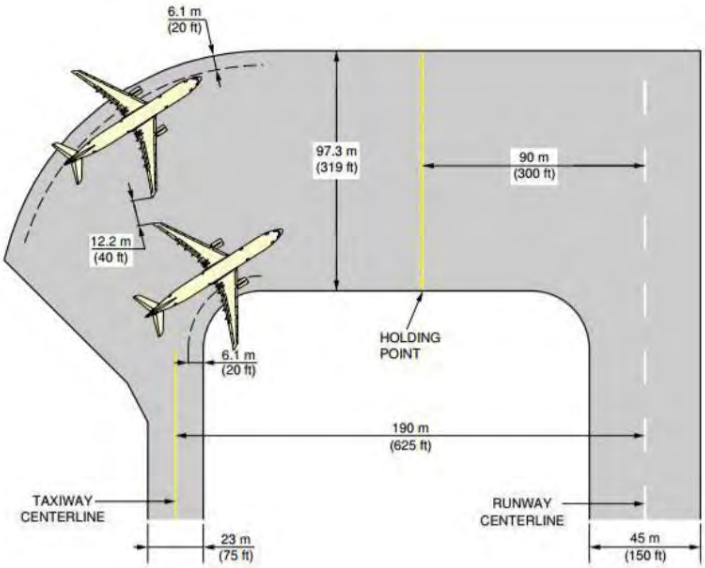
Figure: Airbus A320
Source: Airbus Manufactures

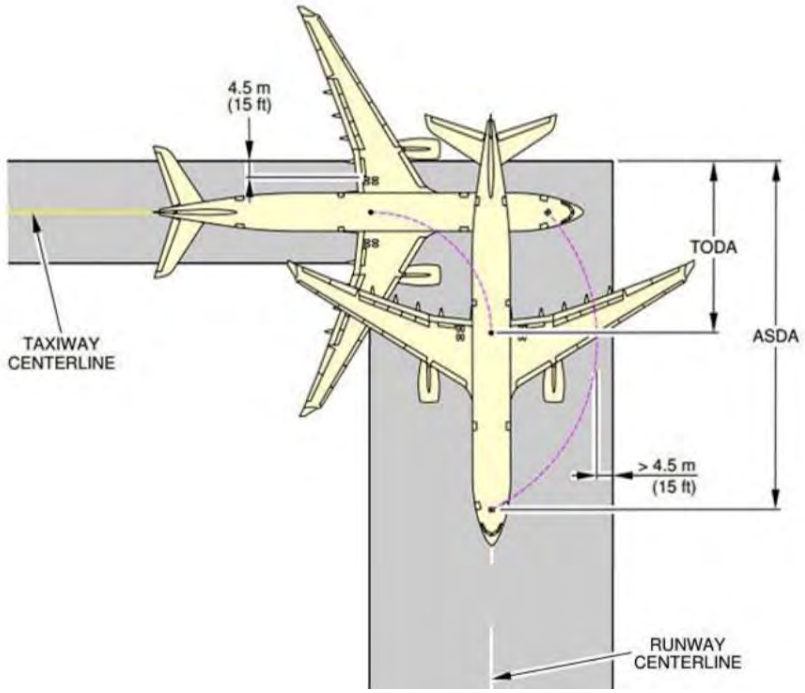
2.6.2 Turning Radius of Taxiway and Runway



135° Turn - Taxiway to Taxiway
Cockpit Over Centerline Method
FIGURE-4-5-4-991-008-A01

Source: Airport and Maintenance Planning



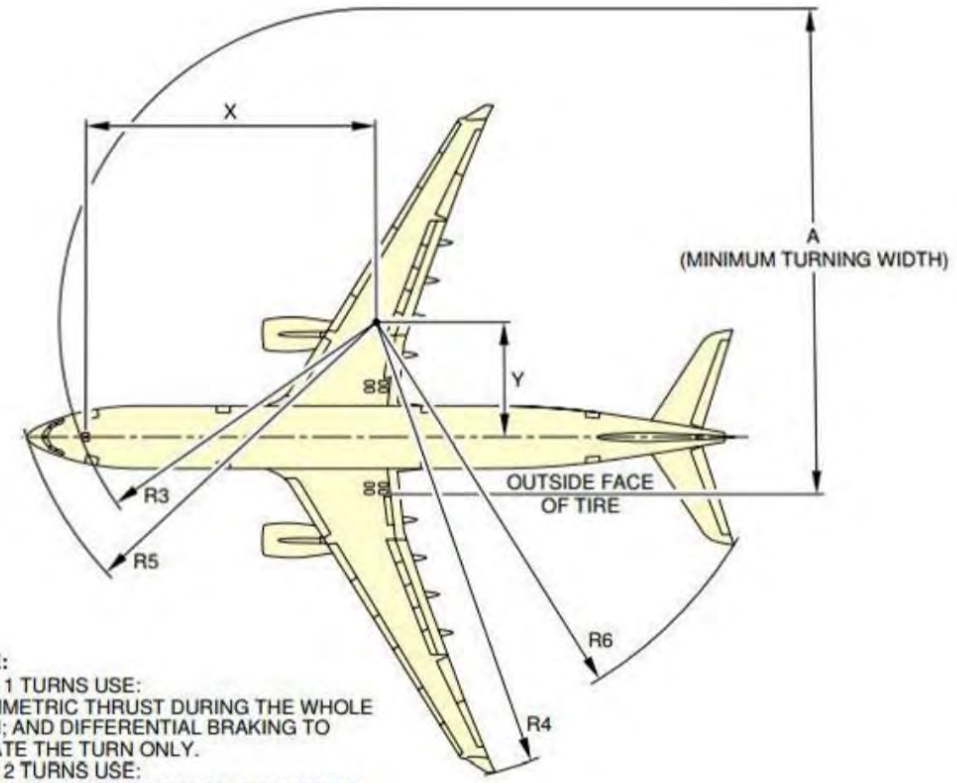


90° TURN ON RUNWAY ENTRY					
AIRCRAFT TYPE	MAX STEERING ANGLE	45 m (150 ft)/60 m (200 ft) WIDE RUNWAY			
		MINIMUM LINE–UP DISTANCE CORRECTION			
		ON TODA		ON ASDA	
A330–200/–200F	65°	22.5 m	74 ft	44.7 m	147 ft
A330–200/–200F	72°	19.7 m	65 ft	41.9 m	137 ft
A330–300	65°	24.2 m	80 ft	49.6 m	163 ft
A330–300	72°	21.2 m	69 ft	46.5 m	153 ft

Source: Airport and Maintenance Planning

2.6.3 Turning Radius of an aircraft

**ON A/C A330-300



NOTE:
TYPE 1 TURNS USE:
ASYMMETRIC THRUST DURING THE WHOLE TURN; AND DIFFERENTIAL BRAKING TO INITIATE THE TURN ONLY.
TYPE 2 TURNS USE:
SYMMETRIC THRUST DURING THE WHOLE TURN; AND NO DIFFERENTIAL BRAKING AT ALL.

A330–300 MINIMUM TURNING RADII										
TYPE OF TURN	STEERING ANGLE (deg)	EFFECTIVE STEERING ANGLE (deg)		X	Y	A	R3 NLG	R4 WING	R5 NOSE	R6 TAIL
1	72 (MAX)	67.8	m	25.4	10.4	44.6	27.6	41.6	33.7	33.1
			ft	83	34	146	91	136	111	109
2	72 (MAX)	63.8	m	25.4	12.5	47.6	28.5	43.7	34.4	34.4
			ft	83	41	156	94	143	113	113
1	65 (MAX)	62.1	m	25.4	13.4	49.0	29.0	44.6	34.7	35.1
			ft	83	44	161	95	146	114	115
2	65 (MAX)	60.1	m	25.4	14.6	50.7	29.6	45.8	35.2	35.8
			ft	83	48	166	97	150	115	117

NOTE:
IT IS POSSIBLE TO GET LOWER VALUES THAN THOSE FROM TYPE 1 BY APPLYING DIFFERENTIAL BRAKING DURING THE WHOLE TURN.

F_AC_040300_1_0010101_01_05

Minimum Turning Radii

Source: Airport and Maintenance Planning

3 SITE ANALYSIS

3.1 The site selection

As per requirement for an airport at Khulna division, Government tried to find appropriate site for an airport near Khulna city and failed. Then, the government officials and CAAB decided to take a place near Bagerhat district along with Khulna- Mongla highway as a suitable placement for Khan Jahan Ali airport in 1996. Though, rather than land accusations, no further development were processed within this long time period. Now as the Prime minister of Bangladesh declared to move forward with the project CAAB finally fixed the site for the airport with total of 514 acres of land. The site location is highly strategic which is 33km from Khulna city, 29 km from Bagerhat city and 20 km from Mongla sea port and one of the entry point of Sundarbans. Koromjal Wildlife Rescue Centre which is the North entry point of Sundarbans located just at the opposite side of Poshur River from Mongla Sea port. Accordingly MOCAT, CAAB and Cell visited this site on the 3rd November of 2015 and submitted its full report by 2nd December, 2016. A full analytical presentation of the proposal and site presented in front of Prime Minister where she approved the site for Khan Jahan Ali Airport.

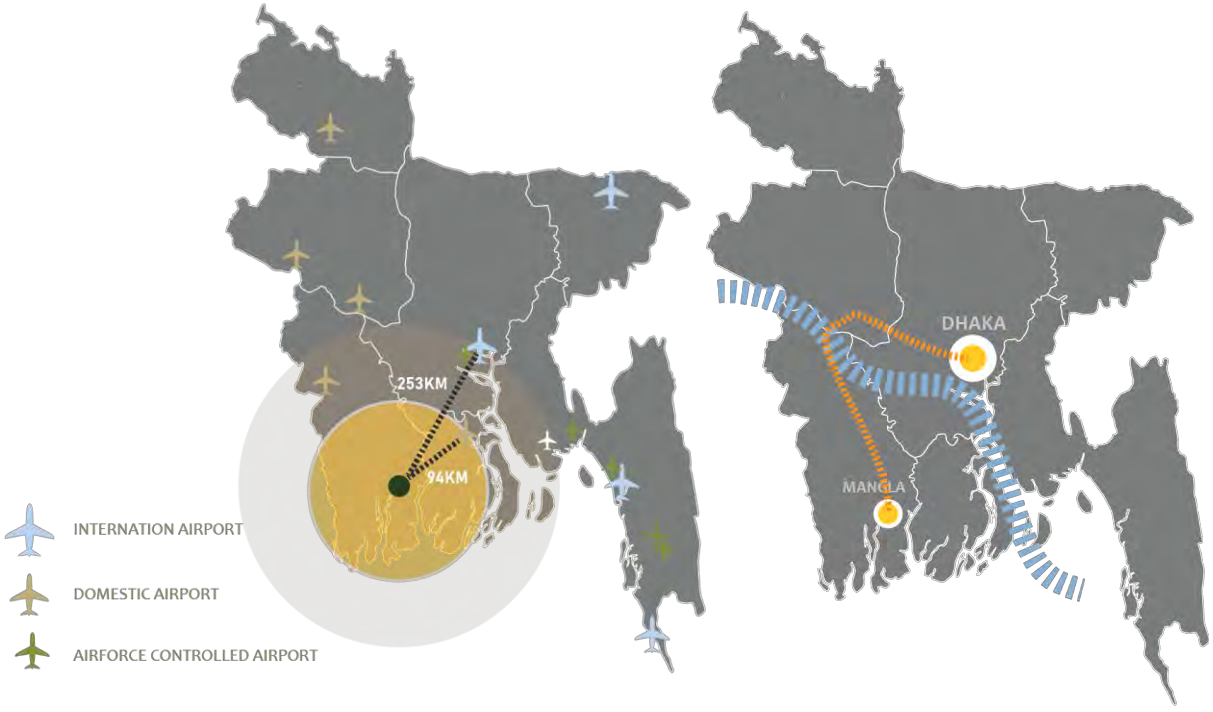
3.2 Status of the Site

There were different aspects which were considered to come up with this site. Geographic location of the site is crucial with an appropriate distance from 2 major city and also a sea port. Some considered criteria for site selection is mentioned below.

Land Availability	Around 1000 acre
Population density	At minimum rate
Future expansion	Possible
Communication with capital city	Possible
Distance from capital city	187 km
Distance from closest divisional city	33 km
Distance from nearest airport	93 km
Distance from HSIA	205 km
Distance from Sundarbans	20 km
Road communication	Good
Existing crops	1 time crops
Land acquisition and rehabilitation	Easier as less populated area
Status of land	Acquired by Government
Social restriction	Nil
International air routes	Closed to the site
Final Recommendation of location	Suitable

As the Padma river bridge construction is ongoing these create a significant connection with the site. When the construction of the bridge will be done, then the existing Dhaka-Mawa highway via Sreenagar will connects the capital with proposed site. With that, in existing situation, through Jamuna Bridge, Dhaka is connected with the site. River Padma and Meghna connect the site for transportation of aviation fuel.

3.3 Site Location

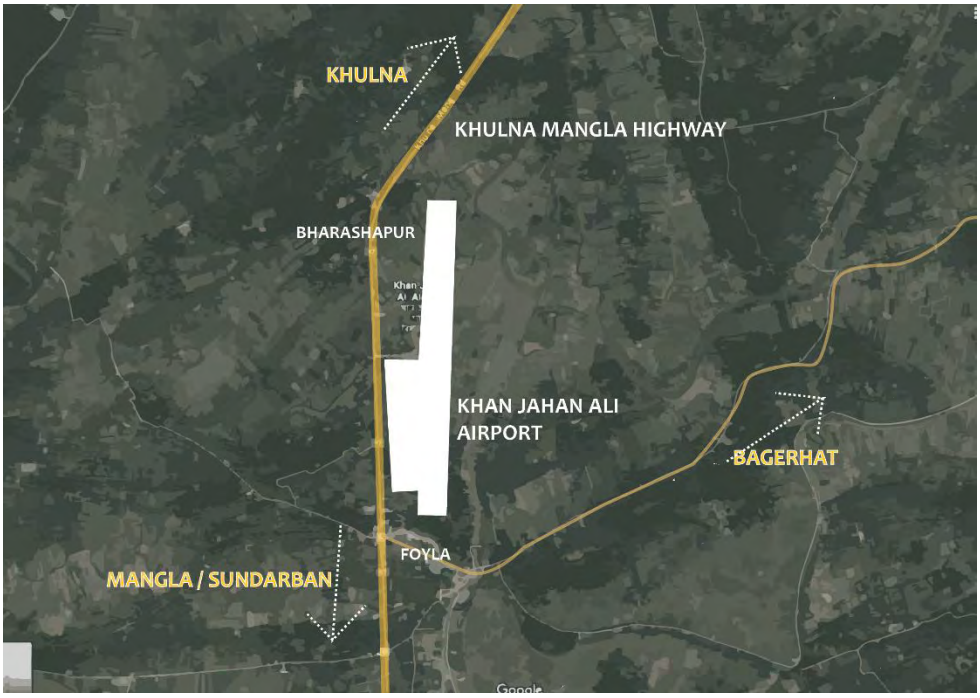


Source: Author

All Existing Airports location in Bangladesh are shown in the map A. Where we can see that, the nearest domestic airport located in Barisal district which is 94 km away and the nearest international airport is 253km away at Dhaka.

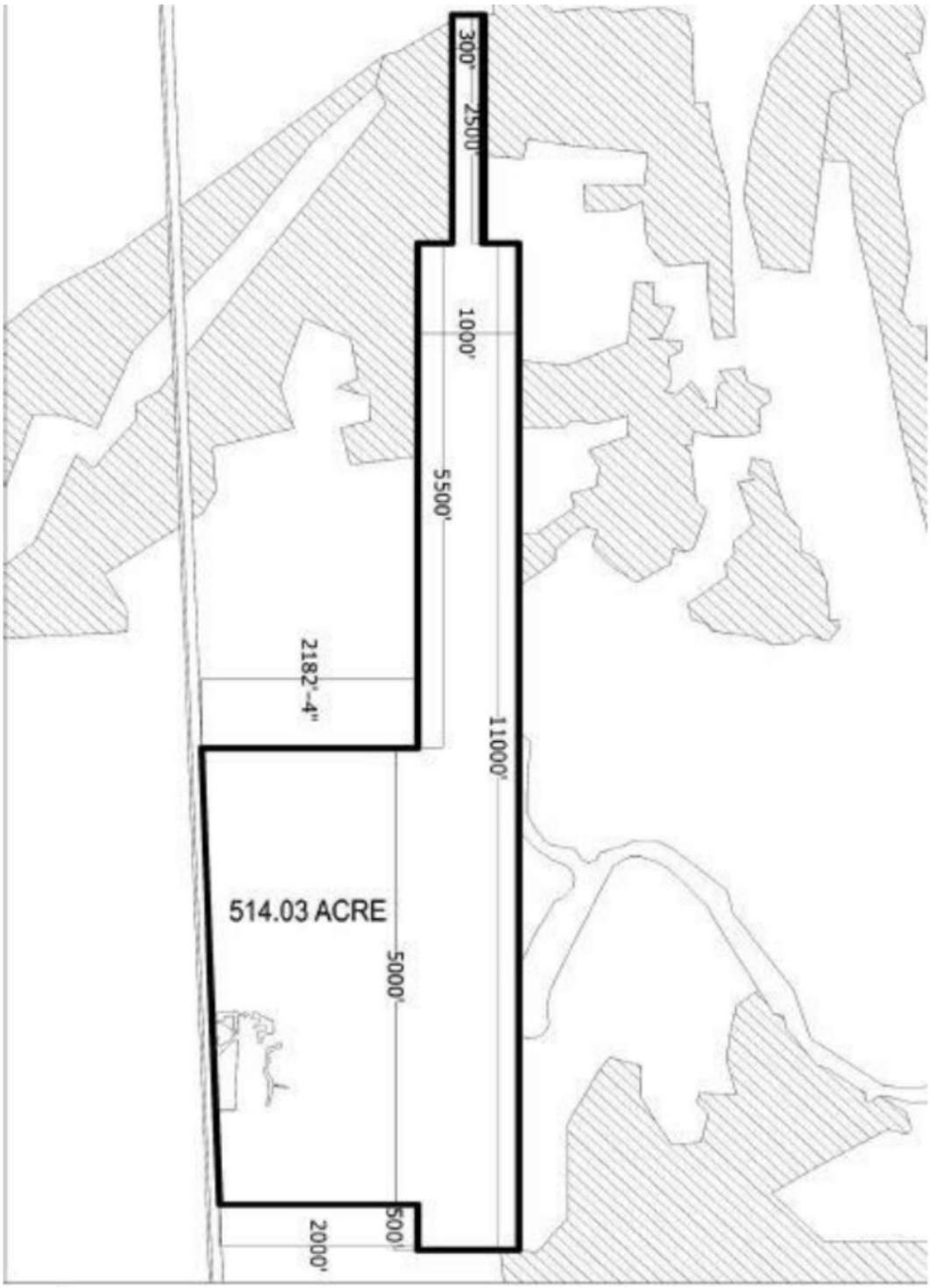
Also the west-southern part of Bangladesh divided by the Padma River from the capital. Even with the construction of Padma Bridge is ongoing, fast transportation from capital is difficult from this region.

(Source: Author)



(Source: google earth)

3.4 Site plan with dimensions



SITE PLAN

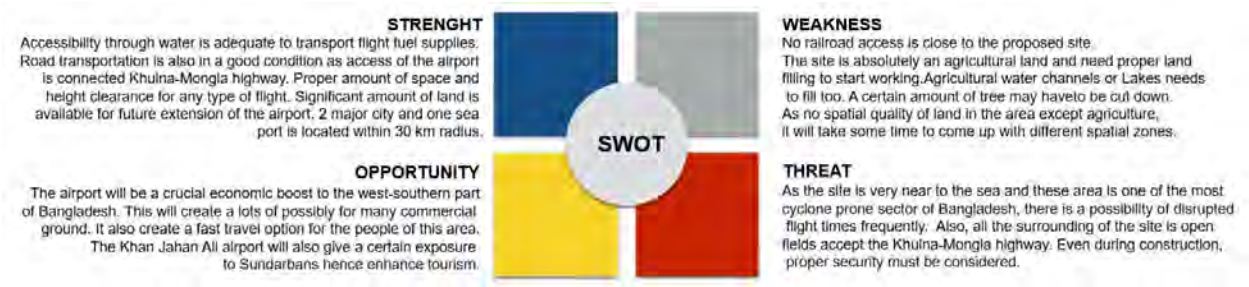
3.5 SWOT Analysis

Strength: Accessibility through water is adequate to transport flight fuel supplies. Road transportation is also in a good condition as access of the airport is connected Khulna-Mongla highway. Proper amount of space and height clearance for any type of flight. Significant amount of land is available for future extension of the airport. 2 major city and one sea port is located within 30 km radius.

Weakness: No railroad access is close to the proposed site. The site is absolutely an agricultural land and need proper land filling to start working. Agricultural water channels or Lakes needs to fill too. A certain amount of tree may have to be cut down.
As no spatial quality of land in the area except agriculture, it will take some time to come up with different spatial zones.

Opportunity- The airport will be a crucial economic boost to the west-southern part of Bangladesh. This will create a lots of possibly for many commercial ground. It also create a fast travel option for the people of this area. The Khan Jahan Ali airport will also give a certain exposure to Sundarbans hence enhance tourism.

Threat- As the site is very near to the sea and these area is one of the most cyclone prone sector of Bangladesh, there is a possibility of disrupted flight times frequently. Also, all the surrounding of the site is open fields accept the Khulna-Mongla highway. Even during construction, proper security must be considered.



(Source: Author)

3.6 Site pictures

(Source: Author)

4 CASE STUDY

4.1 Adolfo Suarez Madrid - Barajas Airport (Terminal 4)

Airport type: Public

Location: Barajas, 28042 Madrid, Spain

Owner: Government of Spain

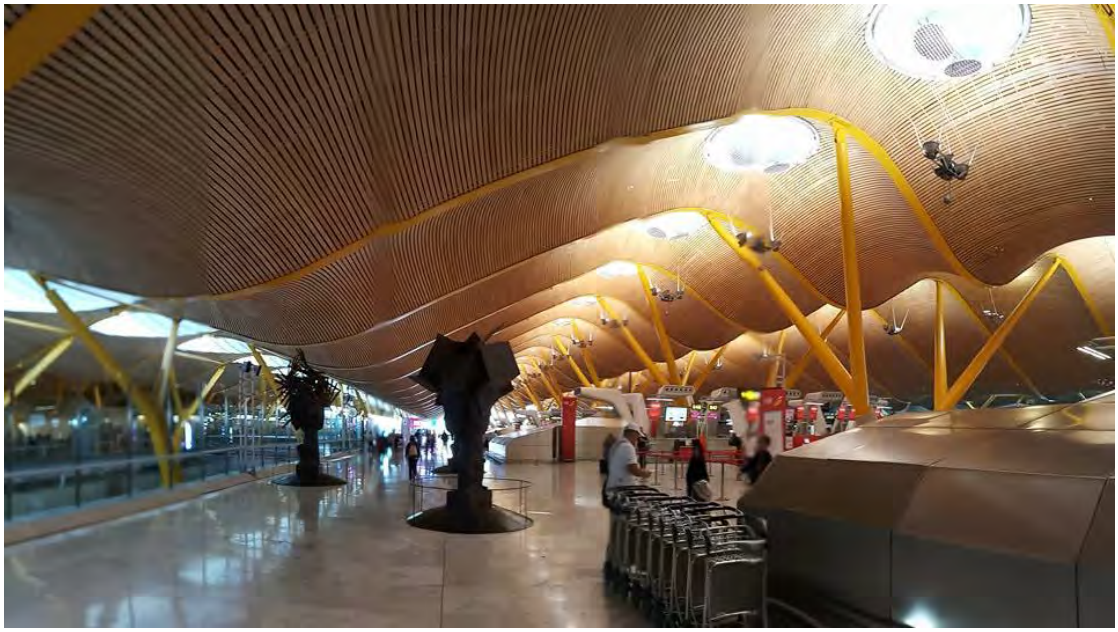
Operator: AENA (Aeropuertos Españoles y Navegación Aérea)

Serves: Spain

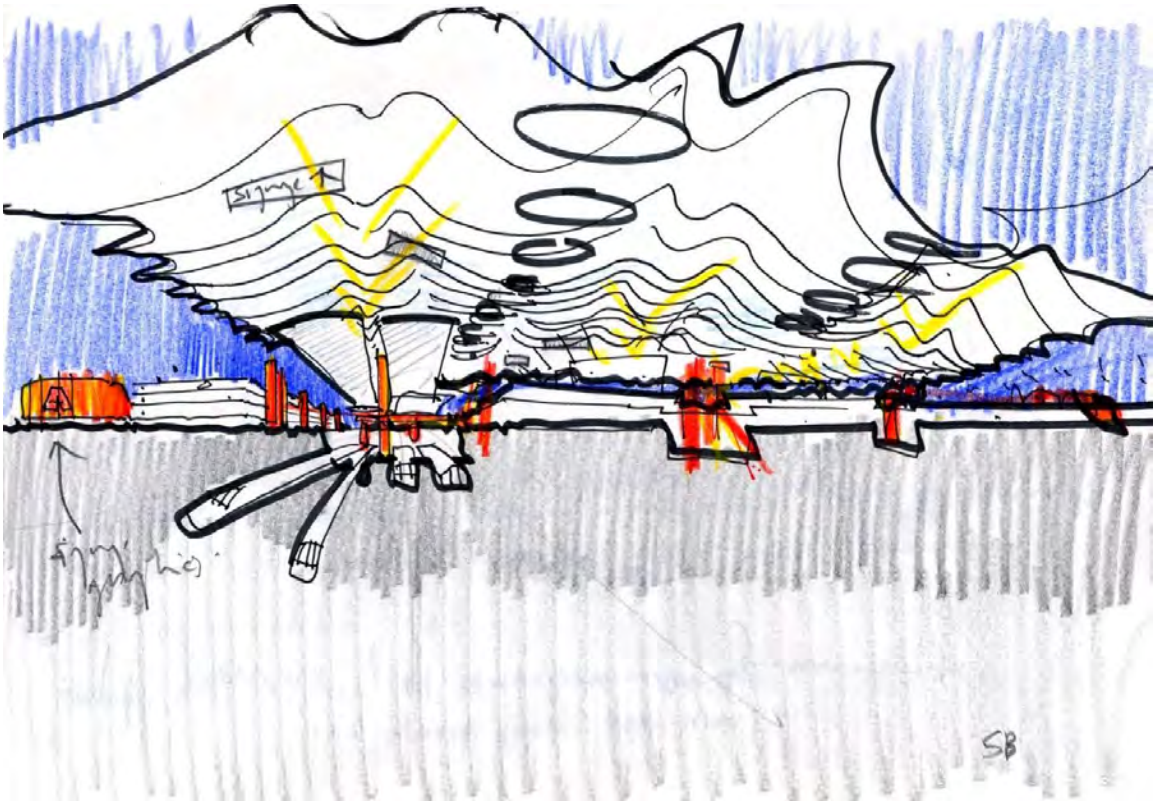
Architects: Estudio Lamela, Rogers Stirk Harbour + Partners

Area: 760,000 Square meters (8,180,572 square feet)

The new terminal and runway of Adolfo Suarez Madrid - Barajas Airport became functional form 5th February, 2006. The design won the Stirling prize of 2006 and one of the world's largest airport terminals in terms of physical area. There are a satellite building which is terminal 4S and approximately 2.5km apart from main building.

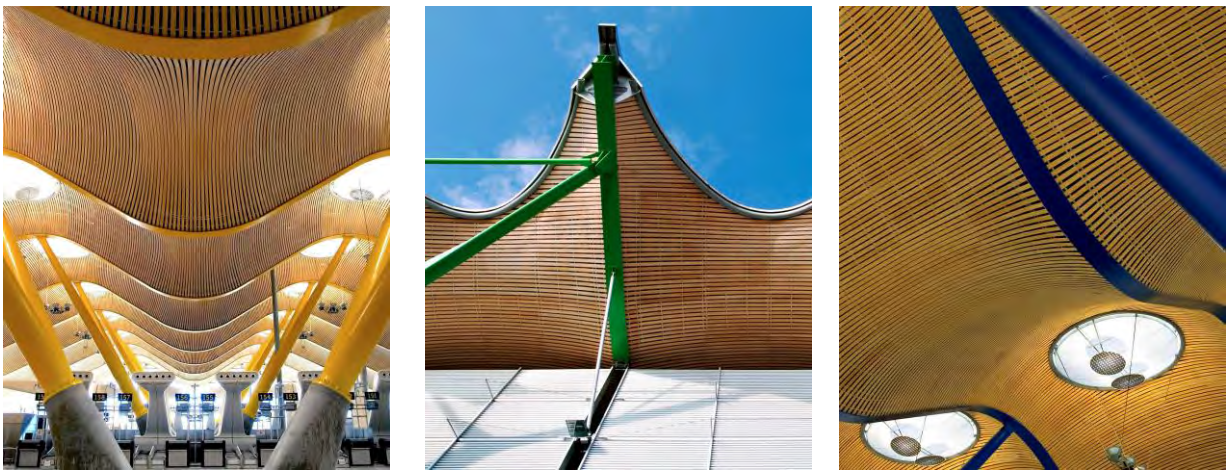


Outer lobby of Madrid -Barajas Airport (terminal 4)
Source: Author



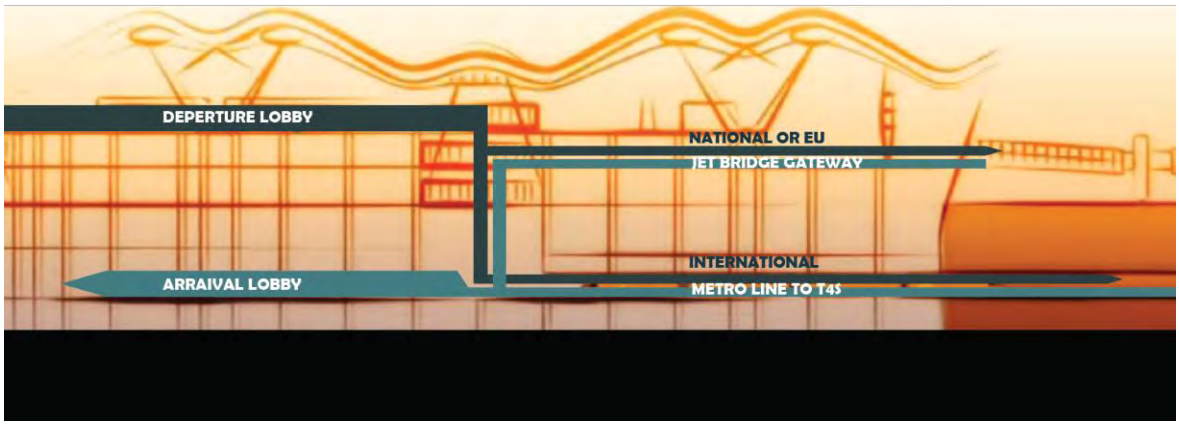
Initial conceptual sketch of T4
Source: https://www.lamela.com/en/proyectos/t4-terminal-madrid-barajas-airport/

T4S is the satellite building which serves for International non- Schengen passengers. It is connected with the main building through underground service tunnel which includes



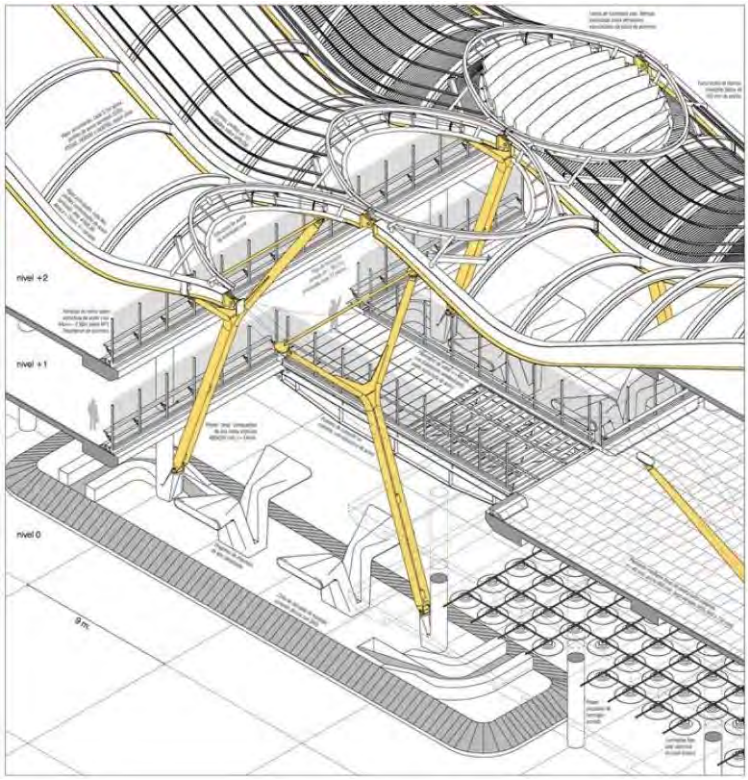
Detail of material use and structural features
Source: https://www.lamela.com/en/proyectos/t4-terminal-madrid-barajas-airport/

the APM. The target for building a new terminal with these huge area was to make Spain the European gateway from Latin America. The additional terminal added 90 million passenger capacity per year the airport.

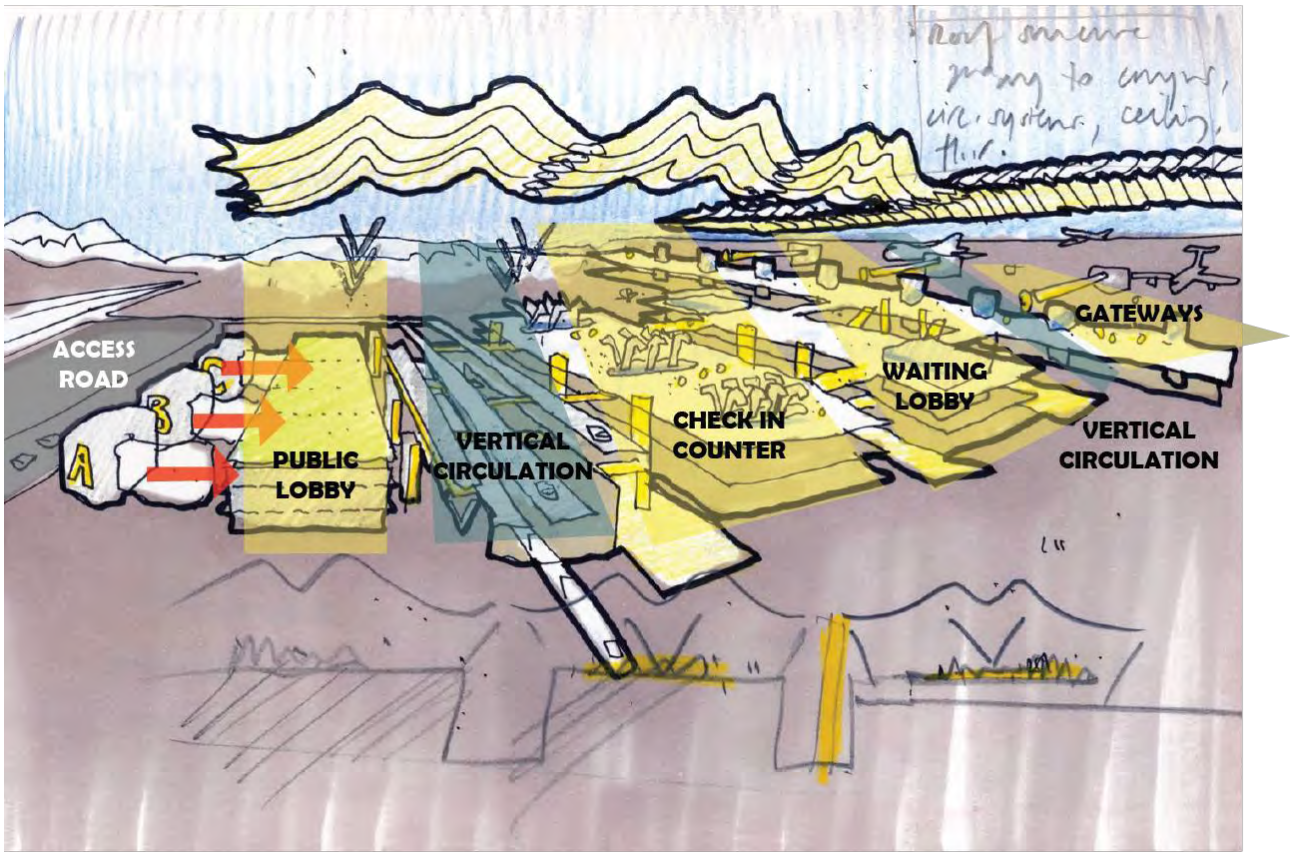


Passenger circulation flow
Source: Author

The project support total number of 67 aircraft position where 40 for T4 and 27 for T4S. This new project added 9000 new vehicular parking space with the previous airport building. The parking are placed in multilevel building in 6 different modules.



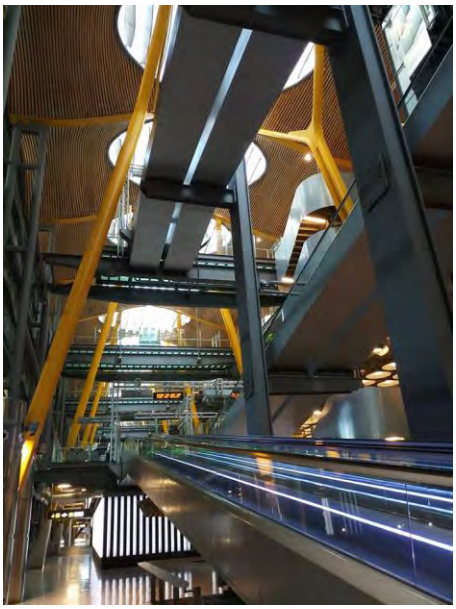
Axonometric detail drawing of structure
Source: https://www.lamela.com/en/proyectos/t4-terminal-madrid-barajas-airport/



Zoning in different linear modules
Source: Author

The Terminal can be divided into three linear modules which creates the functional differences of passengers flow. For the passengers who have departure flights have separated functions in different modules as Receptions and ticket counter, check in counter and control, Departure zone. In a different level of the building, opposite are functioned for arrived passenger to depart form the building. Both Departure and arrival zone are connected with a mezzanine level in the middle which serves as public zone with store and restaurant at the front side. The back are filled controlled by service zone. Within these 3 linear module there are atrium spaces with vertical circulation for

passengers and also security and luggage. Also three are light filled canyons that provide natural light in the lower levels of the building which make the building energy sufficient. The linearity of passenger's circulation makes it directional to them and also define the stages of a flight process.



Vertical circulation and ticket counter
Source: Author

Dynamic metal structural elements holds the massive curved roof on top of the building. Use of vernacular material in a massive building makes it unique in the world. The buildings atmosphere with its space quality clear a passenger's mind before taking off. Use of bamboo roof in the inner side and metal structure create a picture of many tree giving its shadow to the lobby. Glasses uses all around the building to engage natural light with the building and make the environmentally sustainable.

5.2 Hong Kong International Airport

Airport type: Public

Location: 1 Sky Plaza rd, Chek Lap Kok, Hong Kong

Owner: Government of Hong Kong

Operator: Hong Kong Airport Authority

Serves: Hong Kong

Architect: Foster + Partners

Area: 516000 Square meters (5,554,177 square feet)

Hong Kong International Airport is the primary airport of the government of Hong Kong is one of the most important transit point in south-east Asia. This airport's handling capacity of the passenger's 72 million people annually. The airport has been in operation since 1998 by replacing the Kai Tak Airport. It has one of the world's largest passenger terminal buildings (the largest at 1998)

Figure: Arial view
Source: Foster + Partners

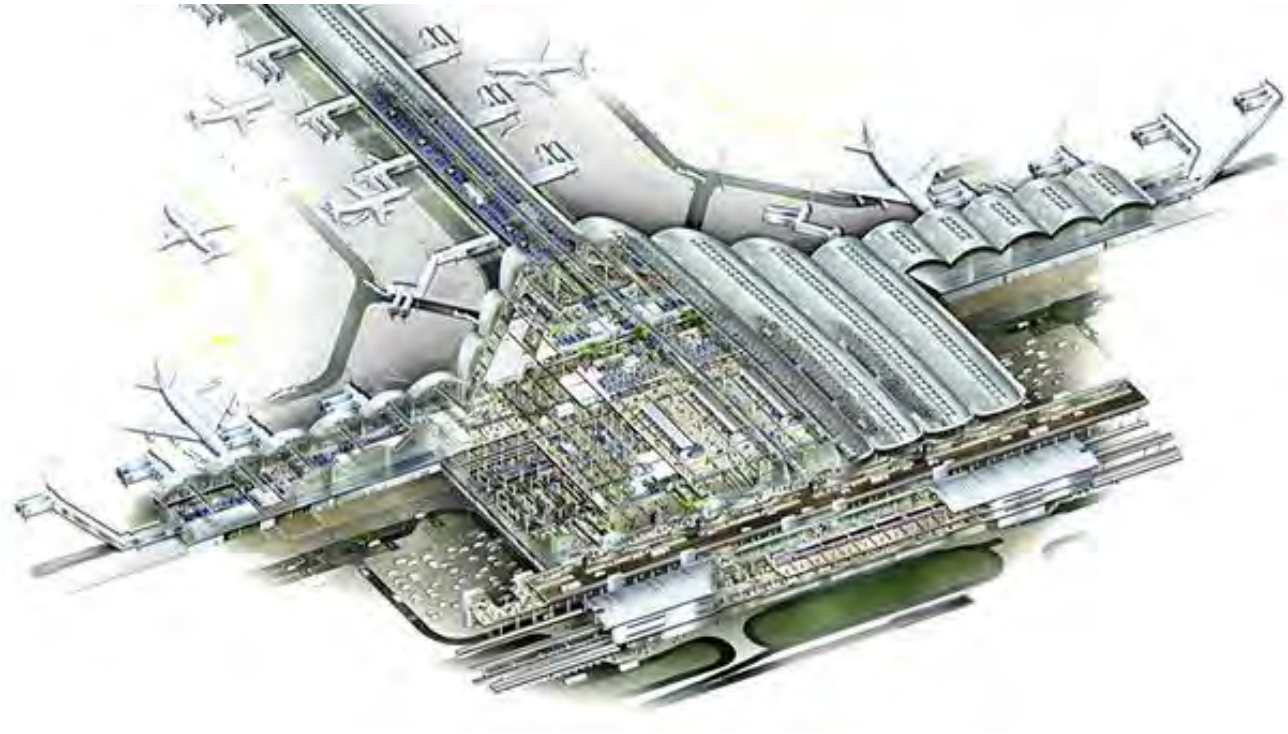


Figure: Axonometric view
Source: Ahttps://www.behance.net/gallery/18533325/Hong-Kong-Airport-Cutaway

The airport has total amount of 90 boarding gates of which 78 are jet bridge gates. Other 12 gates are virtual gates in which passengers have an assembly point or waiting zone to meet and then they are transported to the aircraft through apron buses.

Source: Foster + Partner

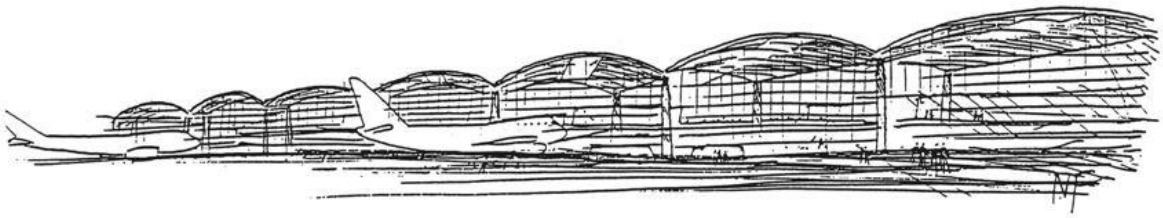


Figure: Sketch, Source: Foster + Partners

There are 2 terminal in the airport where terminal 1 is the 3rd largest airport terminal in the world. With that there is a midfield concourse away from the main terminal building. This concourse were on operation since 2015 and have 20 aircraft parking stands. The two runway located at both side of the midfield in parallel formation.

Figure: Entrance; Source: Foster + Partners

The concept of the terminal building are developed from Stansted Airport, which is model developed worldwide for airport planning. The target of this project is to create a large roof canopy on top of all the functions and make it as much light as possible to be

sustainable. With the variations of forms this canopy can be easily accessible for natural light and an air ventilation beneath it can make the inner environment cooler.

The vaulted massive and single roof of Hong Kong International Airport develop same concept to make the building more environmentally efficient. More than that, architect use a directional form to create a significant identification of the pathway. The form itself act to show passengers which way to go.

The airport can be access from the city through main road or rail links. The vast atrium with glass bridges at the main lobby make travelers feel relieved while departing.

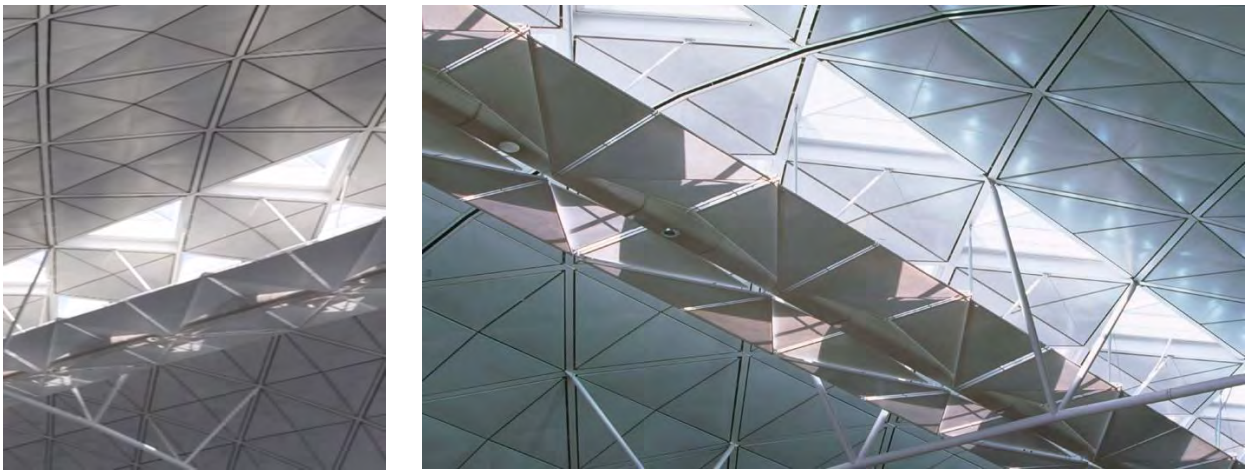


Figure: Vaulted roof
Source: Foster + Partners

5 PROGRAM DEVELOPMENT

As said before, airport is a structure which contains crucial functional and technical issues which can never be interrupted while designing. The primary programs for Khan Jahan Ali Airport is mentioned previously. According to CAAB, the passenger capacity of the airport will be 500,000 annually. The possible active aircrafts which will be used by Bangladesh Biman are Boeing 777 and Airbus a320. Boeing 777 can take 314 to 451 passengers and Airbus a320 can take 180 to 220 passengers at a single flight. With 4-8 flights will take place, there will be approximately 3000-3500 passengers using this airport per day. After counting additional personals with passengers and stuffs the number of user of this airport will reach 10,000(approx.) person per day.

There will be a terminal building with arrival and departure circulation flows and necessary functions. A minimum of 2 level security check will be held during departure period, one while entering airport main lobby and second, before boarding aircraft. There will a common lobby for public with different amenities; like shop, restaurant or cafeteria, public toilet. Check in counter will include luggage collection and different air services including ticket delivery. A passenger waiting zone will be provided in between gates and check in counter. There will be Jet Bridge loading system by which passengers can board directly from the terminal building into the aircraft.

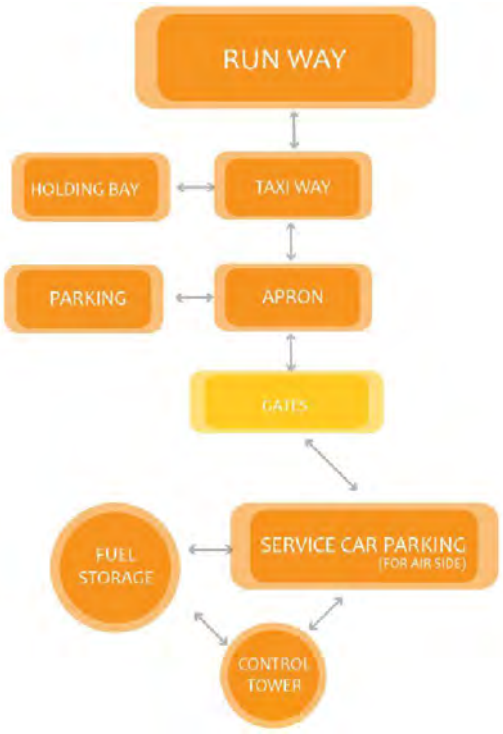
For arrival circulation, passenger will reach in a different level through the jet bridge gateway and reach conveyor belt for collecting luggage. There will also be an additional luggage store for unclaimed luggage. A security check will take place after collecting luggage.

A control tower is a crucial component of airport. It contains different units which takes air traffic control and monitoring. There are different functions like pre light info unit, community engineering unit, Radar & Radar Tech. Unit, Biman operation unit, weather dept., telephone exchange room, area control room inside of a control tower.

Runway, Taxiways and Apron are mandatory airside component. With that, there will be an administration section by CAAB and flight fuel and mechanical equipment storage section for aircrafts. A proper access way and drop off from different vehicular module are required. Also, an amount of 400 car parking will be incorporated.

The calculated required functional space are shown below_

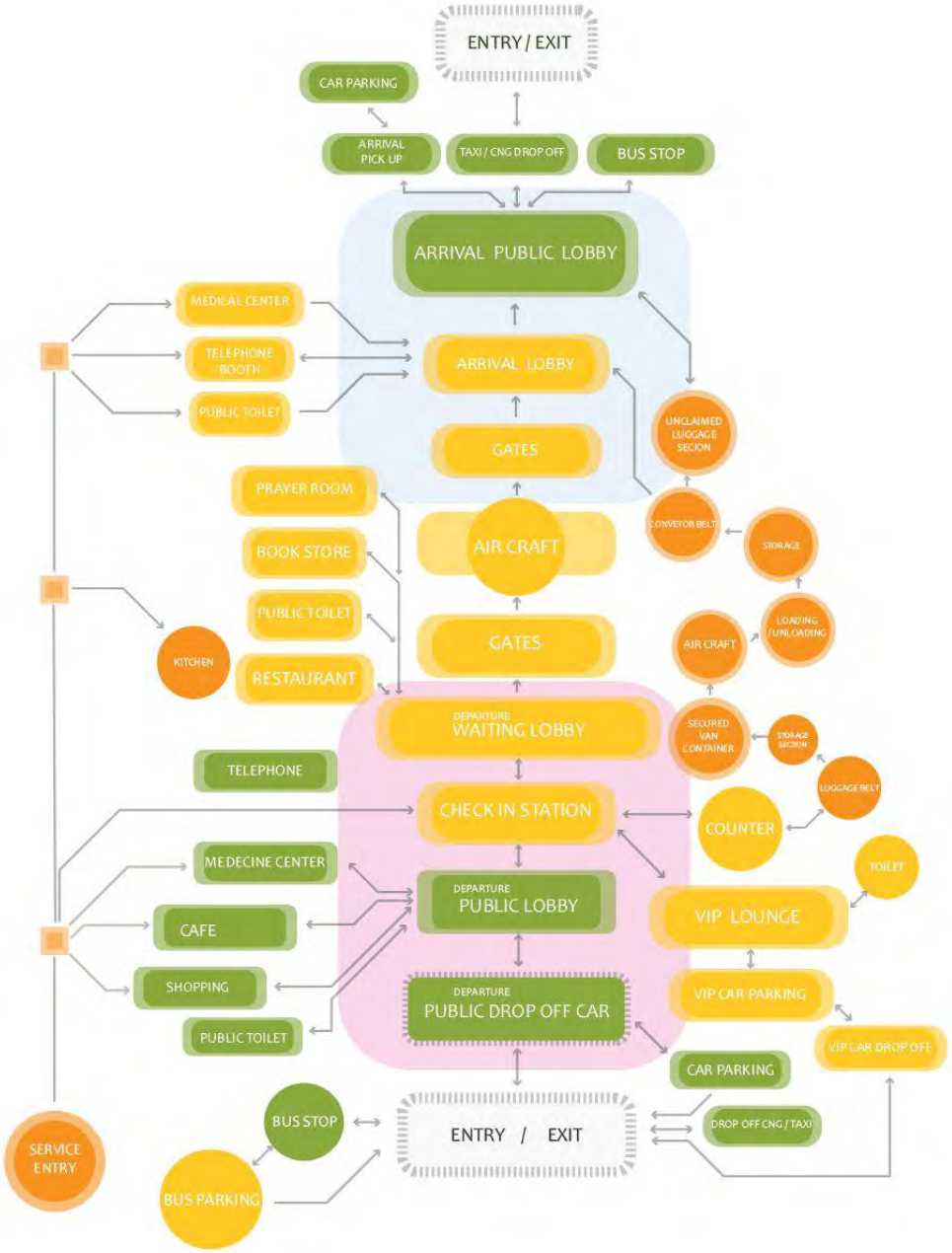
5.1 Functional Flow (Airside)



Source: Author

One of the most technical part of airport design is how the airport services connects with the aircrafts. Airside is mostly divided into three parts which are Runway for aircraft's takeoff and landing, Taxiway for aircraft circulation and apron to connect with the land activities.

5.2 Functional Flow (inside terminal building)



Source: Author

5.3 Estimated Required Area Calculation

5.3.1 Departure Section

FUNCTIONS	SQUARE FEET
Concourse	15000
Lobby	10000
Queuing(1000 person at a time)	1000 X 6 = 6000
Check in Counters	8 X 825 = 6600
Working Area	5000
Small cafe	1500
Medicine center	1500
Other shops	10 X 1500 = 15000
Telephone booth	150
Newspaper stand	150
Commissions	400
Public Toilet (m + f)	2 X 400 = 800
Total	62,100 sqft

5.3.2 Waiting Section

FUNCTIONS	SQUARE FEET
Passengers waiting lobby	1500
Waiting lobby sitting	400 X 8 = 3200
Book store	2 X 1500 = 3000
Restaurant	2000

Kitchen	600
Prayer room	1200
Toilet with change room (m + f)	2 X 400 = 800
Total	12,300 sqft

5.3.3 Arrival Section

FUNCTIONS	SQUARE FEET
Arrival lobby	10000
General concourse	15000
Baggage Handling	3 X 2500 = 7500
Conveyor belt (3 belt)	3 X 7500 = 22500
Working Area	5000
Unclaimed baggage store	3000
Medicine center	1500
Telephone booth	150
Newspaper stand	150
Commissions	650
Public Toilet (m +f)	2 X 400 = 800
Total	66,250 sqft

5.3.4 Control Tower

FUNCTIONS	SQUARE FEET
Pre Light info Unit	350
Control tower	450
Community Operation	270
Community Engineering Unit	270
Radar & Radar Tech. Unit	270
Biman Operation Unit	540
Weather Department	270
Telephone Exchange Room	270
Area Control Room	270
Toilet	2 X 225 = 450
Stair	110
Prayer Room	450
Total	5,970 sqft

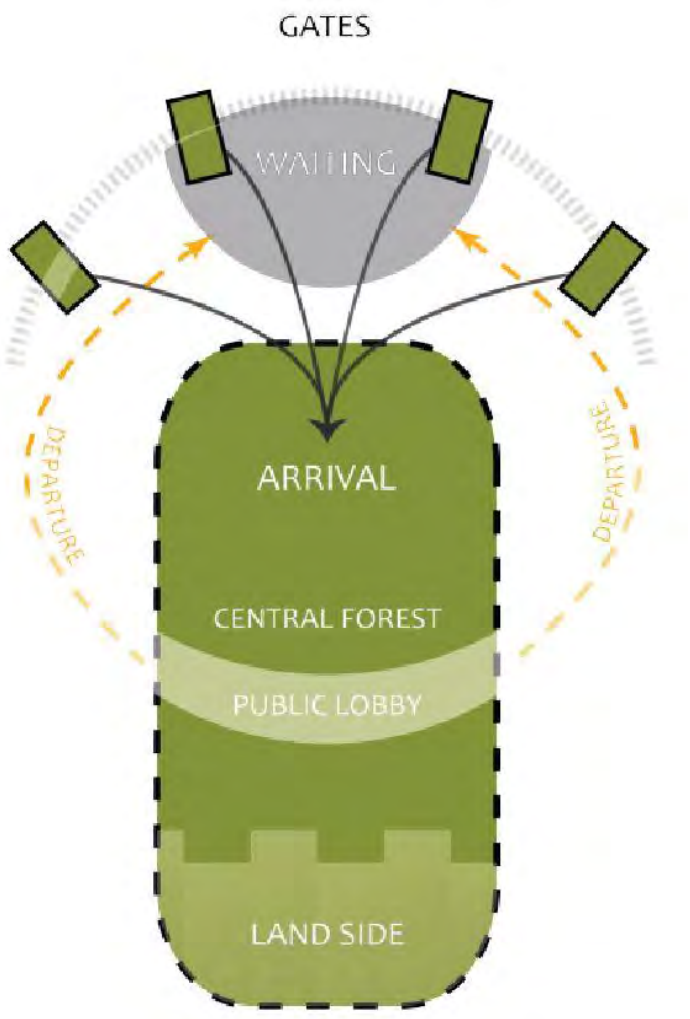
5.3.5 Others

FUNCTIONS	SQUARE FEET
Administration	2200
Airline Operation	6750

Airport Security	1350
Employee Snacks & Cafe	700
Kitchen	350
Toilet	2 X 275 = 550
Car Parking (400 cars)	128 X 400 = 51,200
Mechanical Room	1500
Total	64,600 sqft
GRAND TOTAL	**211,220 sqft**

6 DESIGN DEVELOPMENT

6.1 Concept



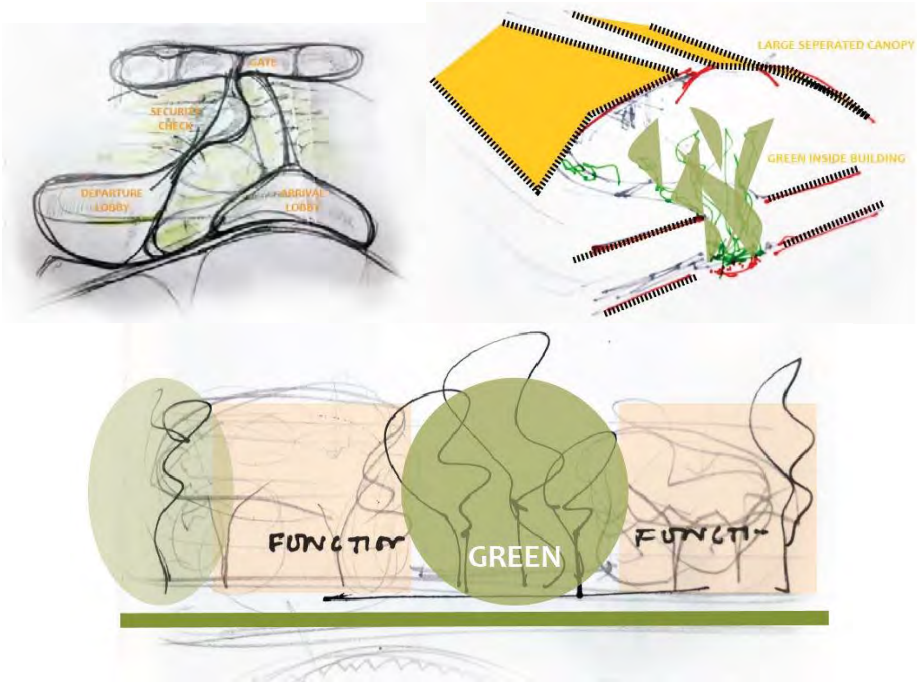
Source: Author

The primary idea of the project is to identify Sundarban as the most significant feature of south -western Bangladesh. As this airport will be a gateway of the region for others, the first aperture of the airport will be an exposure of Sundarban. A dense natural forest is placed in between the terminal and connecting function with a target to provide a primary experience of Sundarban to the passengers.

In addition to the first idea, the terminal building is also divided into major two parts with public accessed and controlled accessed. The form of this natural flowing green path is derived from the formation of south Bengal delta routes. This green path also lead humans to the public space of the airport which connects with the surrounding community.

Source: Author

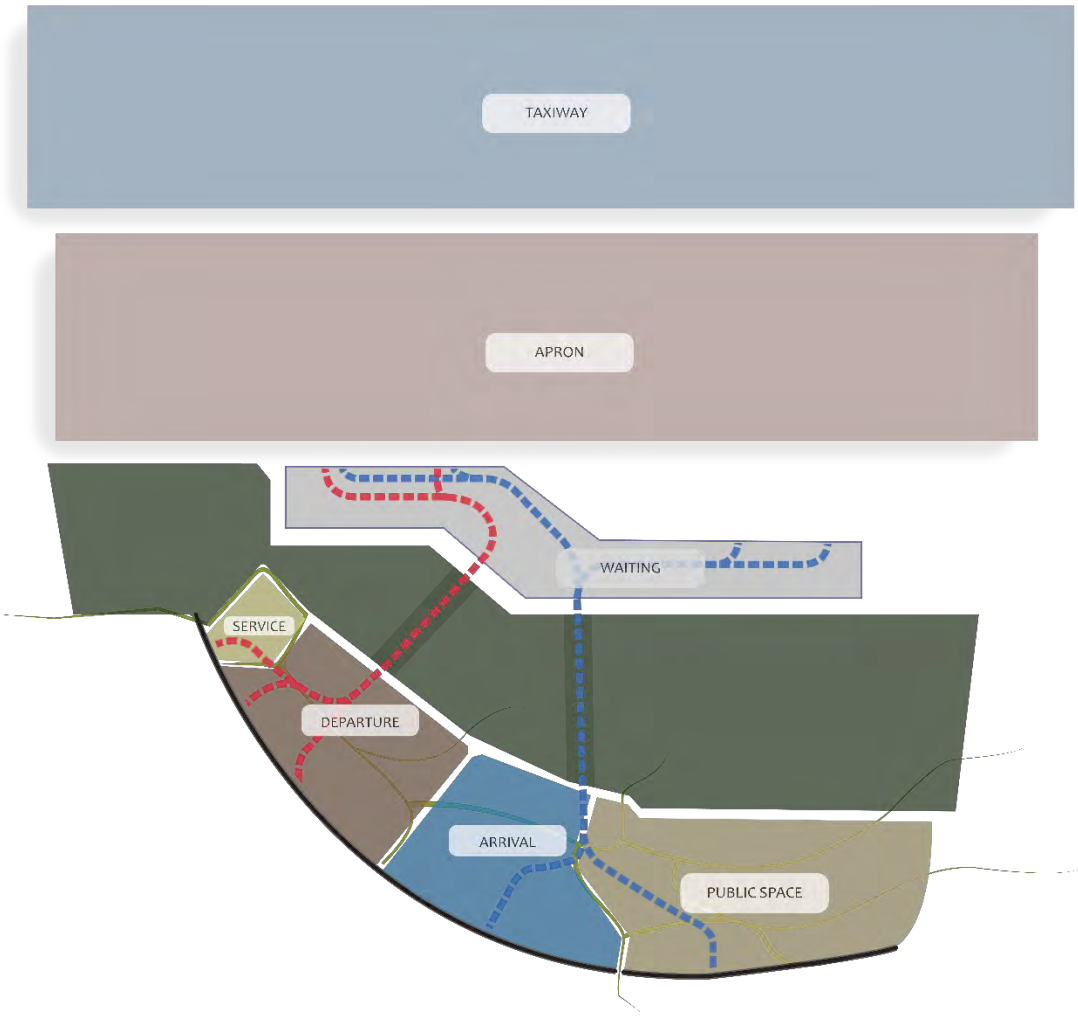
6.2 Primary Sketches



Source: Author

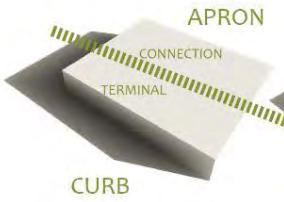
6.3 Functional Zoning

Functional flow in an airport have major 2 circulation which are departure route and arrival route for the passengers. With that there are some other major circulations like, luggage service route, land side vehicular route, airside service route, aircraft route. While designing a domestic airport I placed departure and arrival lobby at a same level to reduce level changing of pedestrians and traffic. Simple transparent bridge route give access to the waiting zone with required functions and gates. From there passengers circulate to an aircraft. With this the public space is place at south to involve the community within the facility as a refreshment zone.



6.4 Form Generation

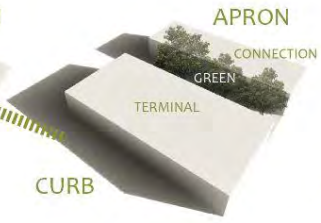
PHASE 01



TYPICAL CONCEPT OF A TERMINAL BUILDING

A BUILDING WITH THE FUNCTIONS OF TERMINAL AND CONNECTIONS

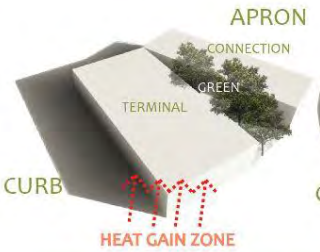
PHASE 02



INTRODUCING FOREST, AS A REFLECTION OF SUNDARBAN

GREEN DIVIDED TERMINAL AND CONNECTION INTO TWO PARTS

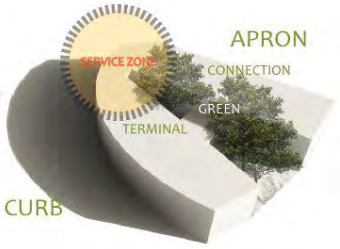
PHASE 03



tERMINAL BUILDING PLACED IN AN ANGLE TO MINIMIZE HEAT GAIN.

AS WITH NORTH SOUTH ORIENTATION THE FRONT FACADE OF THE TERMINAL HAVE WEST FACED GLASSES, TO REDUCE THAT THE TERMINAL PART OF THE BUILDING HAVE BEEN ANGLED
- ARRIVAL THROUGH WOODS INTRODUCED

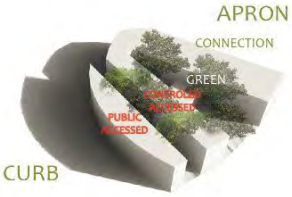
PHASE 04



INTERLOCKING SPACE OF TWO MASSES DEFINED BY SERVICE ZONE.

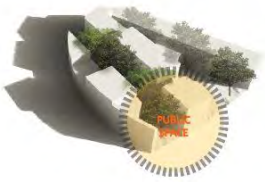
BOTH SIDE OF THE BUILDING REQUIRES SERVICE ACCESS WHICH SHOULD BE CONNECTED.

PHASE 05



TERMINAL BUILDING DIVIDED INTO 2 MASSES TO GAIIN NATURAL LIGHT.
THE FUNCTIONS ARE DEFINED IN TWO PART AS, PUBLIC ACCESSED AND CONTROL ACCESSED.
GREEN SPACE INTRODUCED INSIDE THE TERMINAL BUILDING

PHASE 06



AIR CONDITIONAL ZONE SEPERATED AND OPEN PUBLIC SPACE INTRODUCED AT THE END OF GREEN PATH WITH LEADS TO THE CENTRAL FOREST.
ALL FUNCTIONS PLACED UNDER A LARGE CANOPY

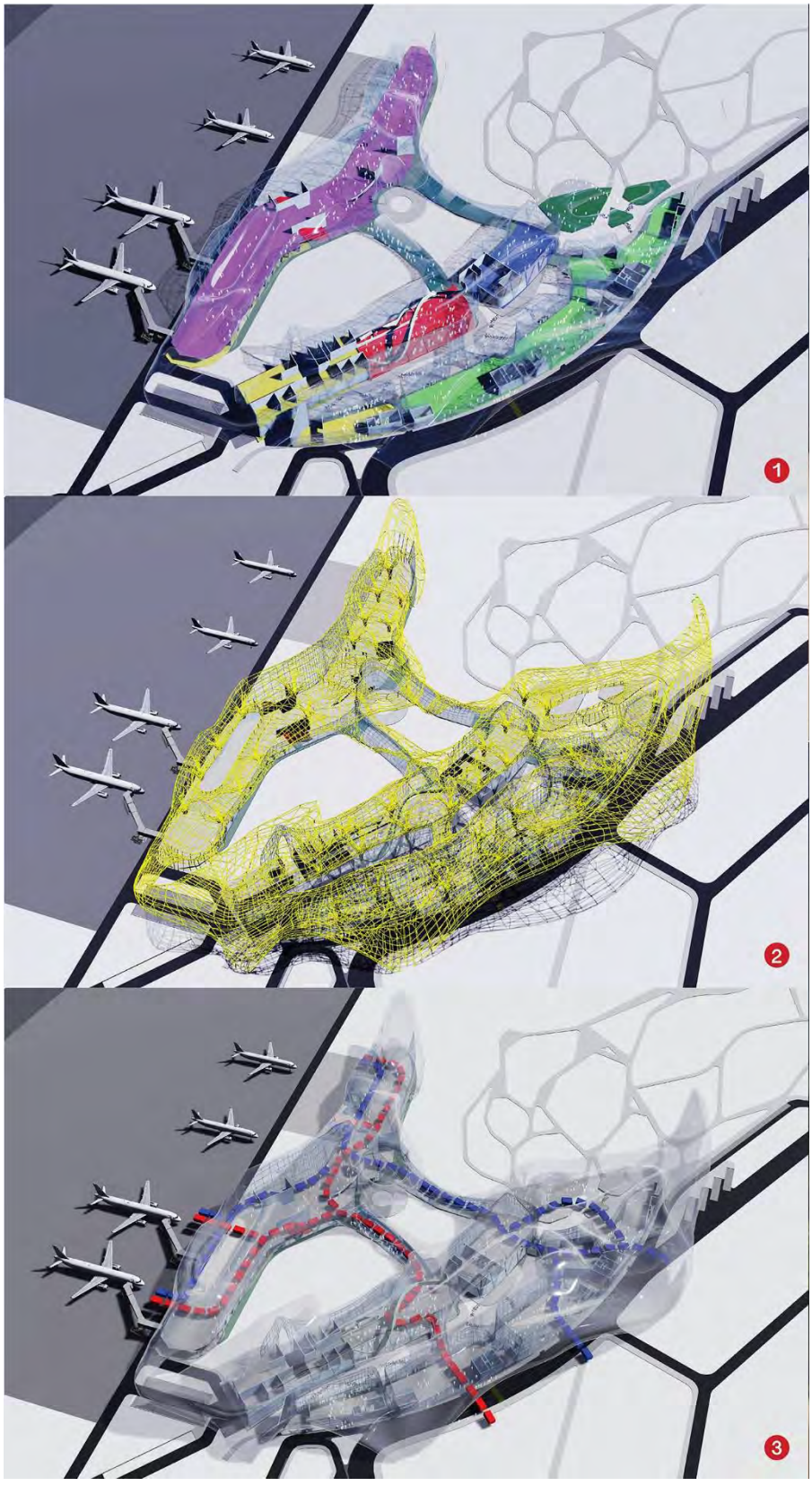
PHASE 07

THE TOPOGRAPHICAL FORMATION INTRODUCED INTO THE UPPER CANOPY
LARGE CANOPY ROOF WHICH IS IN PARAMETRIC FORM COVERED ALL THE AVAILAVLE FUCTION WITHIN THE AIRPORT

PHASE 08

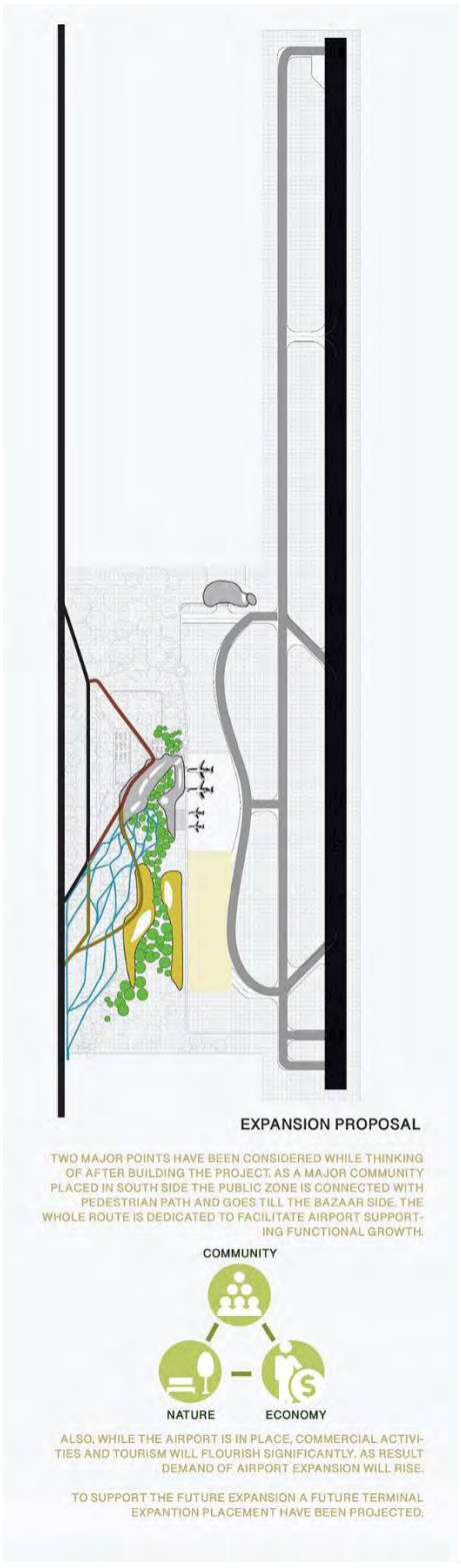
A FINE TUNED AND REDUCED GRAPHICAL FORMATION WITH THE PERAMETRIC ROOF CONCEPT WITHIN IT.
GREEN TRAIL PLACED ACCORDING TO THE TROPOGRAPHYCAL FORMATIONS

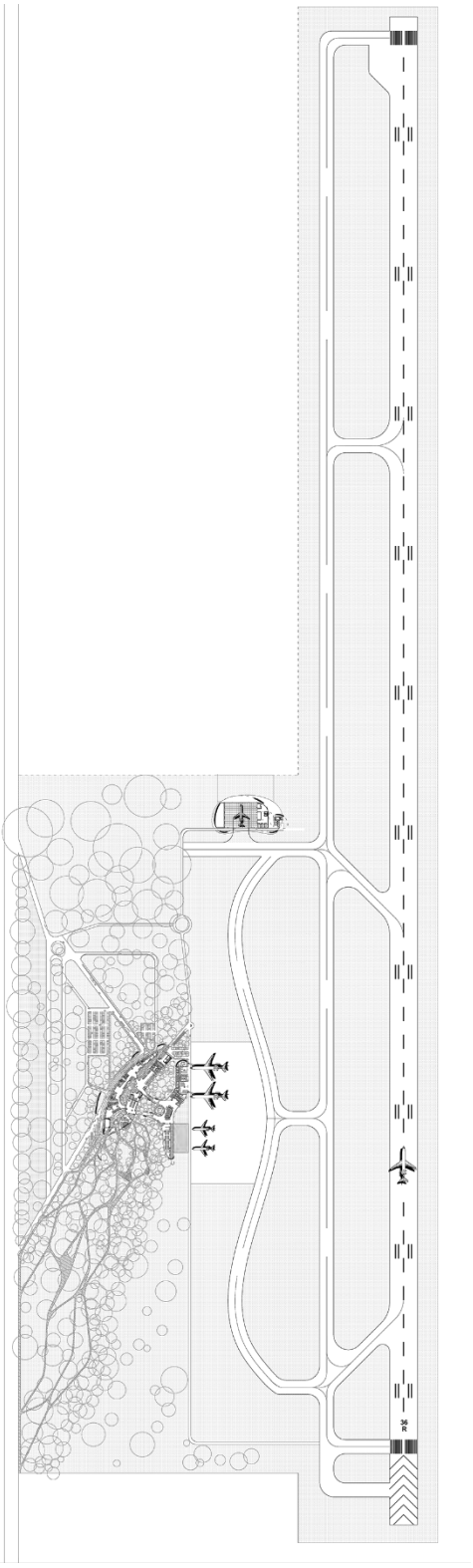
6.5 Structure Detail Diagram



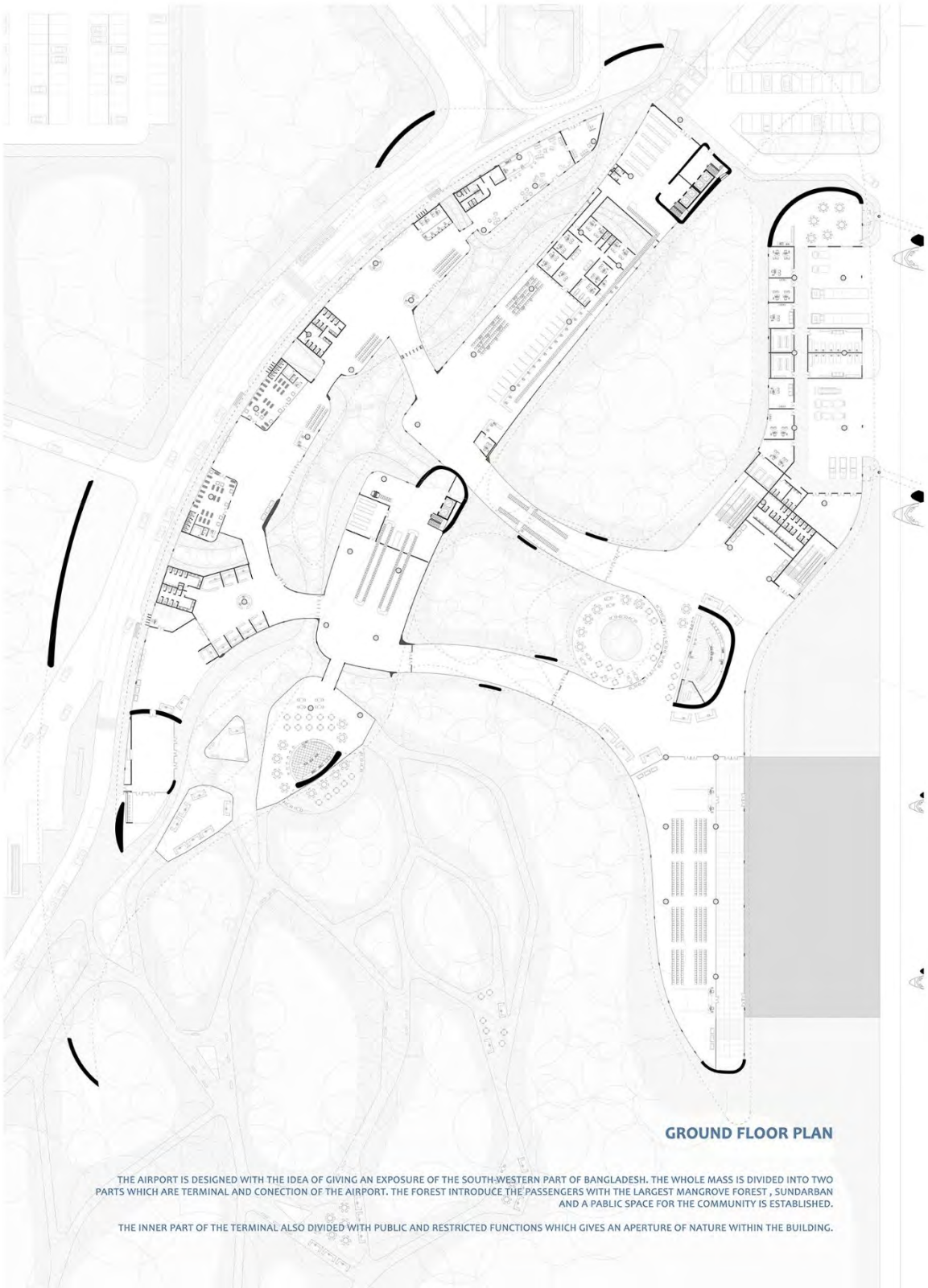
1. Zoning
2. Structure
3. Circulation

6.6 Drawings and Perspectives





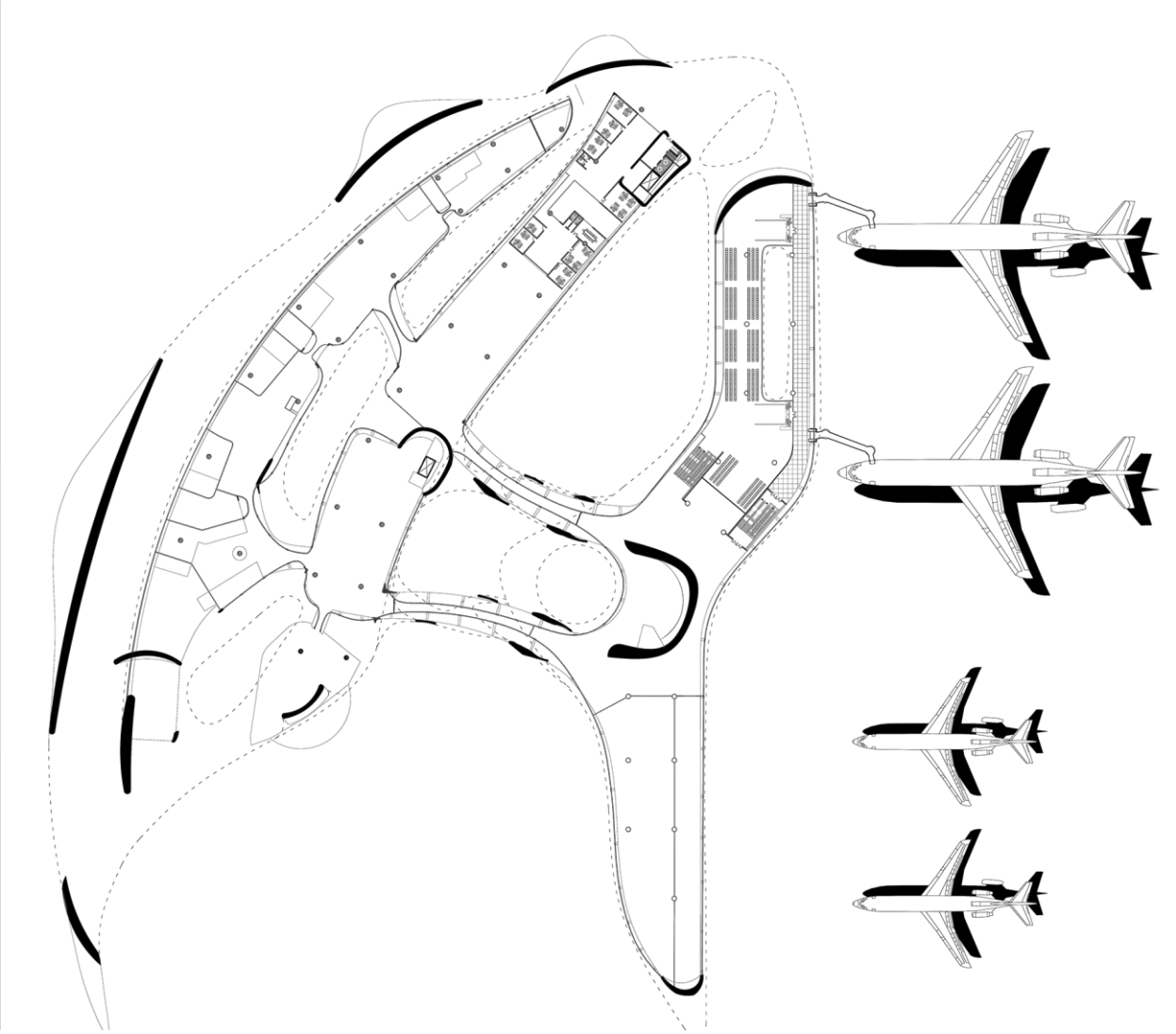
Master Plan



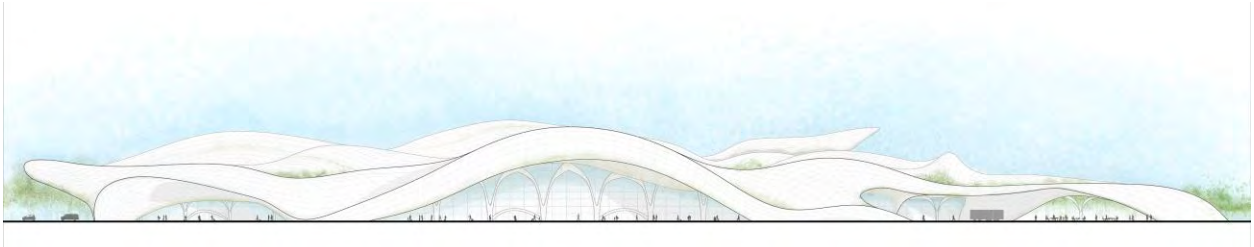
GROUND FLOOR PLAN

THE AIRPORT IS DESIGNED WITH THE IDEA OF GIVING AN EXPOSURE OF THE SOUTH-WESTERN PART OF BANGLADESH. THE WHOLE MASS IS DIVIDED INTO TWO PARTS WHICH ARE TERMINAL AND CONECTION OF THE AIRPORT. THE FOREST INTRODUCE THE PASSENGERS WITH THE LARGEST MANGROVE FOREST , SUNDARBAN AND A PABLIC SPACE FOR THE COMMUNITY IS ESTABLISHED.

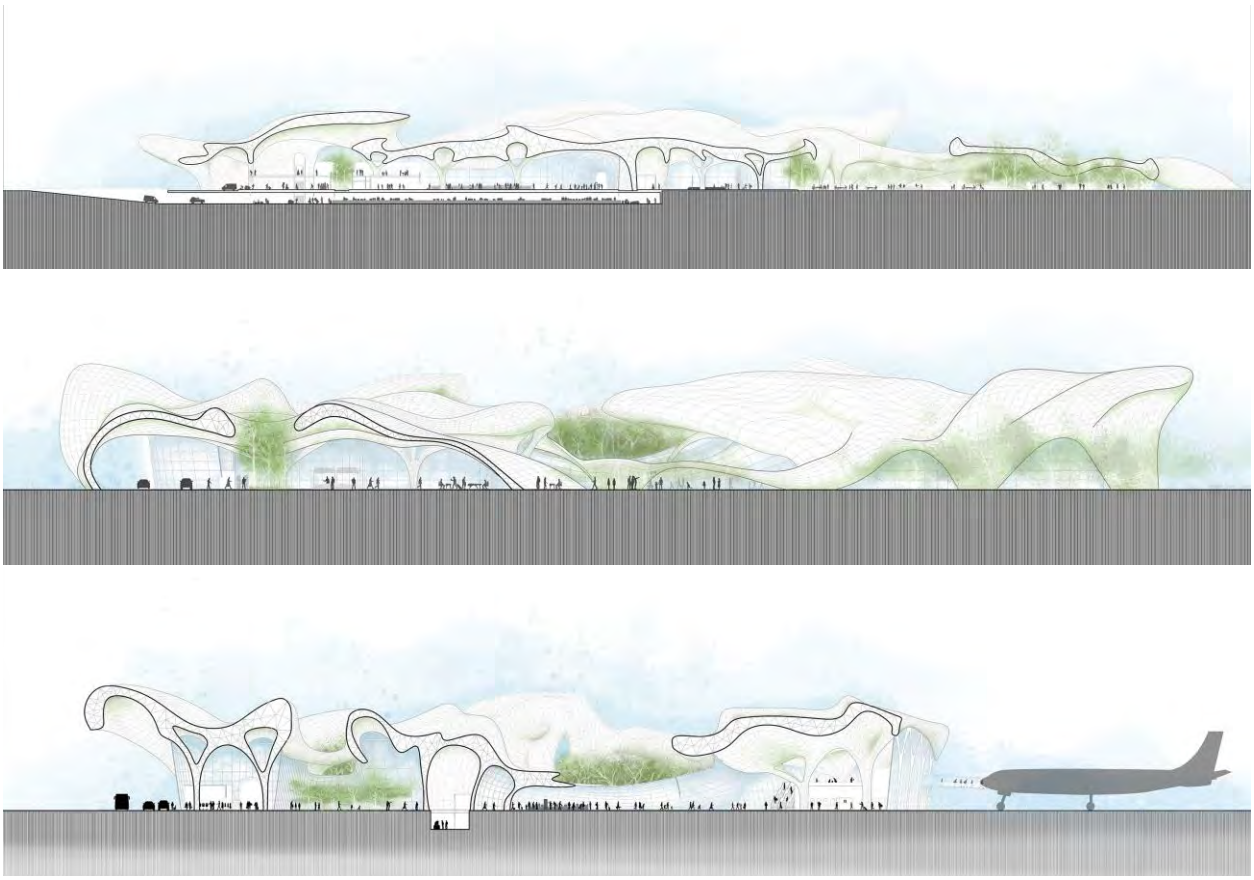
THE INNER PART OF THE TERMINAL ALSO DIVIDED WITH PUBLIC AND RESTRICTED FUNCTIONS WHICH GIVES AN APERTURE OF NATURE WITHIN THE BUILDING.



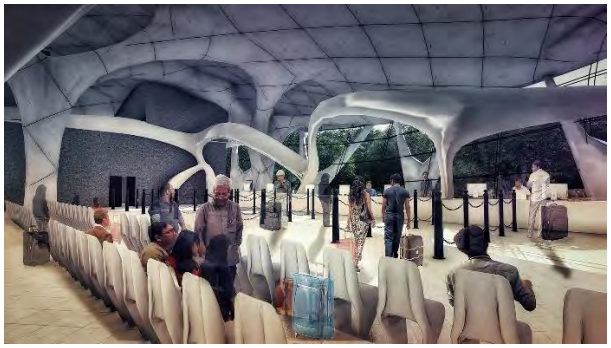
First floor plan



Front Elevation



Arial View



7 CONCLUSION

Designing any type of transport hub is a critical task for any designer. As for airport the primary challenge is to think of an effective circulation path for all the activity where passengers can always easily access their required direction. There are significant amount of supporting functions inside, but it should be the prime target for a designer to create a clean, short and tactical circulation path for passengers. With that, consideration of local community and surrounding is important as an airport affects a large region around it. The key accomplishment of the project is to think according to the surrounding natural aspects and implemented an exposure of it; creating not just a path to pass on, but a path to be remembered of through aesthetical formation and nature; implementing the typological planning while designing to create an opportunity for expansion and finally a fundamental stable well-favored structure.

While working on the project I learned to explore different aspects of large transport hub with a scope of capacities, climatic considerations and structural system. Addition to that, the site location has significant possibilities to grow economically and it was a major acquirement that under what considerations a major regional structure should be build. The project blends with the surrounded community to contribute within the design and also creates opportunities for it to expand in required basis. However, with all this practical considerations, if this airport is made, this will create a significant demand rise of tourism within this area and will be beneficial for the economic advancement of government and people in the region.

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