Bangabandhu Sheikh Mujib International Airport

Sreenagar, Dhaka, Bangladesh

By

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Abstract

This Dissertation aims to provide a clear vision to its reader about the importance of a new airport with the growing air traffic and cargo business in the current socio-economic situation of Bangladesh. It also studies the roles and functions of an airport, understands the working system of the whole aviation industry, defines the architecture of terminal in chronological order and tries to examine the impact that it will cause on the urban fabric of the surrounding areas. For the last 10 years air traffic has increased dramatically in Bangladesh, cargo transportation has also escalated. External trade has grown from $1 billion to $35 billion, and Shahjalal International Airport presently is not equipped to handle the massive flow of such trade and passengers. It severely lacks facilities, efficient handling and space to accommodate cargo and also the life span of this airport is ending just after 25 more years. Therefore, government of Bangladesh has decided to build a modern international airport connecting east with west; and a point for passenger distribution throughout the world which will become a catalyst for economic growth of the country. And Bangabandhu Sheikh Mujib International airport (BSMIA) has been proposed by the civil aviation authority of Bangladesh (CAAB) to fulfil the demand.

Table of Content

Chapter 3: Literature Review

3.1 Airport Planning Basics

3.2 Planning of the airport

3.2.1 Apron

3.2.1.1 Different parts of Aprons

3.2.1.2 Design Requirement for Aprons

3.2.1.3 Passenger Loading Methods

3.2.2 Holding bays and bypasses

3.2.3 Taxiway

3.2.3.1 Taxiway elements

3.2.3.2 Taxiway Dimensions

3.2.3.3 Taxiway Types

3.2.4 Runway

3.2.4.1 Types of runway

3.2.4.2 Sections of runway

3.2.4.3 Runway Clearances

3.3 Aircraft Dimensions

3.3.1 Cargo Compartment Dimensions

3.3.2 Turning Radius of aircraft

3.3.2.1 Turning radius of taxiway, runway

3.4 Passenger terminal According to strategic Airport Management Program, 2007

3.4.1 Major Terminal Design Considerations

3.4.1.1 Terminal Configuration

3.4.1.2 Terminal Concepts

3.4.1.3 Major Design Considerations

3.4.2 Functions of Terminal Building

3.4.3 Parts of Terminal Building

3.4.4 Terminal facilities and services

3.4.4.1 Access and Landside Interface

3.4.4.2 Processing

3.4.4.3 Holding Areas

3.4.4.4 Airlines and Support Activities

3.4.5 Service Required at Terminal Building

3.4.5.1 Check-in

3.4.5.2 Immigration Duties

3.4.5.3 Security Checks

3.4.5.4 Passenger Screening

3.4.5.5 Baggage Screening

3.4.5.6 Parking Facilities

3.4.5.7 Public Transportation

CHAPTER 4: Case studies of similar projects

CHAPTER 5: Programme and Development

CHAPTER 6: Conceptual Analysis and Design Development

Introduction

Flying was a dream and it began with an imagination. People were always fascinated about flying and it reflects on their paintings, sketches and writings. Even ancient cave paintings, 14th century fresco paintings show the urge of man to fly. The versatile genius in history of mankind, Leonardo da Vinci was also convinced that sometime in future man will eventually learn to make his dream come true. The dream to fly up into the air safely like a bird. Flying remained a utopia in renaissance period which later on became reality in the beginning of the 20th century. The history of the evolution and maturation of airport architecture is the history of 20th century itself. It started with the machines of Wright brothers which were able to fly. The first flights were not more than big jumps which eventually became reliable and useful planes within few decades. With the growing popularity and need a whole new industry with several branches developed and a complete new transportation system formed. The development of air transportation system lead to the formation of the new type of building structure called airport. The 1st airports were no more than a building structure and a level ground for landing and takeoff. It was in 1920s the need of planning an airport came into account with the increasing number of people using the building. Airport soon became a new architectural building task.

The definition of an airport can be given as the gateways for people, city or country, places of arrival and the point of departure.It is undeniably the very first point of interaction for travellers arriving in a foreign country and therefore, airports are vital in creating the very first impression of that country or city. It is not just a building structure anymore. "Airports are a national symbol, therefore no expense is spared to make sure mine is better than yours," says architect Ron Steinert , an airport expert working with the international architecture firm Gensler. The world's most beautiful airports aren't just for show—they also bring heightened functionality. "There's a need for legibility to the actual design and a linear flow," says engineer Regine Weston, an airport expert for Arup who studies the pragmatic side of airport beauty. "So when you're in a building you have a very good sense of what happens next and where you go." In other words, these airports will not only dazzle one person—their design may also help them get to their gate on time. The aviation industry itself is often considered to be a valuable business due to its direct impact on the health of our national and international economies. Airports contribute billions of dollars per year to local economies

and create thousands of jobs, either directly or indirectly. The benefit of travel afforded by a local airport is equalled in importance by the mail, packages and even exotic foods that are delivered across the country by the aviation system. The history of aviation industry in Bangladesh started in 1971, just after the liberation war. The airport at Tejgaon, Dhaka was the only international one. This airport began to fail to fulfill the requirements of a modern international airport. A new airport Hazrat Shajalal International Airport (HSIA) formerly known as Zia International Airport (ZIA) was constructed with the technical support of French experts .Operational activities were shifted from Tejgaon to Kurmitola in the year 1980.It has been the centre of all operational activities of CAAB within the country, and hub airport of the region. Now this airport is left with 25 years of its life span and also its passenger holding capacity has crossed the limit. The government of Bangladesh has approved on building a new international airport with the cost of 7.5 billion US dollars under Public Private Partnership (PPP) on a land of 8000 acre approximately 36 km south from the capital city Dhaka. An Elevated Expressway or mono railway will be built to have easy and direct access to and from the Airport from the centre of the capital city, Dhaka. Later on the surrounding area of the site is planned to develop as a modern Aerotropolis city ('Aerotropolis' is an urban environment that is anchored with an airport). The idea is to decentralize Dhaka with a new city centre at the south with all the modern infrastructure and facilities and divert the growth of development towards south. New opportunities and economic sectors are expected to grow based on the new Airport. The airport has been planned in a way so that it can meet the demand of next hundred years. It will be a gateway to East Asian and Middle Eastern and Western countries as air cargo transportation is growing day by day. A pre-feasibility study of the airport has been done by CAAB and the new airport to be constructed is expected to be equal to the size of South Korea's Incheon International airport.

The thesis covers the evolutions of airports, some interesting case studies, brief review of the technical details of modern airports, the studies of planning and organization required for an airport, schematic diagrams and the issues to be taken in consideration which are necessary to step into the architectural design of modern international airport. Bangabandhu Sheikh Mujib International Airport is an attempt to meet the demand of country's growing need and to provide facilities of international standards to make it a new transit hub of south eastern Asia.

Chapter 1: Background of the project

1.1 Project Introduction

The government has drawn up a plan to construct the first phase of the proposed Bangabandhu Sheikh Mujib International Airport in next five years under build-own-operate-transfer (BOOT) basis. According to the primary plan the airport will be established on about 8000 acres of land with three 12600 feet runways and all other modern facilities like Dubai or Singapore Airports. The project cost is estimated as 7.5 billion US dollars and is expected to be completed by beginning of 2021 marking the 50th anniversary of our independence.

In the first phase a dual terminal and a runway will be constructed. It will also include a parking bay to accommodate 75 aircraft, support facilities and structures including a large maintenance hangar, a fire station and workshop. Two more passenger terminals and runways are expected to be completed on the 2nd phase. Ministry sources said reputable airport building agencies like Italian-Thai Development Corporation, Murray and Roberts of South Africa, Penta Ocean Construction and Obayashi Corporation have informally communicated with the ministry. Once the airport is completed, it will be an international gateway for trade, and offer all the same services and facilities as all the major airports in the world.

1.2 Project Specification

The new airport will be replacing Hazrat Shahjalal International airport which will lead to several impacts on the new location and also all over the world. There are around 400 aircrafts that flies in every 24 hours over the geographical location of Bangladesh. The construction of this new airport with all the modern facilities like refuelling, hangers, transit, hotels, shopping etc are expected to attract more aircraft to land and thus contribute to the economy.

Name of the project: Bangabandhu Sheikh Mujib International AirportTerminal Building

Client: Civil Aviation Authority of Bangladesh (CAAB)

Site location: Sreenagar, Munshiganj

Site area: 8000 acre of land (including the buffer zone, future expansion area and air funnelling zone)

Founded by: Government of Bangladesh

Budget: 7.5 billion US dollars for 1st phase

Date of completion: March 2021 for the 1st phase

1.3 Aims and Objectives of the Project

World's best airports are a celebration of journey while providing ease and comfort. The aim of this project is to provide a fully functioning airport with a well-lit, spacious and comfortable airport building; good orientation system with clarity and simplicity to find destination easily and a friendly atmosphere with proper light, colours and space to create an airport experience that passengers will remember. Passenger flow and enhanced capacity can be enabled through the easily understandable signage concepts, harmonious colour and

lighting concepts. Centralised airport buildings with logical passenger distribution and aesthetically pleasing surroundings are expected to bring about an environment in which passengers will be able to perform all the activities in a stress free manner. The project has huge impact not only in national level but also in international level as well. This airport will be a symbol for presenting Bangladesh in the International platform and open new opportunities to bring in more wealth into the country economic growth by inviting buyers from all over the world.

1.4 Economic Impact of the new Airport

Airports are now widely recognised as having a considerable economic and social impact on their surrounding regions. Commercial airports are critical infrastructure assets that are important components of the country's transportation network. They enhance the movement of people, goods, and services throughout the country and around the world, allowing the economy to operate more effectively and efficiently. Typically, airports involve three revenue streams. Landside parking – passengers and 'meeters /greeters' pay money to park their cars; retail – passengers and 'meeter/greeters' spend money at the airport's retail space (shops) and passengers – passengers (through airlines) pay airport landing fees. However, the presence of an international airport can be a critical factor in attracting new inward investment from outside the area and specially companies from overseas, promoting the export business of that region, adding to the quality of life of citizens by enabling better infrastructures and facilities. Another important factor is that an airport attracts business and leisure visitors and hence inbounds tourism to the area, generating income and employment in the tourism industry. The expansion of facilities like hotels, shops, restaurants, tourist's facilities at and around the airport is in such that these are more profitable than the airlines that use them. Nowadays only about 20% of the income of the major airports results from takeoff and landing fees, the traditional source of income. The remaining 80% is earned by letting space to the airlines, the operators, the luggage handling systems and the similar services, the other companies in the terminal and the users of other buildings on the grounds of the airport. Heathrow, for instance in 2000 has earned $295 million, which far exceeded the income of British Airways, the major carrier at the airport. Through sensible planning and

design, these opportunities can be grasped to the benefit of the airport authority and the community at large. Because of this innovative economic advantage of the location it is possible to call on public resources to fund the building work the airport. Today airports are merely private business enterprises. The image is thus so important and huge amount of money is invested in an airport project by different private sectors.

1.5 Given Program

A. International Terminal:

- Concourse
- Check in counters
- Immigration
- Customs
- Finances
- Offices
- Waiting Lounges
- Restaurant/ Café
- Stores/ Shops
- Medical Facilities

B. Others:

- Control Tower
- Flight kitchen
- Hangers
- Apron
- Taxiway
- Runway
- Helipad
- Parking lot
- Cargo Terminal
- Fire Station
- VIP Terminal

Chapter 2: Site Appraisal

2.1 The Site

Due to unsuitability of any site for selection of the airport in the north, it was decided to look for a place in the south as suitable for the airport. A Team with high officials of Ministry, CAAB and other Govt. organizations visited the following sites in the south on 3rd, 11th & 15th of Nov. 2010 and conducted ground and aerial survey:

1. Sreenagar, Munshiganj
2. Bhanga, Faridpur
3. Shibchar, Madaripur
4. Rajoir, Madaripur
5. Jajira, Shariatpur

Of the 5 sites inspected, the ollowing 4 were discarded on ground of inadequate land (minimum 6000 acre), concentration of dense population, bounded by highways and homesteads

- Bhanga- 4000 acres
- Jajira - 3000 acres
- Shibchar- 2500 acres
- Rajoir- 3000 acres

2.2 Approval for Sreenagar, Munshiganj (Ariel Beel)

Accordingly MOCAT, CAAB and the Cell visited Sreenagar,Ariel Beel on 3rd and 15th November, 2010. A report submitted on MOCAT on 2nd December,2010. Later on a power point presentation placed before Honourable PM on 12th December,2010 and PM approved the site.

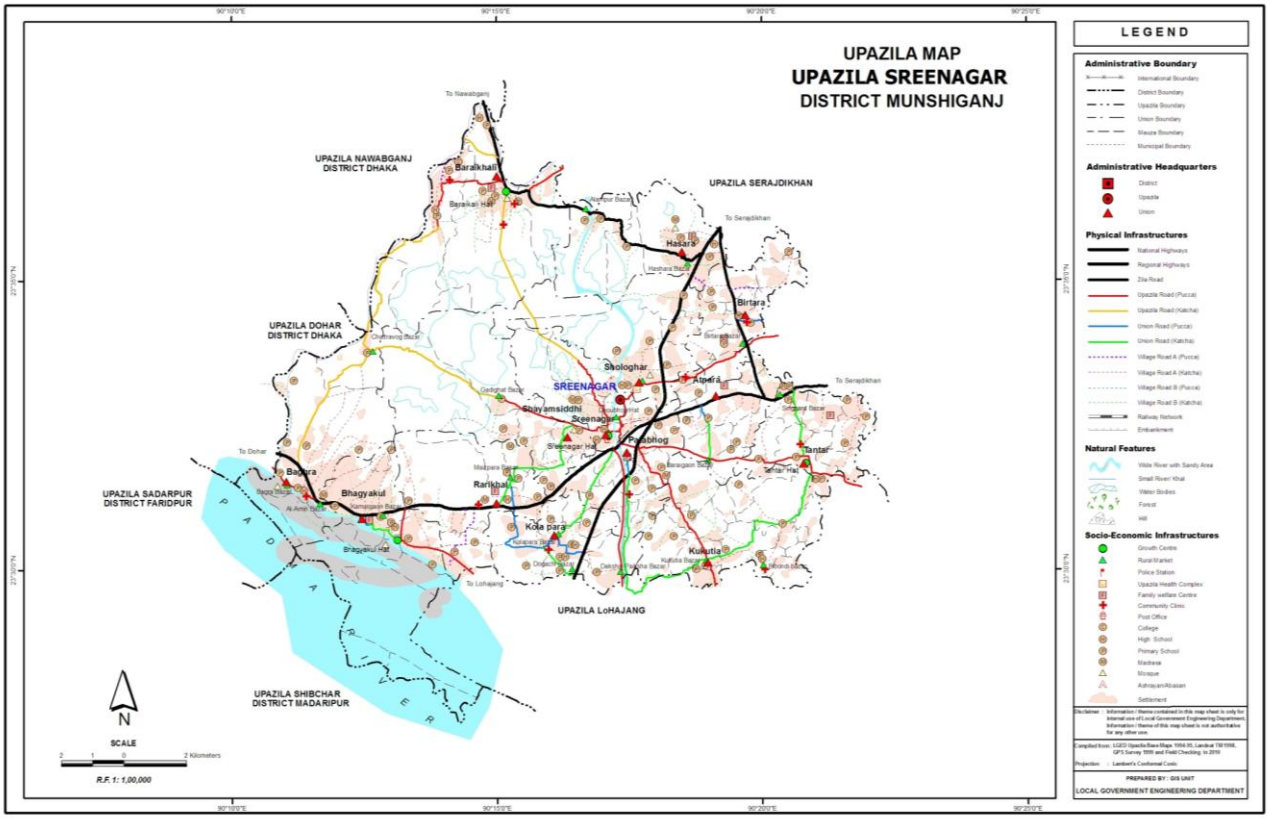
2.3 Reasons for recommending Sreenagar, Munshiganj

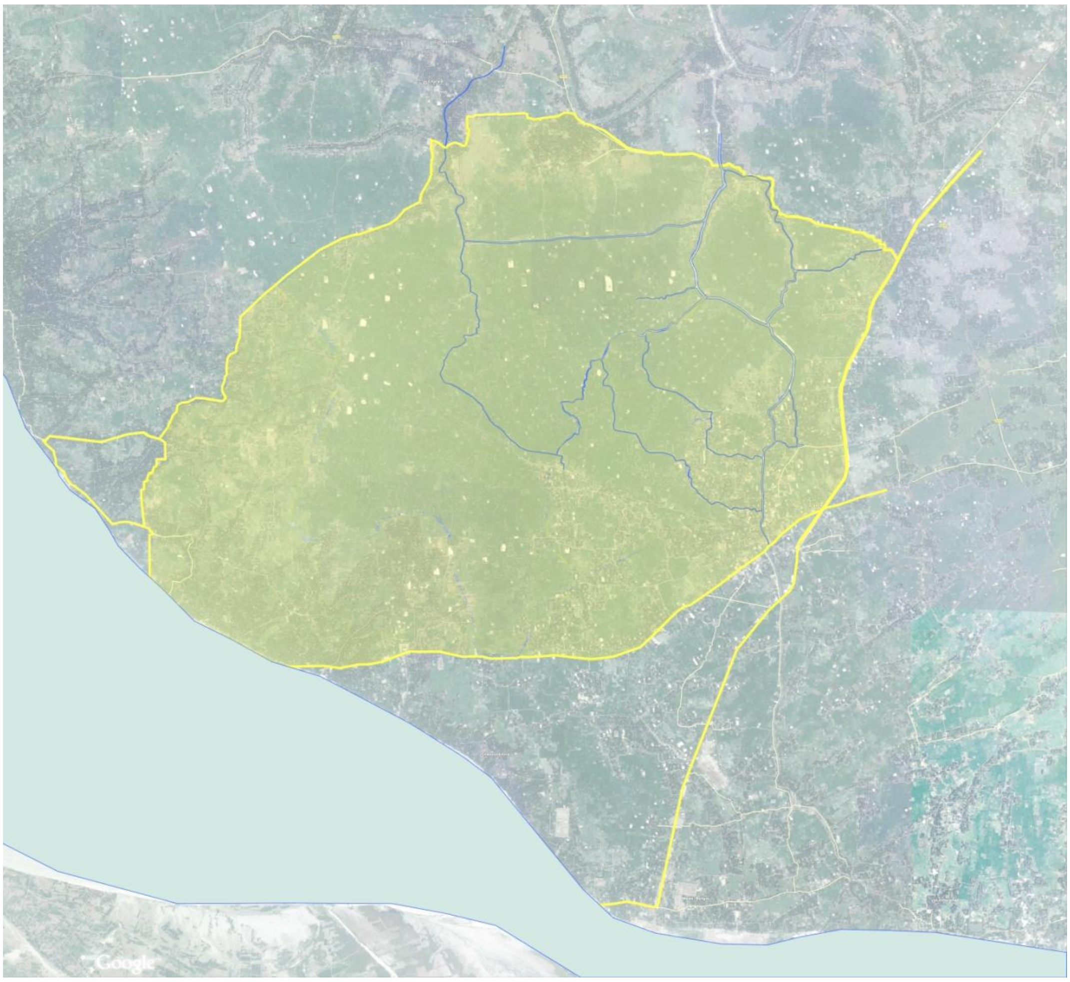
Criteria	Sreenagar,Munshiganj
Availability of land	8000 acre
Density of population	Almost nil
Future expansion	Possible
Communication with capital city	Not Difficult
Standing Crops	Crops 1 time
Distance from capital city	28 KM
Land acquisition and rehabilitation	Easier due to less settlement
Distance from HSIA	45 km
Road communication	Good
Land acquisition/ Status of land	To be acquired
Social Problem and Condition	Nil
International Air Routes	Closest to the site
Final Recommendation of location or BSMIA	Suitable

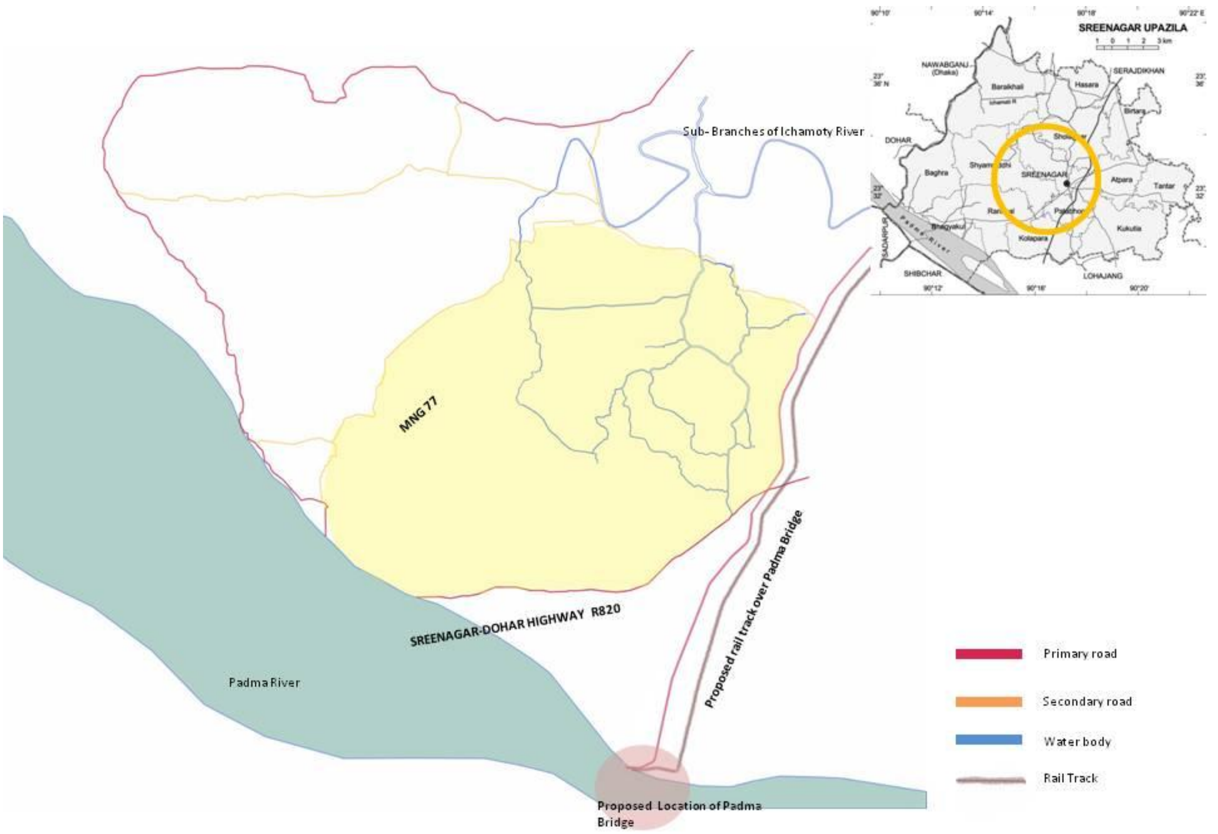
2.4 Other important information

- Dhaka- Mawa highway via Sreenagar connects the proposed site
- River Padma and Meghna connect the site for transportation of aviation fuel
- Alternate Trans- Asian highway and railway will be connected to the site via Padma and Paturia-Daulatdia bridges.
- Padma bridge is going to be completed by 2018
- Bangabandhu Bridge access road

2.5 Site Location






SREENAGAR UPAZILA
Sub- Branches of Ichamoty River
MNG 77
SREENAGAR-DOHAR HIGHWAY R820
Proposed rail track over Padma Bridge
Padma River
Proposed Location of Padma Bridge
Primary road
Secondary road
Water body
Rail Track

2.6 SWOT Analysis

Strength- river route is available for aviation fuel transportation, in case of weather diversion; aircraft will not require to cross the international boundary and thus ATC problem to airlines and air traffic management can be avoided.

Weakness- currently does not have any railway near the site. Earth filling is necessary as the land is currently being used for agriculture. Ponds and narrow water canals for irrigation purpose are present on the site which needs to be filled up. Cutting of trees are necessary.

Opportunity- south oriented growth promoteof development will be encouraged, new satellite city can be developed.

Threat- near Padma River.

The approach road is from the Dhaka-Mawa highway. The site mostly covered with farm land. Few canals were cut for the agricultural work. Flood free areas with density almost nil.

2.7 Wind Force and Direction

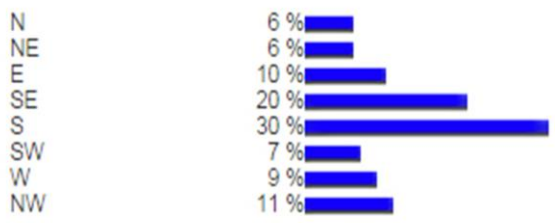
Wind-force per Day (January 2004 - December 2014)

Jan	Feb	Mar	Apr	May	Jun	
2.4	**3.2**	**4.1**	**5.3**	**4.7**	**4.5**	[kph]
77	82	83	86	87	74	Data availability[%]

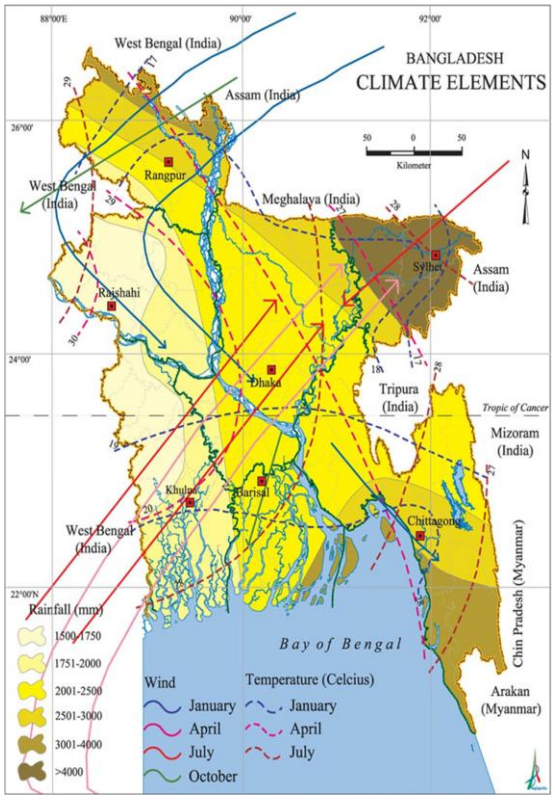
Jul	Aug	Sep	Oct	Nov	Dec	
4.7	**3.3**	**3.1**	**2.0**	**1.5**	**1.6**	[kph]
87	87	87	82	90	79	Data availability[%]

Averaged Value (January 2004 - December 2014) : **3.4 kph**

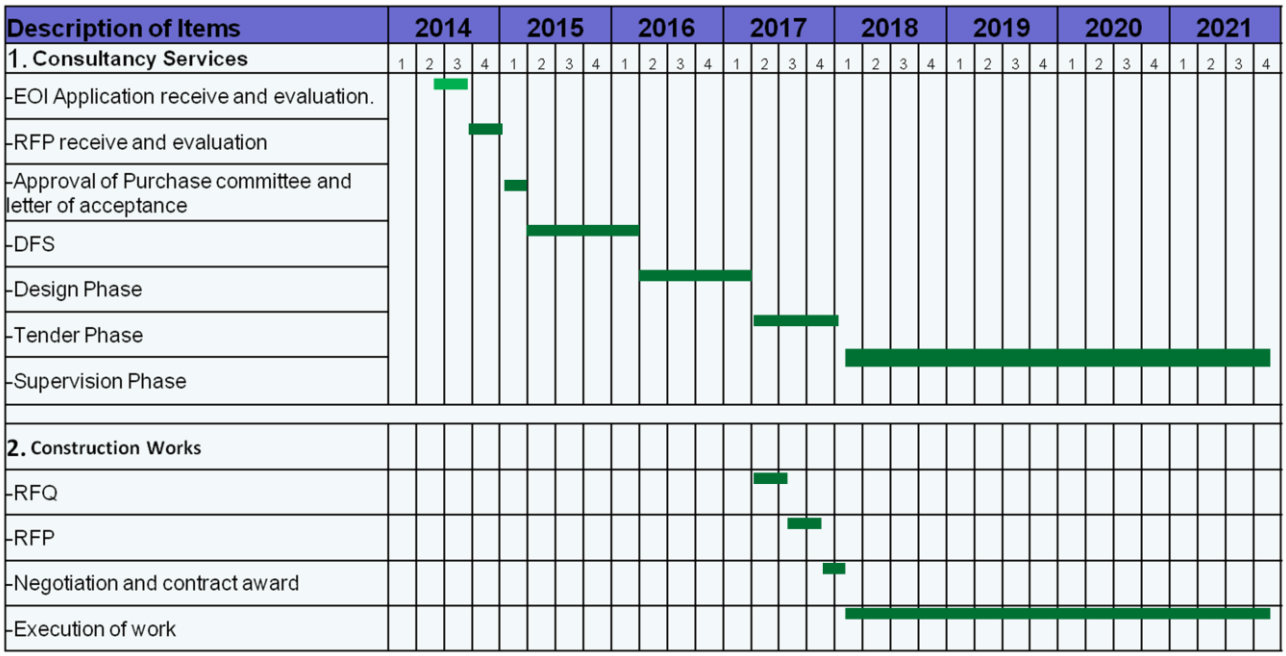
Wind-direction (January 2004 - December 2014)



Source: Weatheronline.com



2.8 Roadmap for the project Work



RFQ- Request for Qualification **RFP**- Request for Proposal

Ariel Beel of Sreenagar upazila under Munshiganj district may be the best suitable site for BSMIA. A reputed international Consulting Firm may be selected for finding out investors. An authority namely "Bangladesh Sheikh Mujib International Airport" may be established To implement the project which includes not only the Bangabandhu Sheikh Mujib International Airport, but also a modern and planned city to be named after the father o the Nation, Bangabandhu Sheikh Mujib City.

With an exemplary performance, aiming at achieving goals to be a future hub of the region, **Bangabandhu Sheikh Mujib International Airport**, characterized by its unique architecture inspired from the spirit of the liberation war of the Country, will be a landmark in our aviation history. On successful completion of the Project, the airport will serve as an impressive gateway adding to the enhanced image of the country. The airport and its facilities along with the planned city will act as a catalyst for economic growth of the nation.

Chapter 3: Literature Review

In 1920s it was 1st realised that it is necessary to plan carefully the position of different buildings of airports like hangers, offices, post offices, warehouses, custom offices, waiting halls etc on the complex and the links between them. The concept of comfort and appearance on that time were based on the affluent passengers. But now things have changed as airports are not limited only to the upper class of the society. It is now becoming more and more popular and in some cases only mode of transportation. The functions of the airports are also changing as airports are now privately managed business enterprises having other properties. Airports are increasingly becoming service canters with a comprehensive range of services. More and more shops, hotels, restaurants, multi storey car parks and even cinemas are getting built within the airports. Now the authority wants the passengers to stay in the airport longer in an atmosphere that stimulates consumptions. Another important aspect that has been drastically changed in the planning is the security system as a result of 9/11 tragedy. Besides all these the architecture of the airport is also getting importance to create individuality and high recognition factor. Airports are generally built in a location with good traffic access and a large catchment area ensuring economic advantages for the city. But on the other hand it causes noise, exhausts fumes and disrupts the ecosystem of that area. Therefore a sensitive consideration of the local urban development plan and buffer zone with innovative landscape ideas comes along with the planning and design of an airport.

3.1 Airport planning basics

There are 5 primary elements that an airport consists of

- The runway
- The parking and service space for the aircraft
- The technical facilities for maintenance of the aircraft
- The flight gates
- Passenger terminals

The secondary elements are

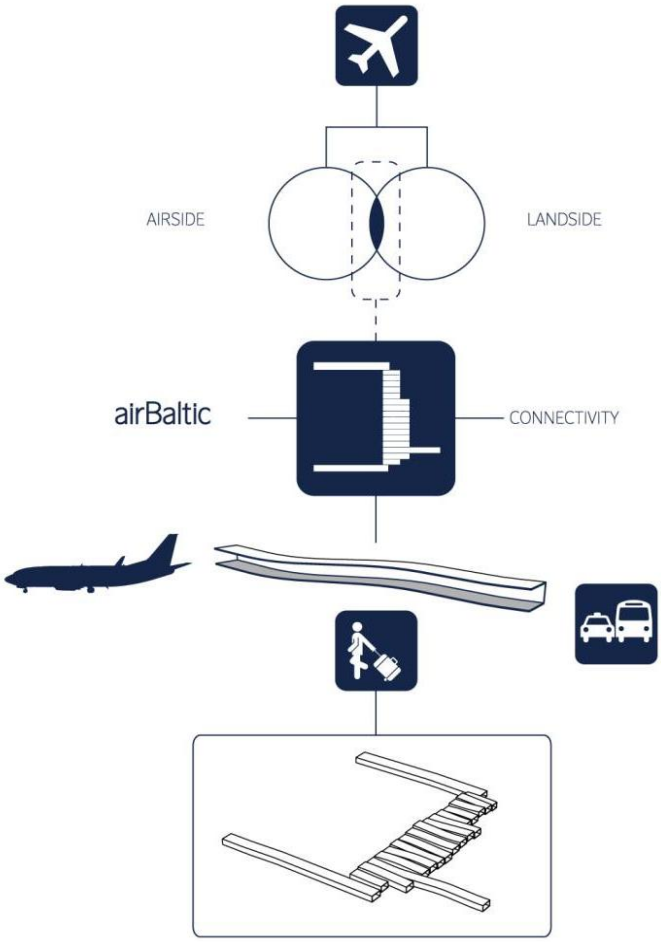
- Tower
- Fire station
- Access drives
- Car parks
- Other buildings

All of these elements should be considered as the part of the airport complex and their position and relation between each other has to be maintained with proper planning and organizations.

3.2 Planning of the airport

Zoning wise the whole airport can be divided as three parts

- Air side
- Terminal building
- Land side



Airside

- Apron
- Taxiway
- Runway

Land side

- Parking curb

Terminal is in between land side and air side allowing passengers to pass through 5 levels of security services.

3.2.1 Apron

An apron is a defined area intended to accommodate aircraft for purposes of loading and unloading passengers, mail or cargo, fuelling and parking or maintenance. It's the Portion of an airport usually paved in front of Terminal building, for Parking, Loading & Unloading of Aircraft. Holding bays are also known as holding aprons, they are provided at busy airports near the runways. They hold Planes Before its Takeoff to wait till the runway is cleared.

3.2.1.1 Different parts of Aprons

- Terminal Apron
- Cargo Apron
- Parking Apron
- Service and Hanger Apron
- General Aviation Apron
- Transient Apron
- Other Ground Servicing Apron

Terminal Apron- The area designed for aircraft manoeuvring and parking adjacent to passenger terminal facilities. From terminal apron, passengers get into the aircraft.

Cargo Apron- Aircrafts that carry only freight and mail may be provided a separate cargo apron adjacent to cargo terminal building.

Parking Apron-Parking apron is the apron where aircrafts can be parked for a specific period of time. It may be used for light periodic servicing and maintenance. Parking aprons are located as close to the terminal apron as possible.

Service and Hanger Aprons-It is an apron where maintenance and repairing of an aircraft is carried out under a hanger.

General Aviation Apron- General Aviation aircraft's, used for business or private flying which requires several categories of aprons to support different general aviation activities.

Service or Hanger Apron

Cargo Apron

Parking Apron

Terminal Apron

Transient Apron

Transient Apron- The aprons used for temporary parking of aircrafts is known as transient aprons. This place is used as access to fuelling and other services.

Other Ground Servicing Aprons-Areas for servicing, fueling or loading and unloading should also be provided aprons as needed not all of the apron types are required for every airport, but the need for them and their size should be estimated based on type and volume of forecast airport traffic at the airport.

3.2.1.2 Design Requirement for Aprons

- Safety
- Efficiency
- Geometry
- Flexibility

Safety- Safety in apron implies that airport maintains specified clearance and follows the established procedures to enter, move within and depart from apron areas. Aircraft security should also consider in locating the aprons area. This area is highly restricted and it should be protected from unauthorized person.

Efficiency- Apron design should contribute towards establishing high degree efficiency for aircraft movement.

Geometry-The planning and design of any apron type dependent upon the number of geometry consideration. As an example the length and width of a land part for the apron development.

Flexibility- Planning of apron should include an evaluation of the following flexibility characteristics:

- Range of aircraft size
- Expansion capability

Range of aircraft size

a) Using one size of aircraft large enough for the largest aircraft type
b) Using as many different size stand as there aircraft types.

Expansion capability

Another key element of flexible apron system is allowance for expansion to meet future needs. The apron should be designed in modular stages so that successive stages become integral addition to the existing apron with the minimum disruption to ongoing activities.

3.2.1.3 Passenger Loading Methods

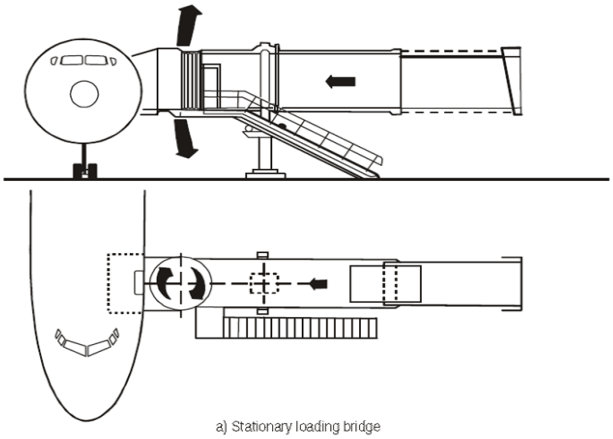
Planning the apron layout, methods for the passenger loading must be taken into account. Which are:

- Bridge loading
- Movable steps
- Passenger transporters
- Aircraft contained steps

Bridge loading-In this method direct upper level loading is made possible by bridge loading permitting the passengers to board the aircraft from the upper level of the terminal building. Two types of loading bridges are used.

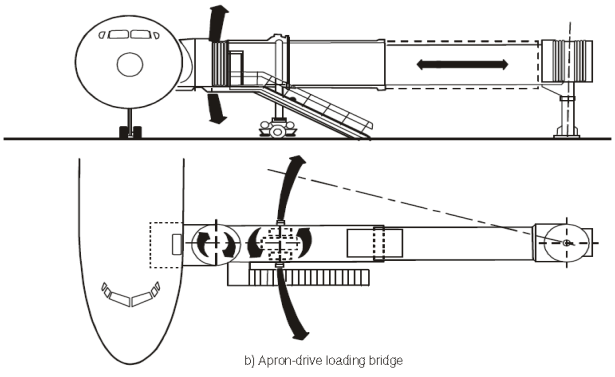
- Stationary loading bridge
- Apron Drive Bridge

Stationary loading bridge - A short loading bridge which extends from a projection in the building as shown.



a) Stationary loading bridge

Apron drive loading bridge- In this type, one end of a telescoping gangway is hinged to the terminal building; the other end is supported by steerable, powered dual wheel as shown.



b) Apron-drive loading bridge

Movable steps- Movable steps are pushed or driven to the aircraft and set at door level. The passengers walk in the open on the apron.

Passenger transporter -Passengers board a bus or specially designs passenger transporters at the terminal building.

Aircraft contained steps- Some aircraft have self contained steps. After stopping, the crew releases the self contained steps and passengers walk on the apron.

3.2.2 Holding bays and bypasses

It is a defined area of an airport where aircraft hold until the runway is clear for it. Holding bays and bypasses are provided where traffic volume are high.

Types of bypasses

- Dual taxiways
- Holding bays
- Dual runway entrances

Dual taxiways-It is a second taxiway or a taxiway bypass to the normal parallel taxiway. Taxi passes can be constructed at relatively low cost, but provides only a small amount of flexibility**.**

Holding bays-Holding bays is an area where aircraft can be held or bypassed. Holding bays allows aircraft to leave and independently re-enter the departure area.

Dual runway entrances- Dual runway entrances is a duplication of taxiway entrances to the runway.The use of dual entrances in combination with dual taxiways will give a degree of flexibility.

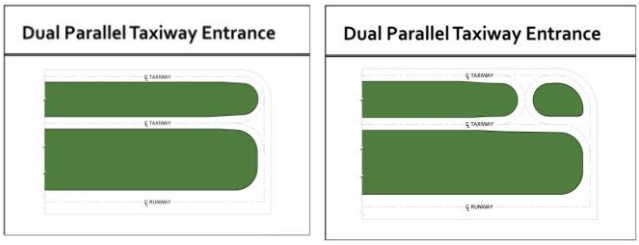
3.2.3 Taxiway

Strip for aircrafts to move slowly (taxi) between runway and apron, runway and runway & apron and apron. They mostly have hard surface such as asphalt or concrete. Busy airports typically construct **high-speed** or **rapid-exit taxiways** in order to allow aircraft to leave the runway at higher speeds. This allows the aircraft to vacate the runway quicker, permitting another to land or depart in a shorter space of time.

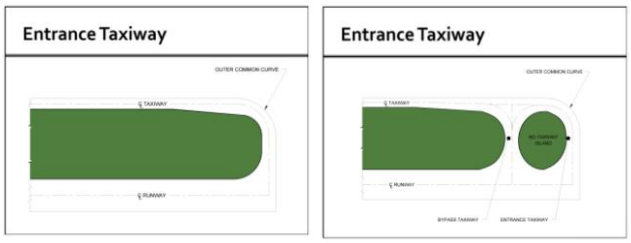
3.2.3.1 Taxiway elements

There are four types of taxiways:

- **Parallel taxiways**: aligned parallel next to runway



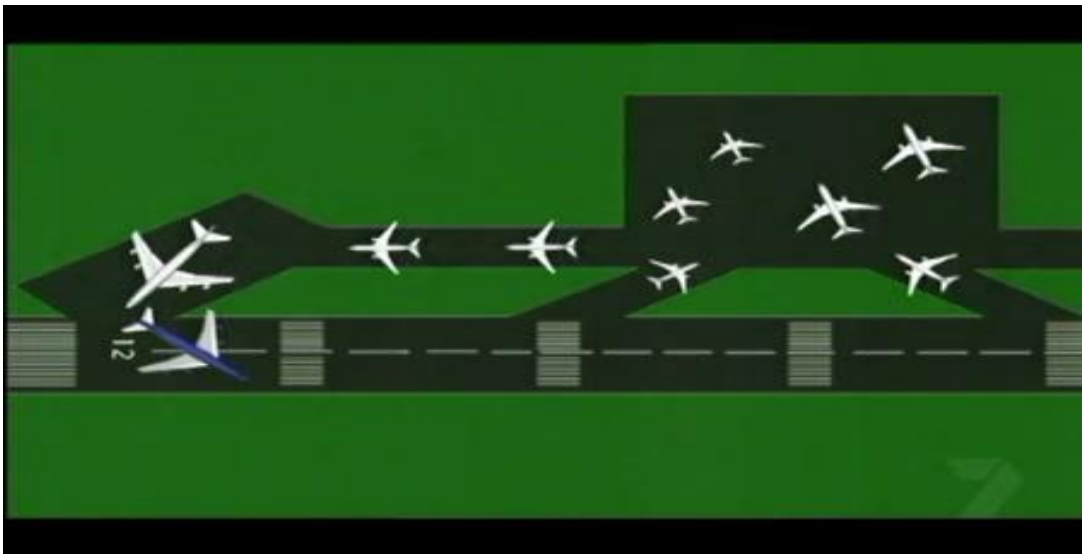
- **Entrance taxiways**: perpendicular to the runway & located near the departure end of runways.



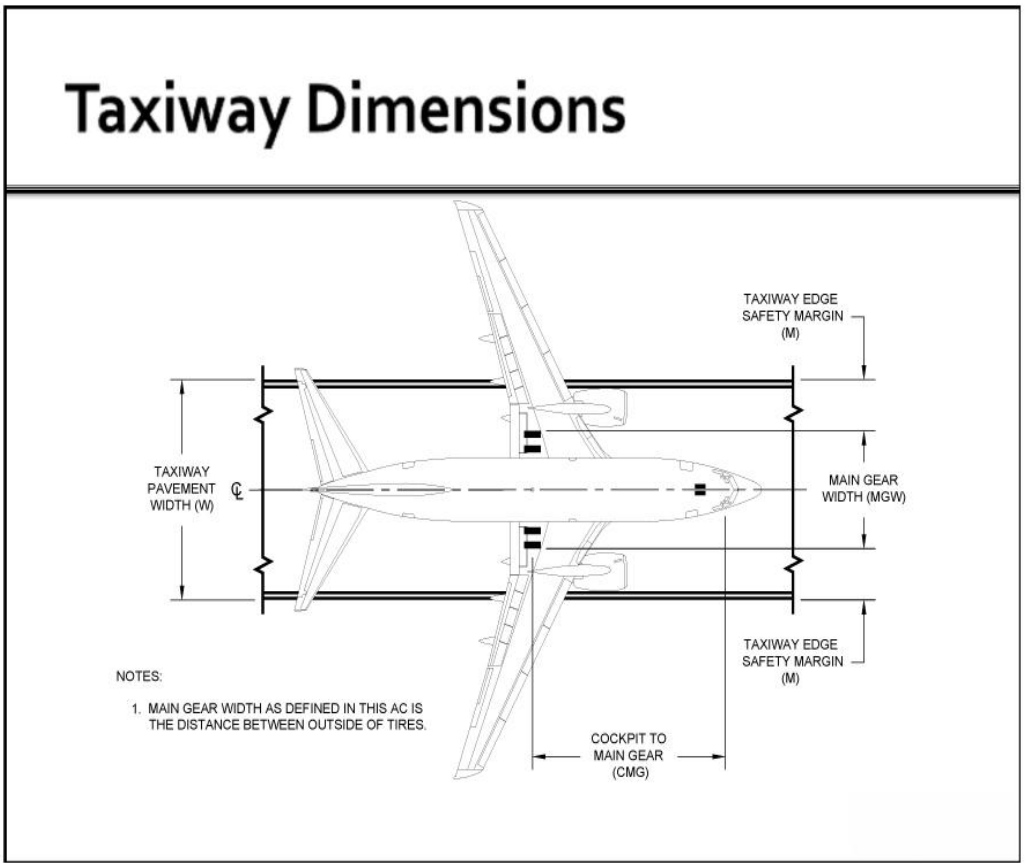
- **High-speed taxiways**: to allow aircraft quickly free-up the runway. (Also known as Rapid Exit) , located at various points along the runway to allow landing aircraft to efficiently exit the runway after landing.

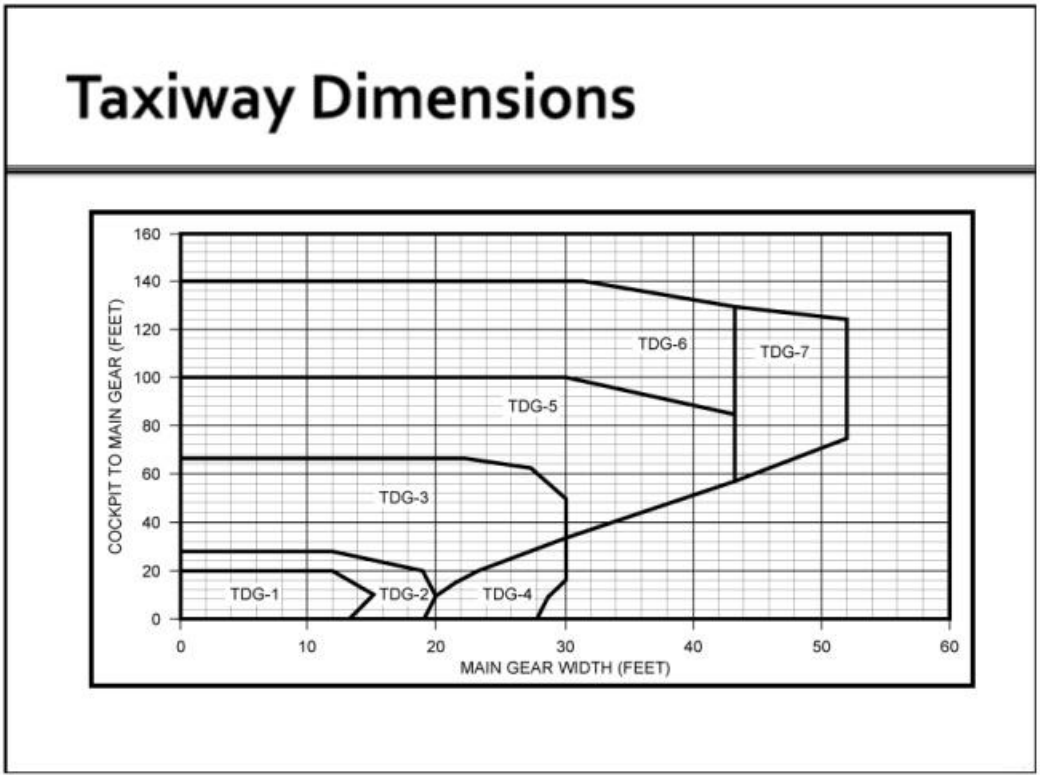
- **By-pass taxiways**: located near apron, to allow aircraft by-pass other aircraft at aircraft parking area

By pass taxiway



3.2.3.2 Taxiway Dimensions

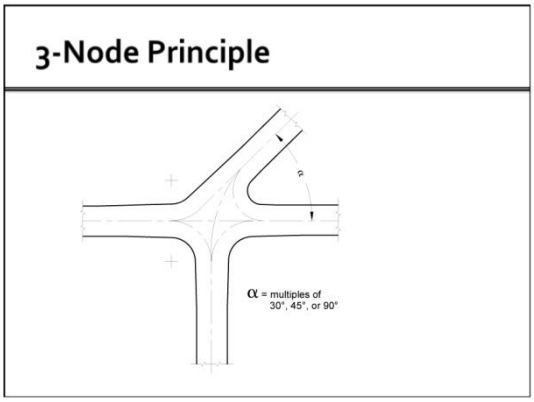


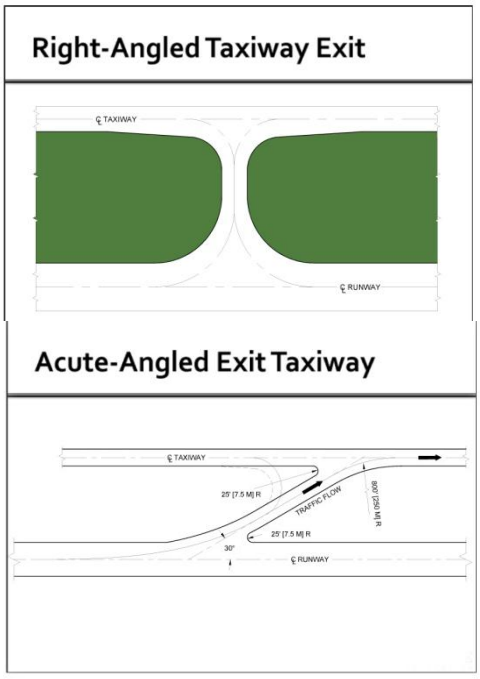


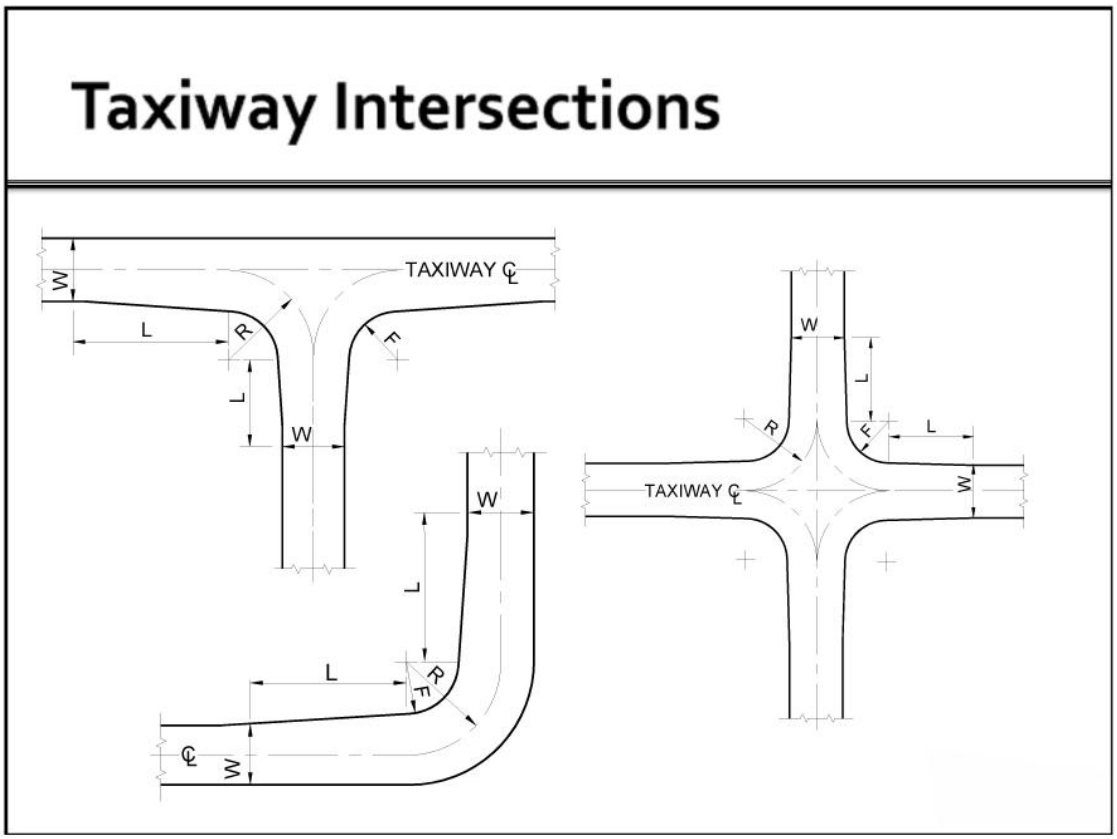
3.2.3.3 Taxiway Types

There are 2 main types of taxiway

- Right angled taxiway
- Acute Angled taxiway







3.2.4 Runway

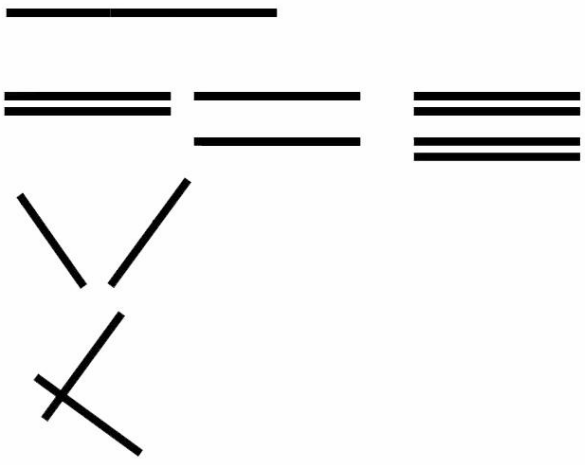
A runway is a paved or hard ground for the safe landing or takeoff of the aircrafts. Runways are named by a number between 01 and 36, which is generally one tenth of the magnetic azimuth of the runway's heading:

- a runway numbered **09** points east **(90°),**
- runway **18** is south **(180°),** runway **27** points west **(270°)**
- runway **36** points to the **north (360°)** rather than 0°

The number of runway depends on the maximum number of flight movement per hour. A runway can handle 45 to 60 flights per hour. In case of parallel runway the safety distance between them has to be at least 500 m. The orientation of the runway depends on the wind directions and the length is determined by the landing requirement of an aircraft. In Bangladesh we only have north-south wind directions and no cross wind directions. The runways in this area are therefore required to have almost 90 degrees or exactly 92.5 degrees. So far it has been seen that a runways with minimum 13,123 ft or 4000 m length are capable of landing most of the aircrafts that are been used. Most of the international airports have runways 250 ft or 80 m wide. Taxing distance is an important issue here as long taxiing distances lengthen flying times, increases fuel consumption and lead to delays.

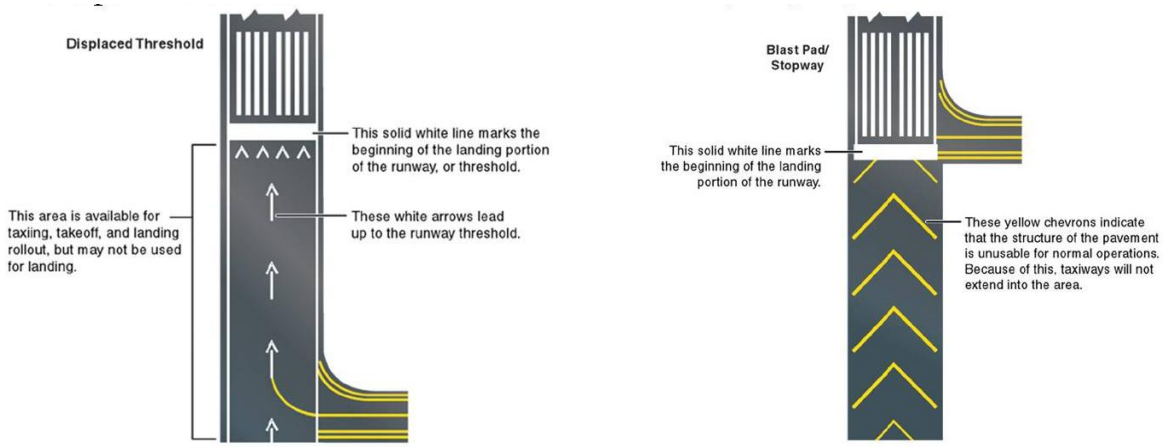
3.2.4.1 Types of runway

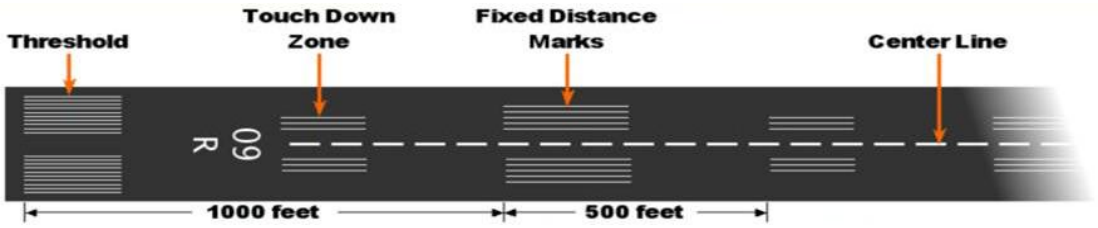
- Single Runway
- Parallel Runway
- Open-V runway
- Intersecting Runway

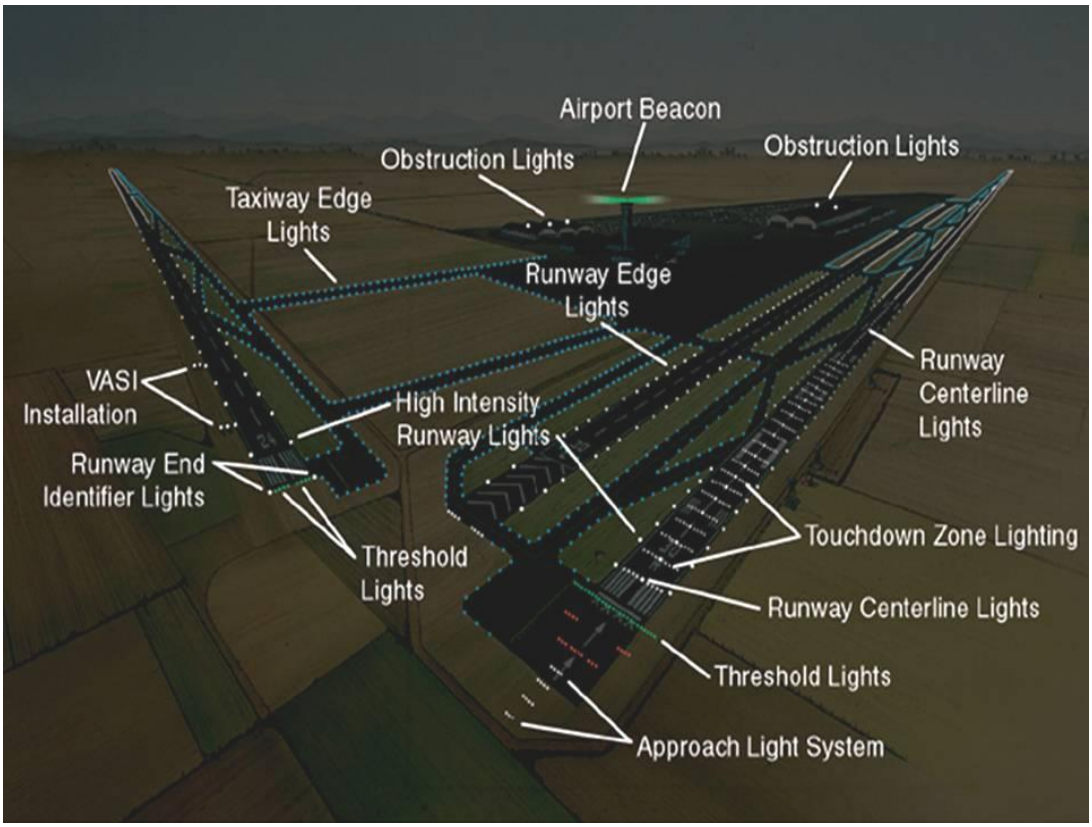


3.2.4.2 Sections of runway

- Runway Safety Area
- Runway
- Blast Pads
- Displaced Threshold

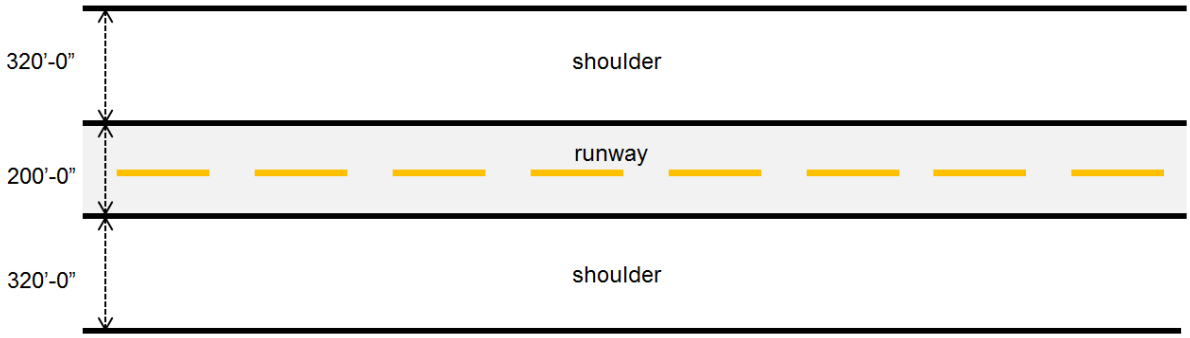


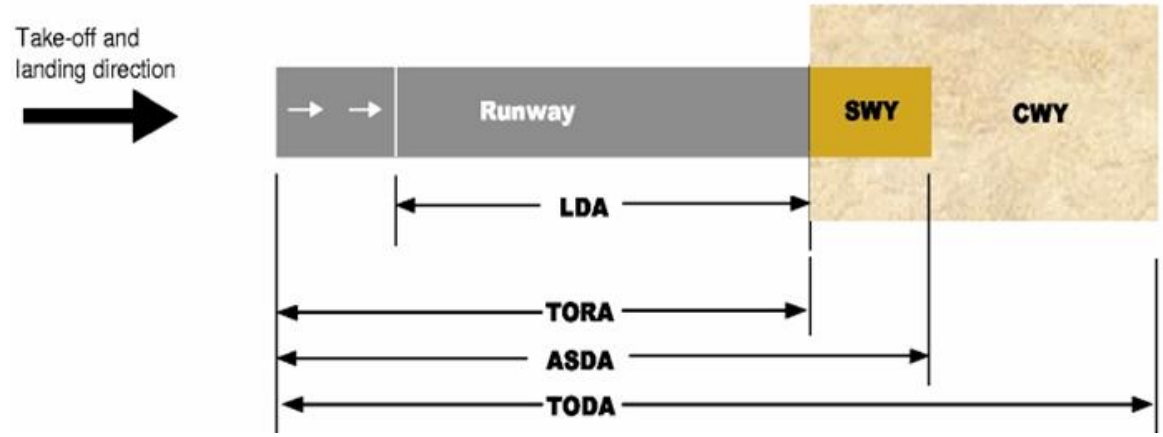




3.2.4.3 Runway Clearances

As per FAA regulations the unobstructed area on both sides of the runway should be a minimum of 150’-0” to 500’-0” and the runway should be at least 200’-0” wide to ensure smooth operations of wide-bodied aircrafts. For optimization, the width of the unobstructed area should be approximately 320’-0” for Airbus 380 to land and take-offwithout any hassles.





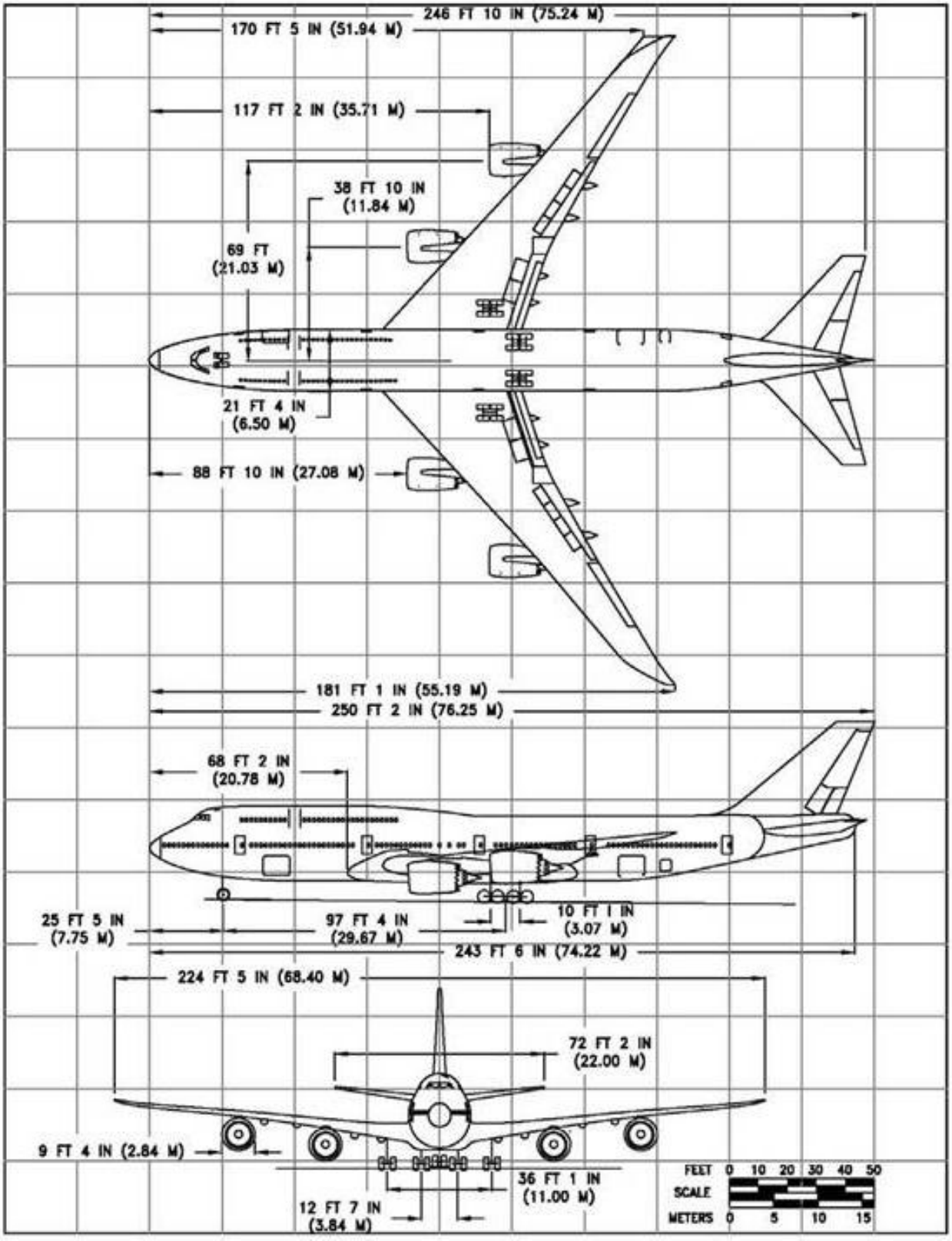
Take Off Run Available	**TORA**
Take-off Distance Available	**TODA**
Accelerate-stop Distance Available	**ASDA**
Landing Distance Available	**LDA**

Stopways, SWY: Area beyond the end of runway.

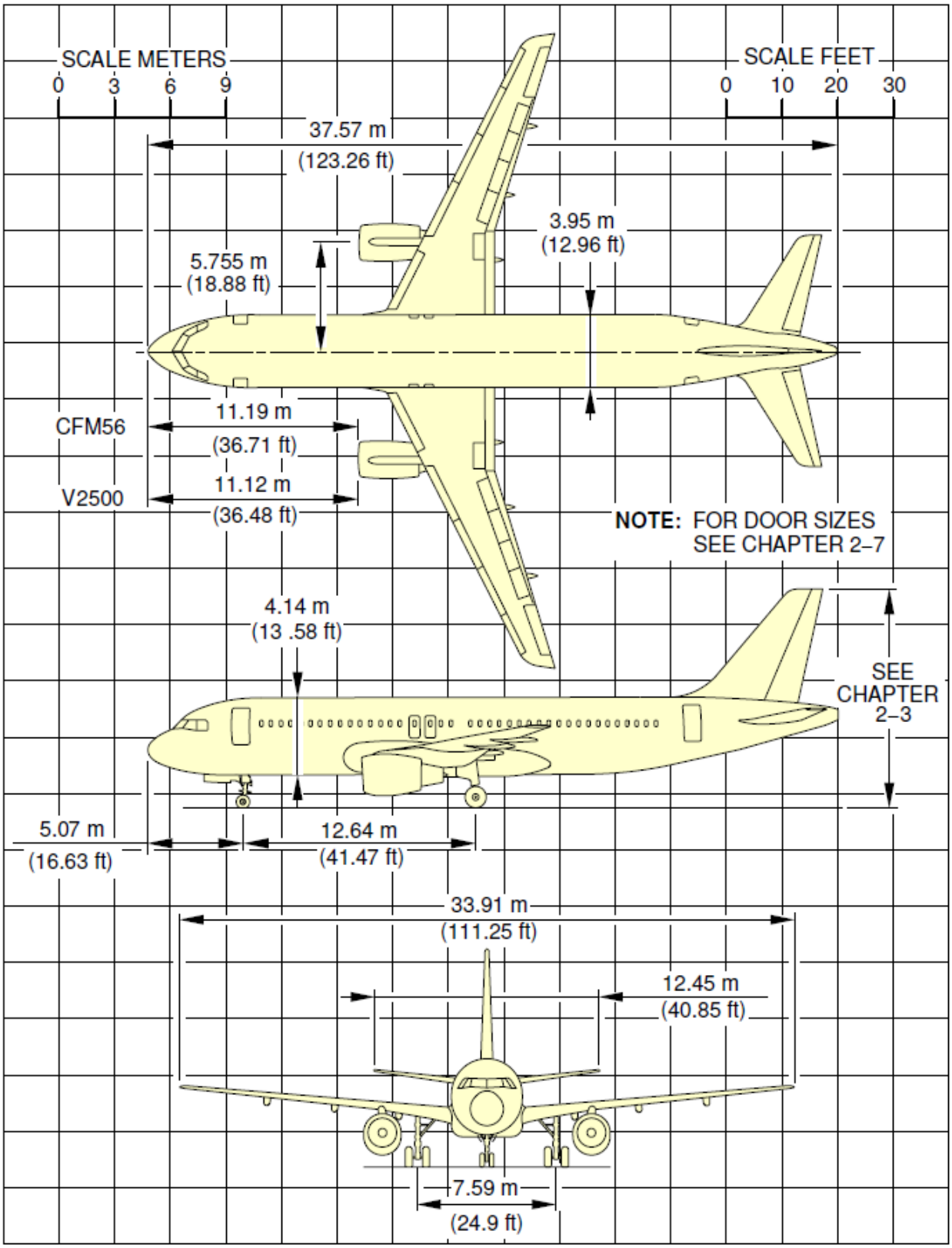
Clearways, CWY: Include the stopway and any additional surface cleared of obstacle.

3.3 Aircraft Dimensions

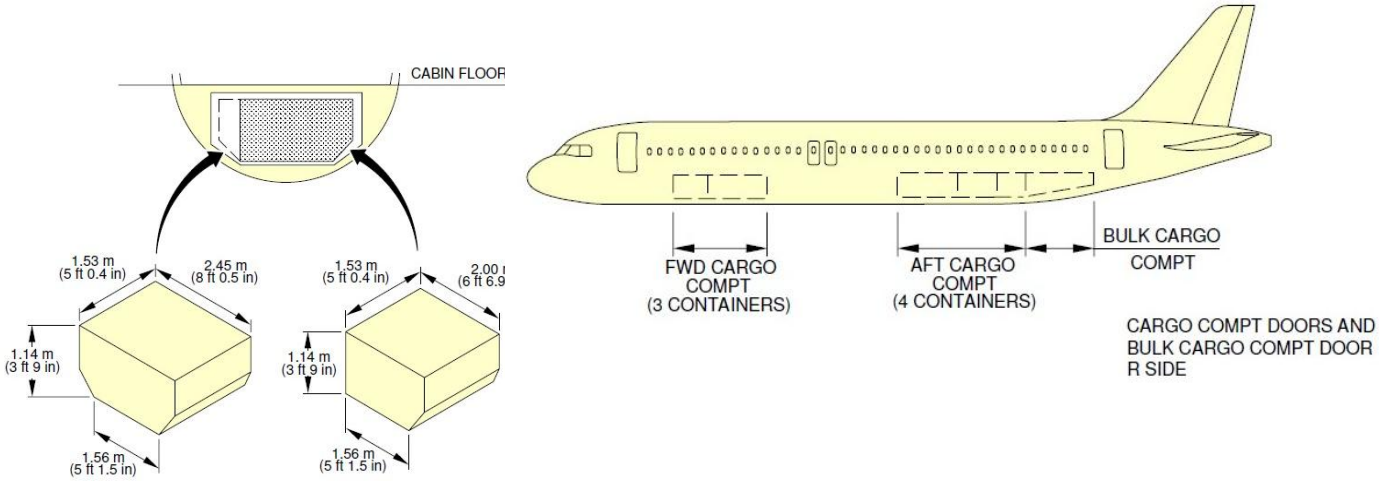
Boeing 747



Airbus A320

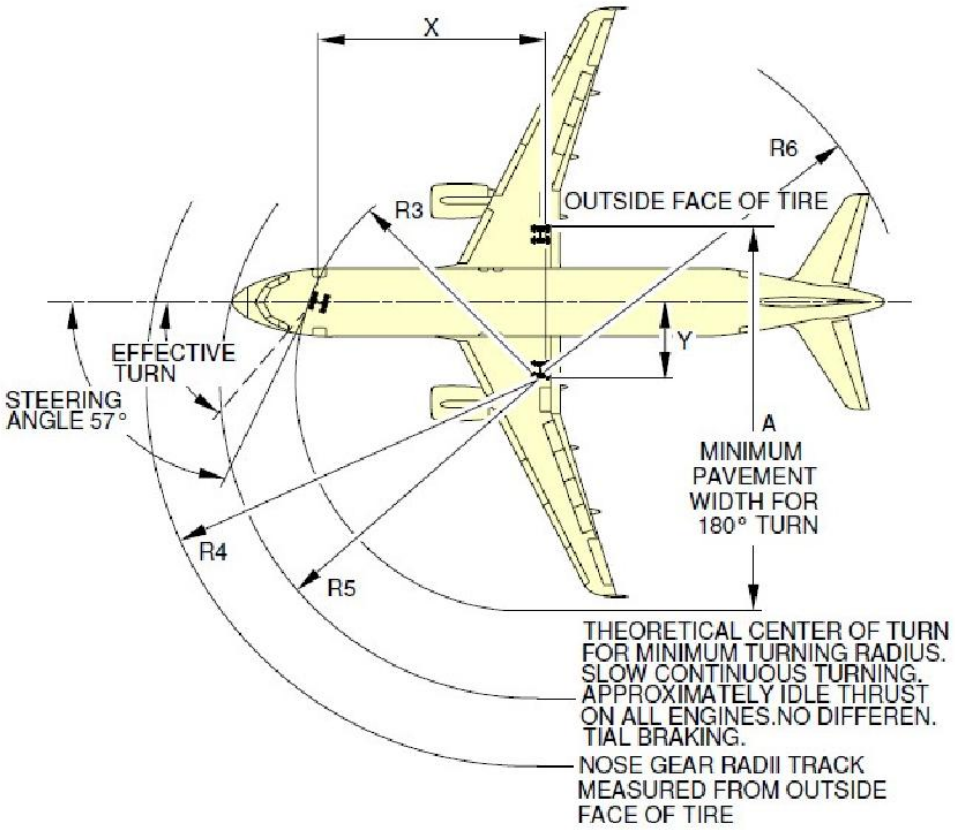

SCALE METERS
0 3 6 9
SCALE FEET
0 10 20 30
37.57 m
(123.26 ft)
3.95 m
(12.96 ft)
5.755 m
(18.88 ft)
CFM56
11.19 m
(36.71 ft)
V2500
11.12 m
(36.48 ft)
NOTE: FOR DOOR SIZES
SEE CHAPTER 2–7
4.14 m
(13 .58 ft)
SEE
CHAPTER
2–3
5.07 m
(16.63 ft)
12.64 m
(41.47 ft)
33.91 m
(111.25 ft)
12.45 m
(40.85 ft)
7.59 m
(24.9 ft)

3.3.1 Cargo Compartment Dimensions



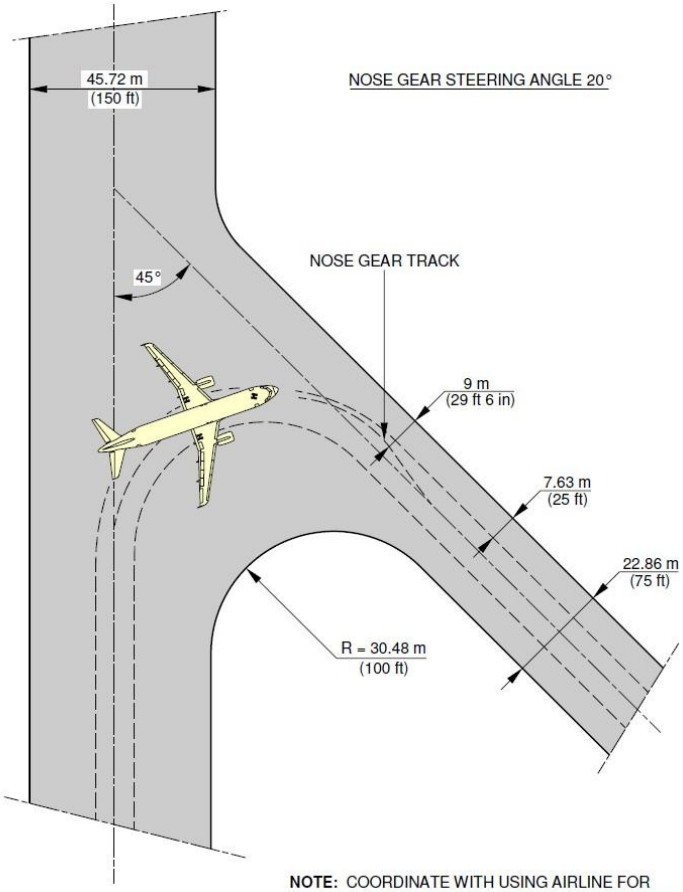
3.3.2 Turning Radius of aircraft

The illustration shows the minimum turning radius of the aircraft which is a vital factor while designing aircraft parking areas or aprons. The safety distances marks the space to be kept between parking positions of each aircraft.

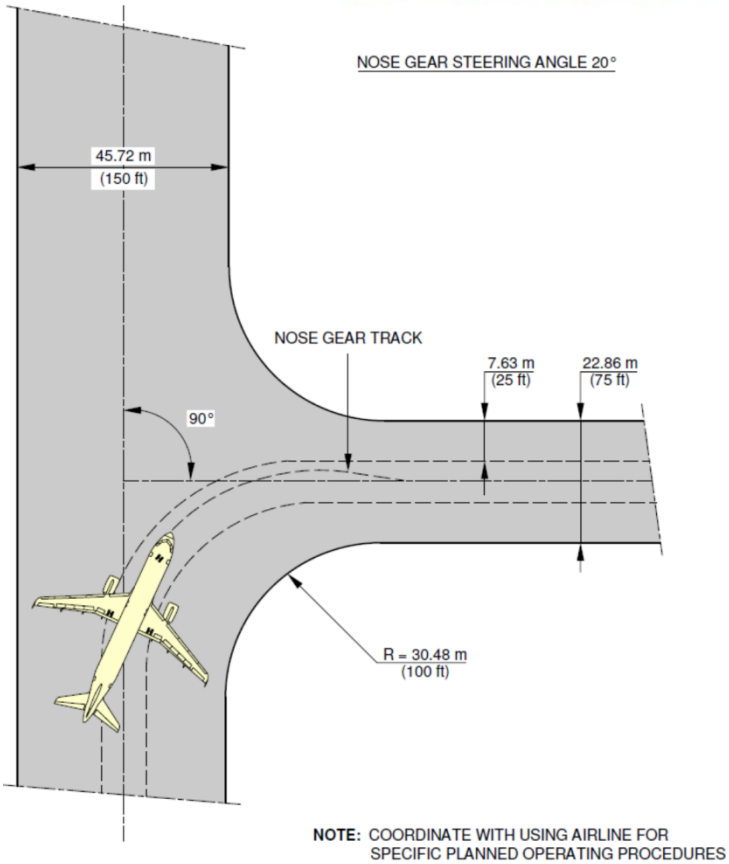


EFFECTIVE TURN ANGLE		X	Y	A*	R3	R4	R5	R6
70°	m	12.64	4.60	22.9	13.81	21.99	18.30	21.91
	(ft)	41.5	15.1	75.1	45.3	72.2	60.0	71.9

3.3.2.1 Turning radius of taxiway, runway

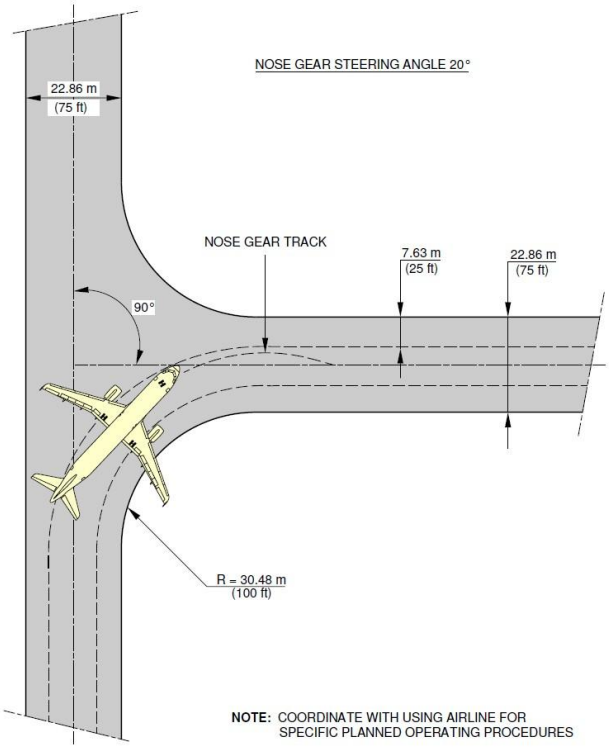


Runway to Taxiway turning- The maximum turning angle is 135°

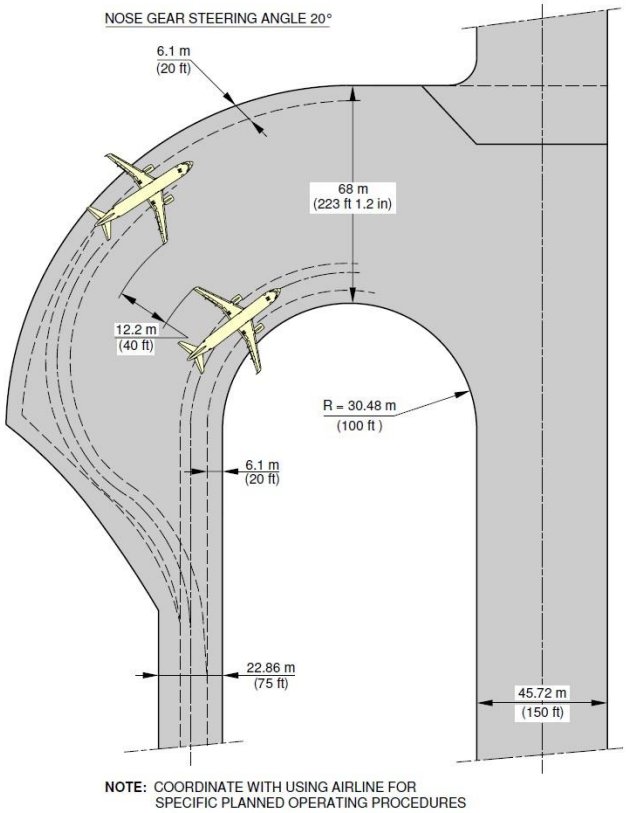


At a turning angle of 90° between runway to taxiway

Taxiway to Taxiway turning



Holding bay (runway) clearances and turning radius



3.4 Passenger terminal

Terminal building is the main building where passengers embark and disembark aircrafts. The terminals are the 'front door' to the Airport and serve as the public interface between the airside and landside elements. It can be of two types- domestic and international. Irrespective of the two types the terminal buildings are generally divided by 3 different levels.

- Departure level, generally the ground floor
- Arriving level , generally the 1st floor
- Luggage handling level in most cases the basement

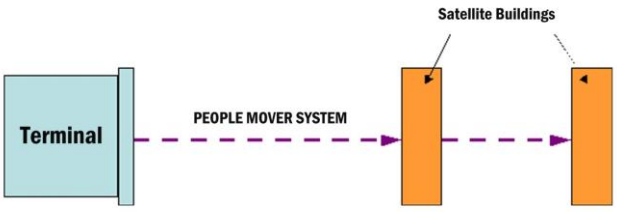
There might be other separate level for other functions such as customs, operating rooms, stuff lounge etc

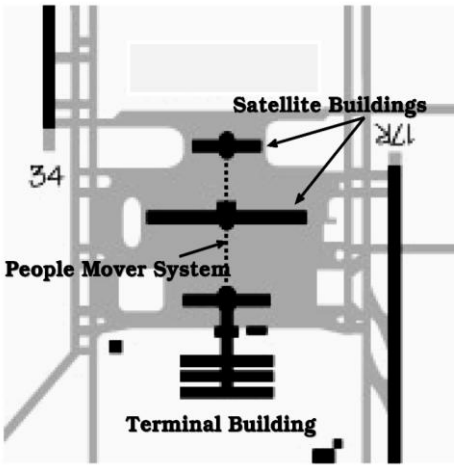
3.4.1 Major Terminal Design Considerations According to strategic Airport Management Program, 2007

- Terminal Configuration
- Terminal Concepts
- Major Design Considerations

3.4.1.1 Terminal Configuration

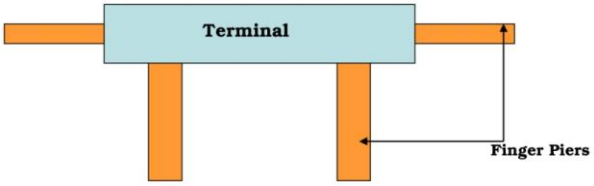
- Centralised processing building connected by people mover system to satellites. Example: Denver International airport, Heathrow airport alternatives.

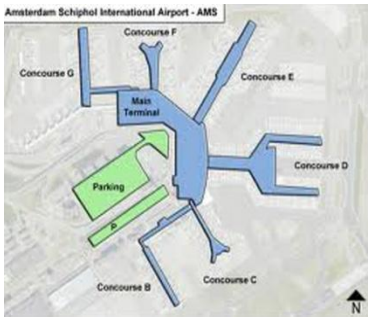




Denver International Airport

- Centralised passenger processing terminal building with finger piers



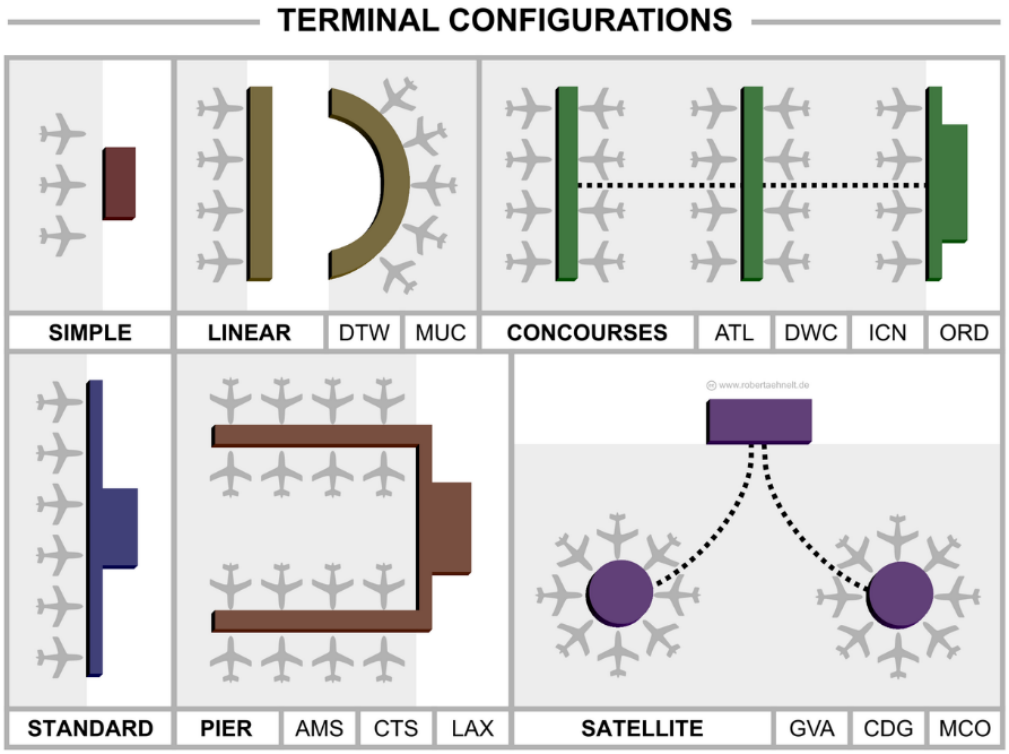


Schipol International Airport

3.4.1.2 Terminal Concepts

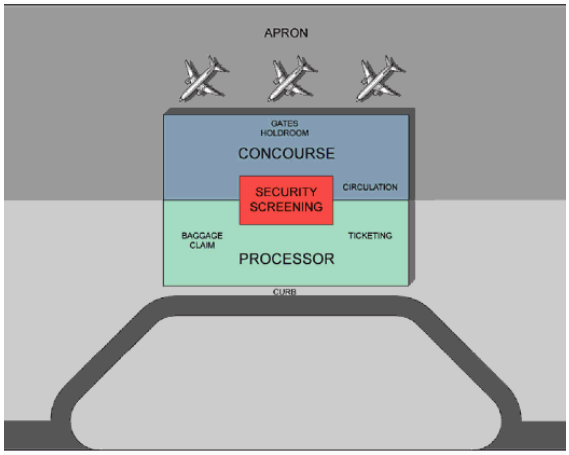
5 Common Terminal Concepts

- Linear
- Pier/Finger
- Transporter
- Satellite
- Compact Module Unit Terminal

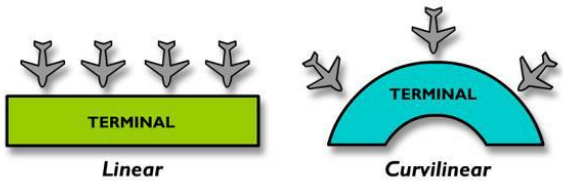


Linear/Curvilinear

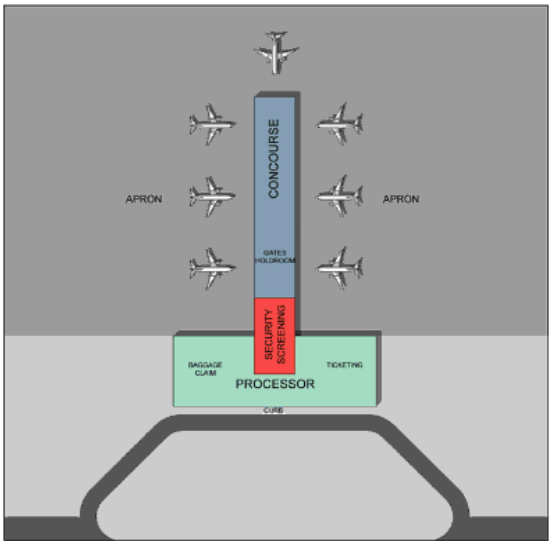
- Simplest & Most straight-forward
- Simple organizational principles
- Consists o a single passenger processing area
- Primarily appropriate for low-activity airports
- Direct relationship between curb side and the aircraft.(Short walking distances)
- Centralized passenger processing
- Example- McNamara terminal of Detroit Metro Airport

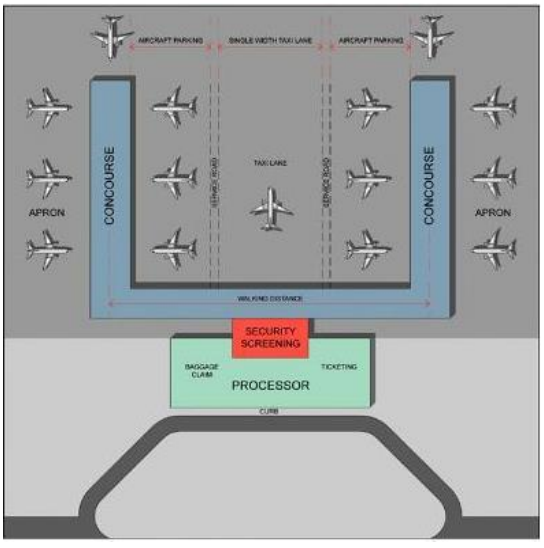


Considerations for Selecting a Terminal Configuration," David A. Daileda, FAIA, FAA White Paper.



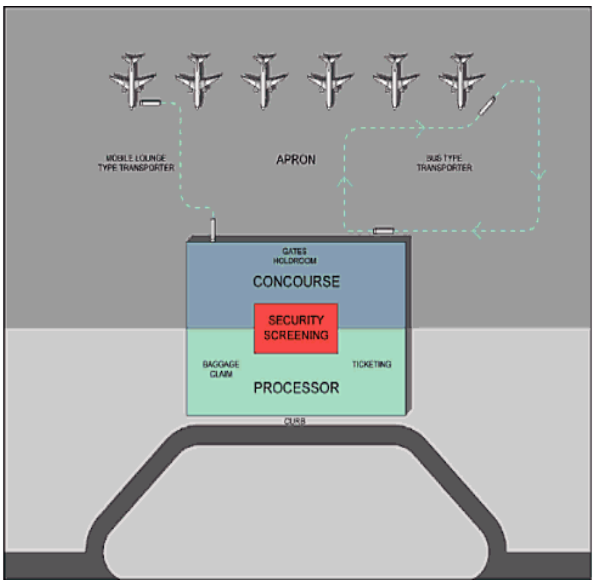
Pier/ Finger





- Air Craft are parked on both side of a concourse.
- Air Craft usually arranged around the axis of the pier in a perpendicular.
- Passengers are usually processed at the simple terminal location and then routed down a "pier" where aircraft are parked in the "finger" slots or gates for boarding.
- This concept fully separates the passenger processing functions from the concourse activities.
- Compare to linear, this concept type increases passenger walking distances from the processing area.
- Compact arrangements of a/c along the pier, allow efficient servicing of the a/c, thus lowering the operating costs for the airlines.
- Example:- Kansai International Airport

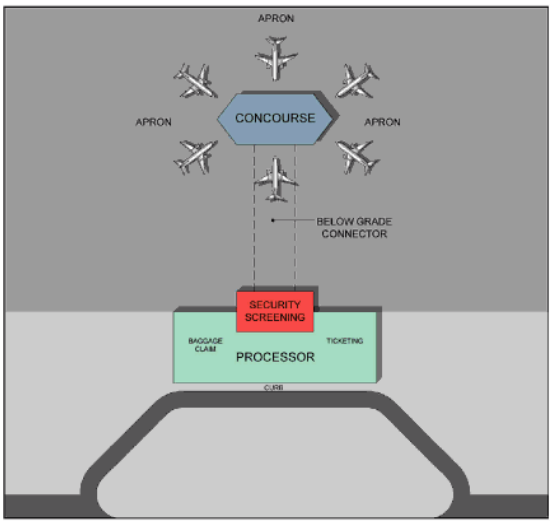
Transporter



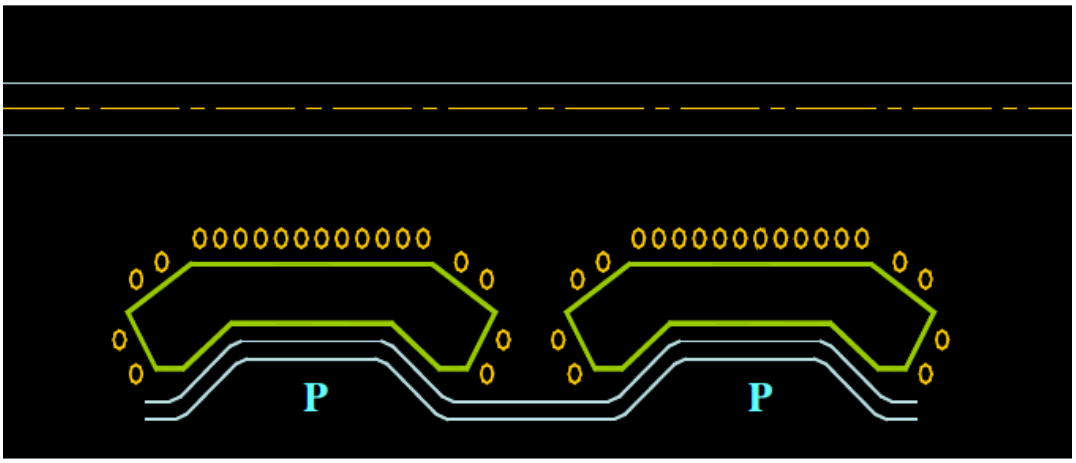
- It provides a complete separation of passenger facilities from those required to service and maintain the aircraft.
- Aircraft and a/c-servicing functions are remotely located from the terminal.
- Passengers access the a/c via the mobile lounges that leave from the terminal gates, go directly to the aircraft.
- The use of buses that drop off the passengers adjacent to the a/c on the apron.
- Airplane taxiing time to and from the runway is decreased as well as reduces the amount of aircraft engine noise around the terminal.
- Example:- Dulles International Airport, Tampa International Airport

Satellite

- It is completely surrounded by aircraft.
- Connected to the processing areas of the terminal via underground, at-grade, or overhead connector.
- Parked in a nose-in arrangement around the satellite.
- Passenger processing is handled in a separate terminal facility.
- It is work well for heavy-activity airport with O&D and large percentage of connecting passengers.
- Example:- Orlando International, Hartsfield-Jackson Atlanta International, Denver International, Chicago O'Hare International



Compact Module Unit



It is defined by the IATA as 2 or more separate, self-contained building, each housing a single airline or group of airlines, each having direct access to ground transportation.

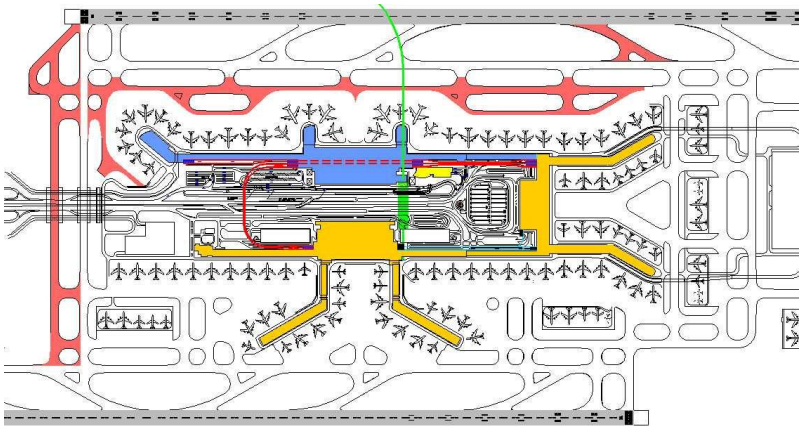
Example:-Kennedy International Airport, NY , London Heathrow

Comparison of the 5 terminal

No.	Terminal Concept	Advantages	Disadvantages
1.	Pier/Finger **Limited Expansion capability**	• Economical to build • Efficient use of land • Centralized resources, economies of scale (human,facilities, amenities)	• Long walking distances • Limited expansion capability • Reduced aircraft circulation & manoeuvrability
2.	Linear **Longer walking distance**	• Shortest walking distances • Simple construction • Lower baggage systems costs (conveying/sorting) using decentralized system	• Duplication of terminal facilities/amenities • Longer walking distances for transfer pax • Longer minimum connecting time
3.	Satellite **Expensive**	• Centralized resources (human, facilities and amenities) • Facilitates pax management	• Requires high technology, underground transportation system • High capital, maintenance & operating cost • Increases minimum connecting times
4.	Transporter **Expensive**	• Ease of aircraft manoeuvrability • Ease of expansion capability for aircraft stands • Simple and smaller central terminal • Cost savings	• Higher instances of pax delays • High capital, maintenance & operating costs • Increased minimum connecting times
5.	Compact module unit terminal **Higher operating cost**	• Short walking distances • Simple pax & baggage transportation/sorting systems within each module	• Multi-compact module units require pax and bag transfer systems between terminals • Duplication of facilities, higher operating costs

Hybrid Concept

- Provide large passengers processing capacity
- Permit centralization of facilities and amenities
- Manpower saving in the centralization system
- Facilitate flow and orientation of passengers
- Reasonable check-in and close-out times
- Higher level of service



Changi Airport Concept

3.4.1.3 Major Design Considerations

- Passenger Flow
- Walking Distance
- Level of service for passengers
- Performance standards
- Traffic peaking characteristics
- Future growth
- Sophisticated and costly airport systems
- Ease of way finding
- Processing times
- Retail

Basic Planning Criteria in Development of Passenger Terminals

- Easy orientation
- Simplicity
- Minimise walking distances
- Minimise level changes
- Minimise pax cross-flows
- Compatibility of facilities with aircraft characteristics
- Built-in flexibility to accommodate future changes in dynamic industry
- Traffic peaking characteristics
- Transfer volume and connecting times

Defining the objectives first for management

- **Type of airport operations**: hub, point-to point, low cost, charters, general aviation

- **Demographics of pax**: international/domestic, business/tourists

- **Level of service**

- **Establish key design criteria/parameters** = design brief: simplicity, clarity, efficiency, minimum change in level, comfort, ambience, architectural statement/icon, state-of-the-art technology, low operating costs

- **Prioritise design criteria/parameters**

3.4.2 Functions of Terminal Building

Main Function of Terminal Airport

- Change of Movement Type-From car, train or bus to plane
- Processing (passenger processing space)-Ticket, check-in, security check
- Provide Passenger Facilities-Shopping, toilets, eating, meeting & greeting, business & conference.

Other Functions are-

- To provide circulation, processing and holding space
- To operate smoothly
- To ensure the premium level of service

3.4.3 Parts of Terminal Building

A terminal building could be made for passengers, cargo and for any other specific purposes. It comprises the basic physical parts as

- Front side of the Terminal
- Visitors Area and Check-in Area
- Shop retails
- Security Hold Area & Baggage Make Up area
- Passengers Meet and Greet area
- Airlines offices, counters for Tour and Travel agencies counters for Taxi services
- Lounges of Business class or Executive Class passengers

3.4.4 Terminal facilities and services

- Access and Landside Interface.
- Processing.
- Holding Areas.
- Airlines and Support Activities.

3.4.4.1 Access and Landside Interface

To ease the transfer of passenger flow. The facilities include:

- Curb side loading and unloading.
- Curb side baggage check-in where this is permitted.
- Shuttle services to parking lots and other terminal.
- Loading and unloading areas for car, buses, taxis, limousines and rapid surface modes.

3.4.4.2 Processing

Areas are designated for the formalities associated with processing passenger

The facilities include:

- Airline ticket and passenger check-in.
- Baggage check-in.
- Gate check-in.
- Incoming and outgoing customs.
- Immigration control.
- Security checks areas.
- Baggage claim.

3.4.4.3 Holding Areas

The areas where passengers wait, in some case with airport visitors, between period occupied by passing through the various process. The facilities required:

- Passenger Lounges -general, departure and gate lounges
- Passenger Services Areas -wash rooms, internet access and public telephone.

- Concessions -restaurant, bar and duty-free shop.

- Observation Decks and Visitors' Lobbies

3.4.4.4 Airlines and Support Activities

The design must also cater to the need of airlines, airport and support personal working in the terminal area. The facilities must be provided:

- Airlines offices -rest and refreshment areas for pilot and crew.
- Airport management offices -security, services.
- Governmental office -police, health, immigration.
- Offices and support areas for maintenance staff.

3.4.5 Service Required at Terminal Building

- Check-in
- Immigration Duties
- Security Checks
- Passenger Screening
- Baggage Screening
- Parking Facilities
- Public Transportation

3.4.5.1 Check-in

Airport Check-in are service counters found at commercial airports handling commercial air travel. The check-in is normally handled by an airline or a handling agent working on behalf of an airline. Passengers usually hand over any baggage they do not wish or are not allowed to carry-on to the aircraft's cabin and receive a boarding pass before they can proceed to board their aircraft.

3.4.5.2 Immigration Duties

Immigration responsible for:

- Monitor persons who leave or enter the country,
- Checking for appropriate documentation,
- Arresting people wanted by international arrest warrants.
- Block the entry of dangerous people to the country.

3.4.5.3 Security Checks

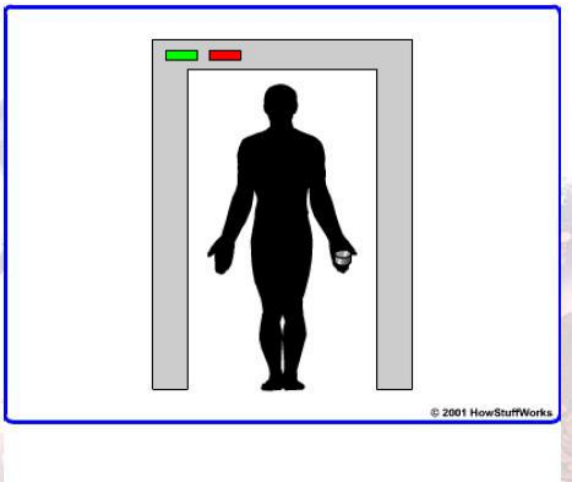
- Passenger Screening:
- Confirming the identity of travelers, Checking a photo ID & transports.
- Body Screening using Metal Detector Gate
- Baggage Screening using X-ray machine

3.4.5.4 Passenger Screening

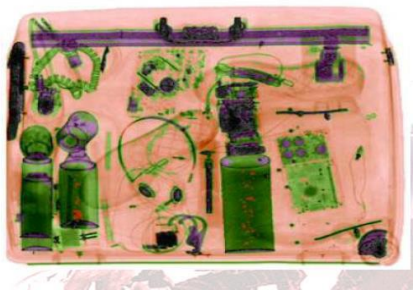
- Purpose: to ensure that certain prohibited items don't board commercial airliners.

- Every passenger thus is screened by airport security staff using the latest screening techniques to prevent any terrorist or criminal activity.

- Every piece of luggage is screened for explosives using the latest technology and equipment before being placed on a plane



3.4.5.5 Baggage Screening



The X-ray machine:-

- Place all carry-on baggage and any items you are carrying with you on the belt of the X-ray machine.
- Laptop computers and video cameras with cassettes must be removed from their carrying cases and placed in one of the bins provided.
- You will also need to remove your coat, jacket, suit jacket or blazer and place it in one of the bins.
- These items go through the X-ray machine

3.4.5.6 Parking Facilities

- **Public Parking Facility-**for airline passengers. Near terminal building.
- **Off-Airport Parking-**for airline passengers. Far away from terminal building, with lower charges.
- **Separate Parking-**for airport employee Far away from terminal area, airport workers using bus go to the terminal.
- **Car Rental Parking-**for taxi or airport limousine. Close to the terminal building. Pick-up / Drop-off

3.4.5.7 Public Transportation

- **Taxis and limousine** -Airport taxis or airport limousines are provided by Airport Limo. The taxis and limousines are readily available at the Taxi and Limousine counters.
- **Bus** -Both public and private buses connect KLIA to several points in Kuala Lumpur and beyond.
- **Express Train**-Kuala Lumpur International Airport can be reached by the KLIA Express (ERL) and the KLIA Transit train services.
- **Aerotrain-Main Terminal Building to Satellite Terminal A**. The journey between terminals takes under two minutes train is able to transport 250passengers one time.

3.5 Passenger Circulation

Arrival Passenger Flow

The flow diagram below shows the flow of passengers embarking the aircraft along with authorized personal including staff and flight crew and their functionalrelationships in an international terminal facility.

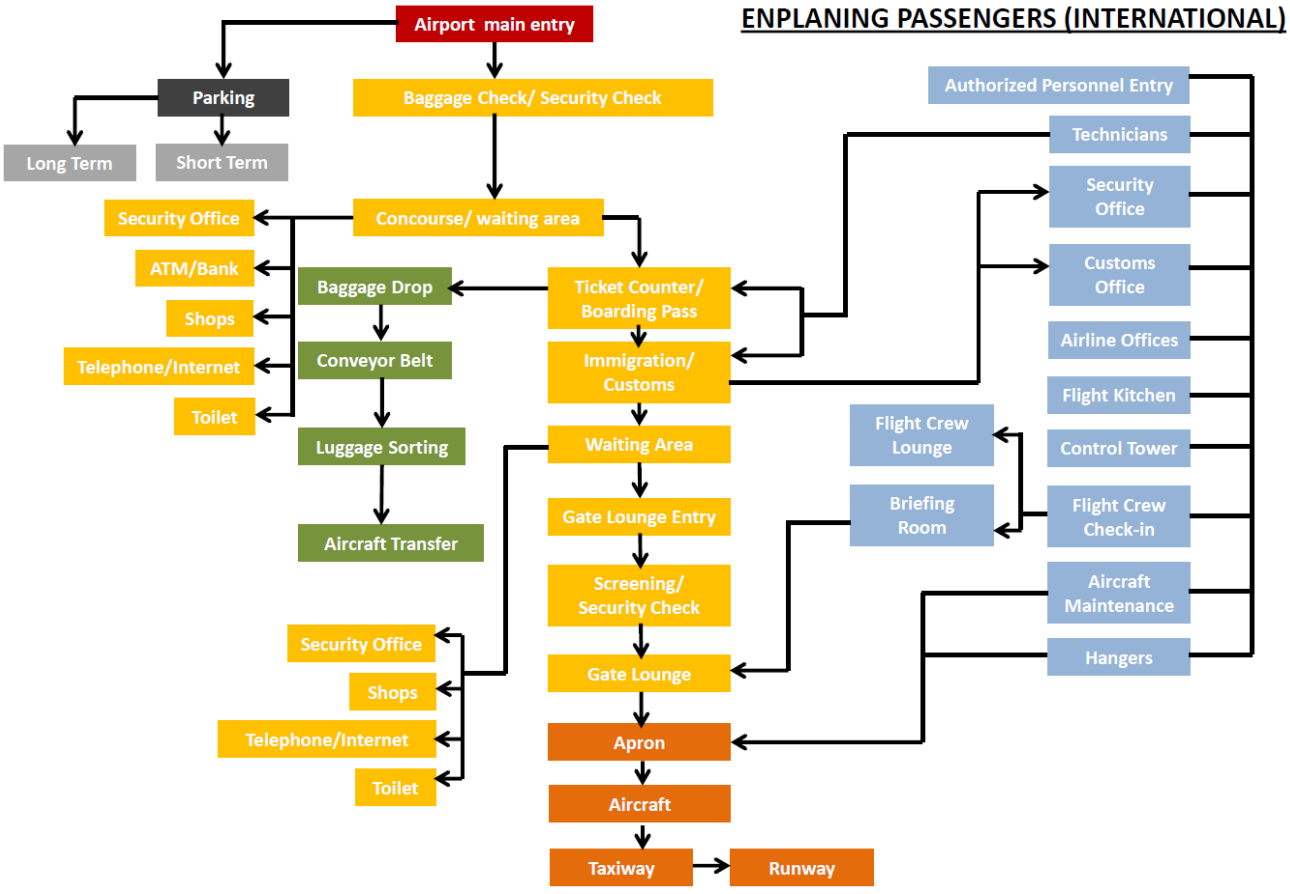


Diagram taken from Shaoki Shamim

Departure Passenger Flow

The flow diagram below shows the flow of passengers dis-embarking the aircraft along with authorized personal including staff and flight crew and their functional.

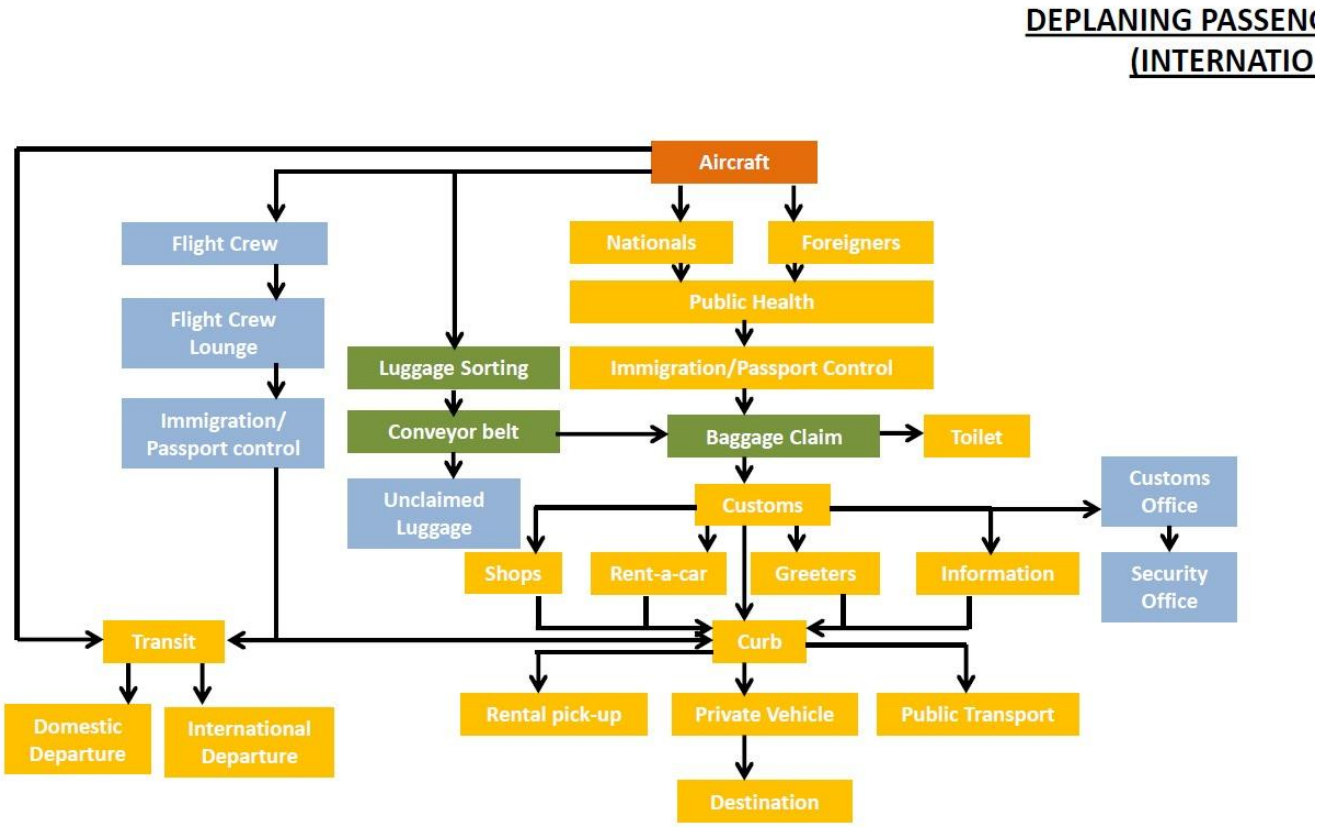
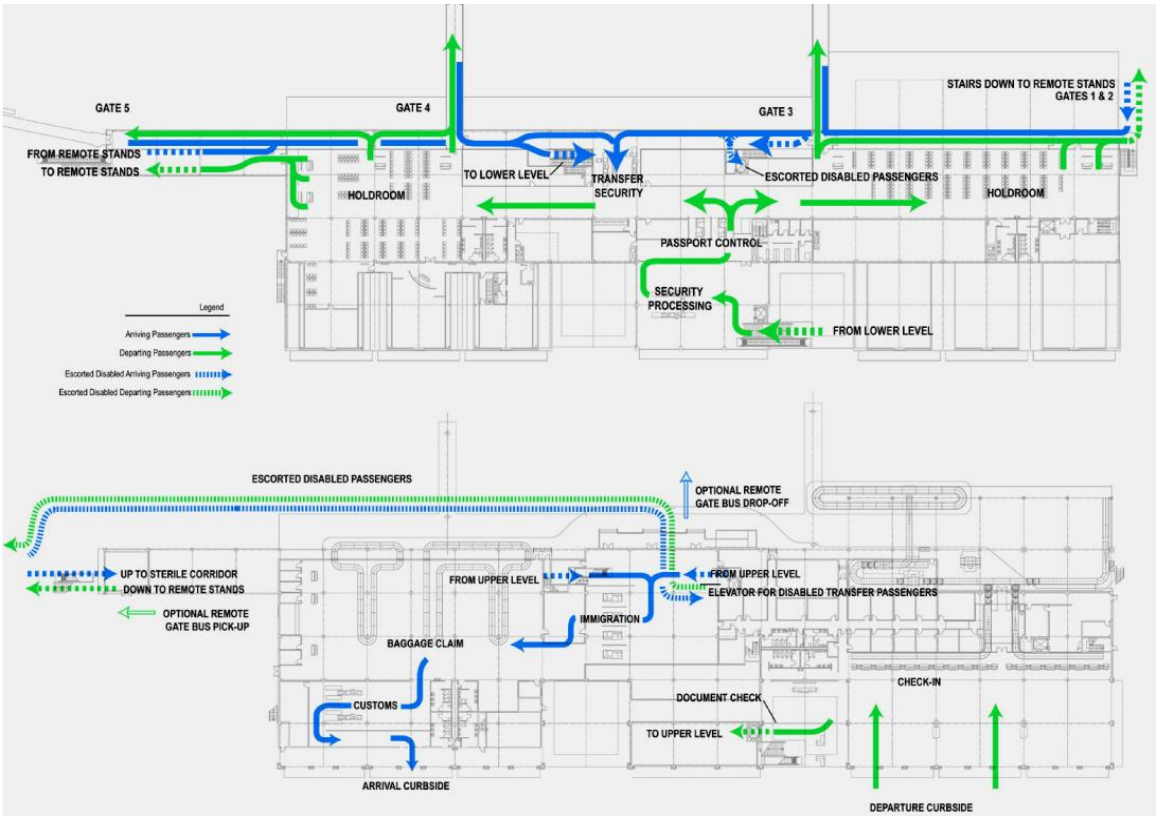
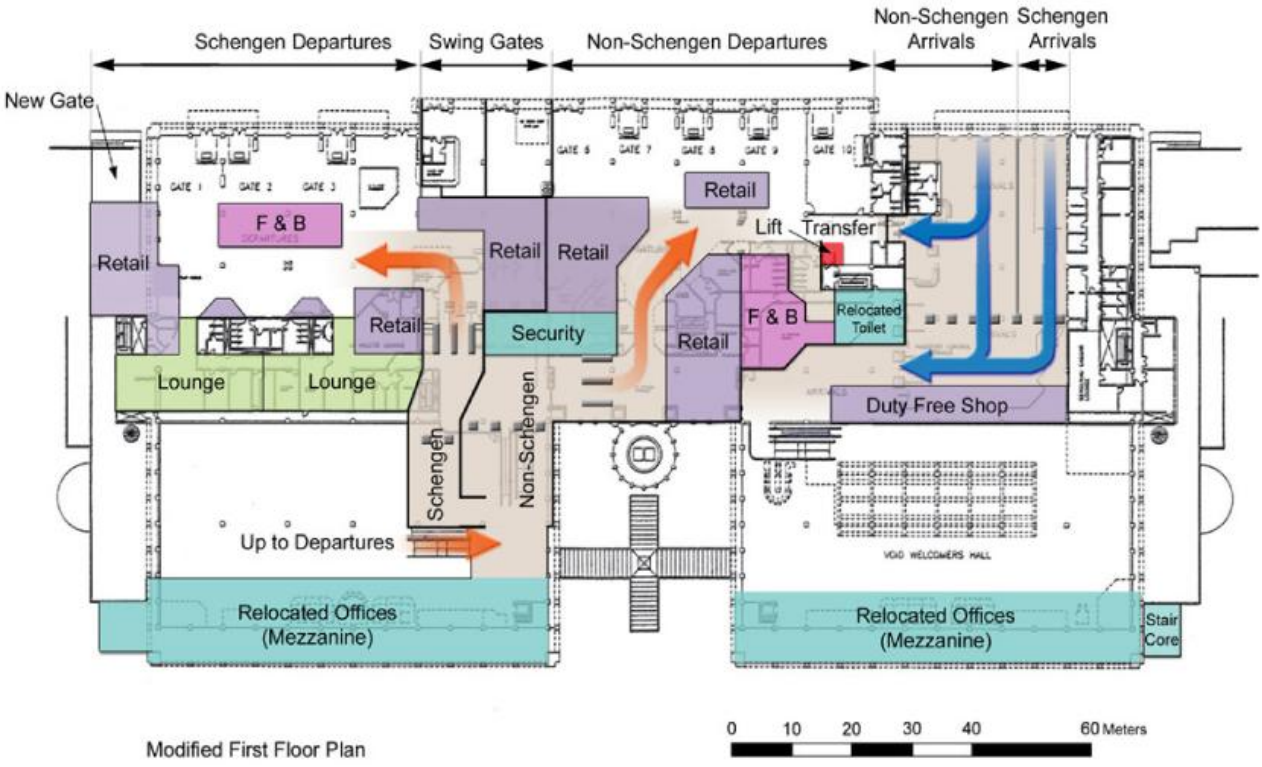


Diagram taken from Shaoki Shamim

Typical Floor Circulations of 1st floor and ground floor



Modified 1st Floor plan



Modified First Floor Plan

3.6 Cargo Terminal

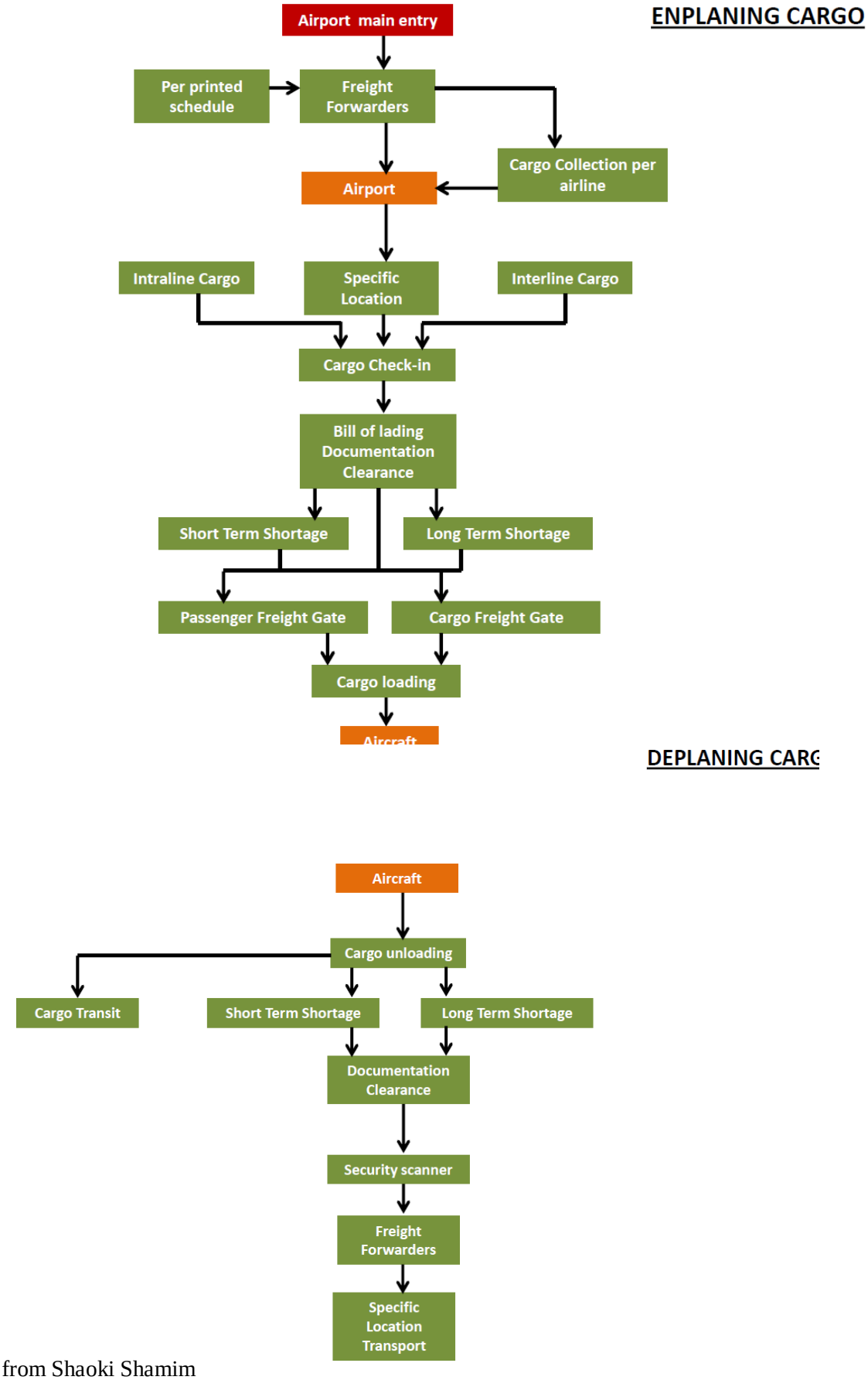


Diagram taken from Shaoki Shamim

3.7 Luggage Handling

Arrival Bag gages

- Unload
- Transfer
- Claim




Departure Bag gages

- Checking
- Screening
- Transportation
- Storage
- Sorting
- Make up
- loading





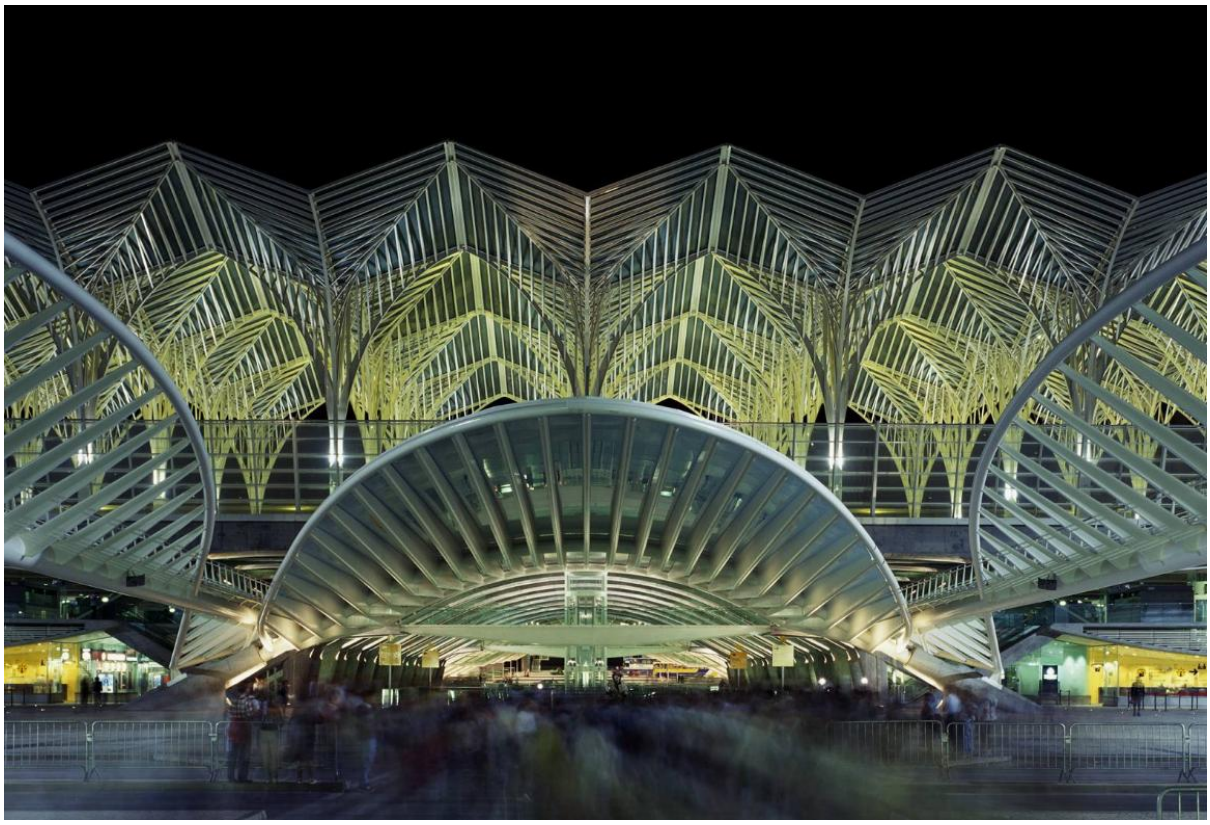

3.8 Structural Analysis

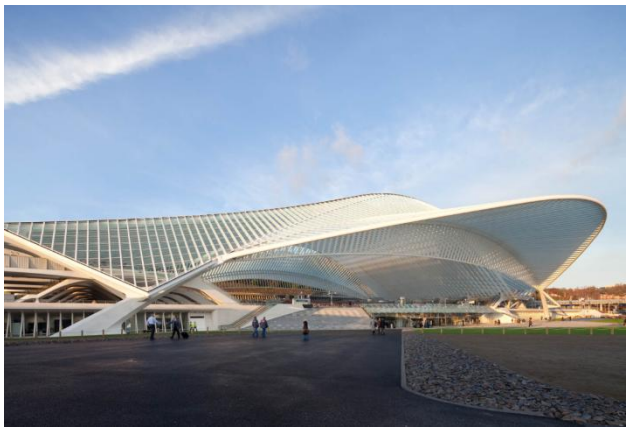
Centre Pompidou-Metz by Shigeru Ban

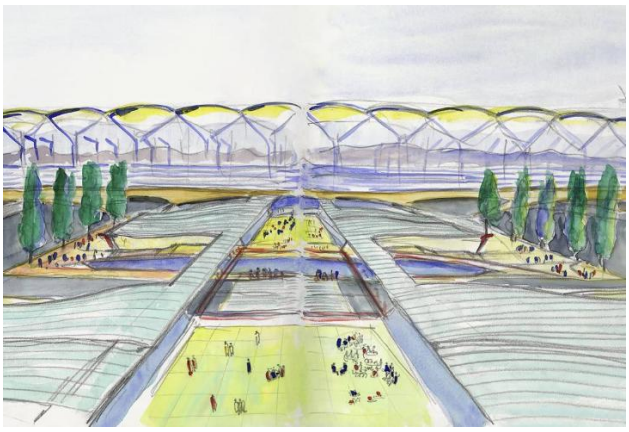
The undulating laminated timber roof structure surrounds a 77-metre metal spire. The frame is covered with a translucent fibreglass and Teflon textile canopy and overhangs the building's walls by up to 20 metres. The new building will provide 5000 square metres of exhibition space, surrounded by two gardens and a gently sloping terrace.

The Centre Pompidou-Metz is a vast modular structure around a central spire rising 77m above ground, a nod to the Centre Pompidou which opened in 1977. The hexagonal roof structure, which echoes the floor-plan, covers a building with a total surface area of 10,700 sq m, including 5,000 sq m of gallery space. Other areas such as the Forum, the restaurant terrace and the garden provide further opportunities to exhibit works.

Santiago Calatrava's structures

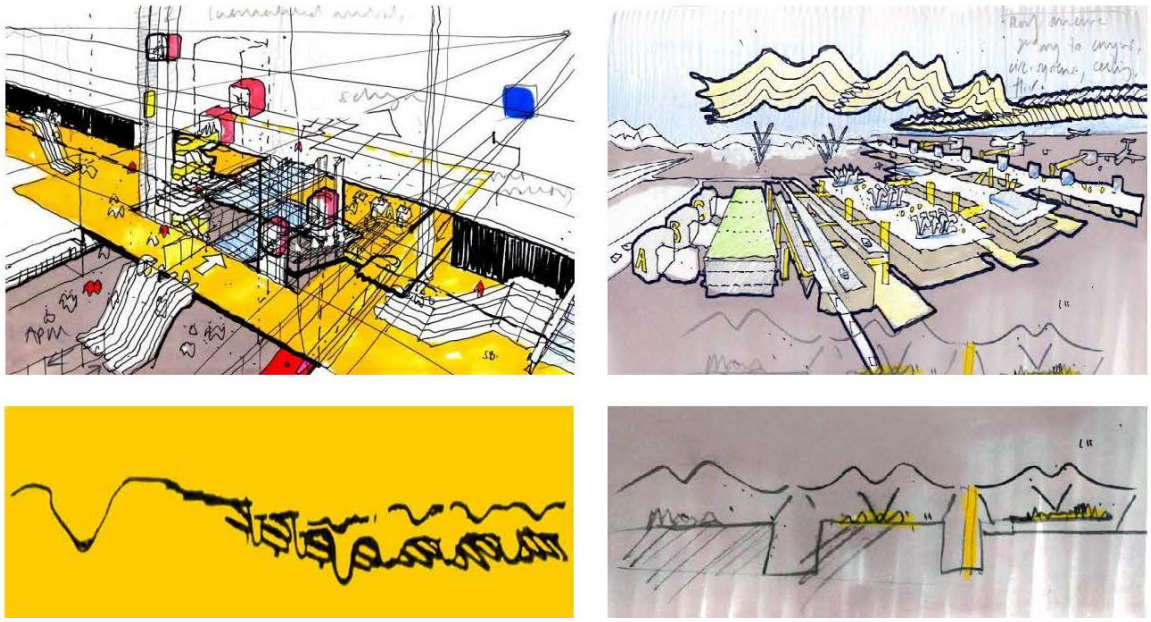






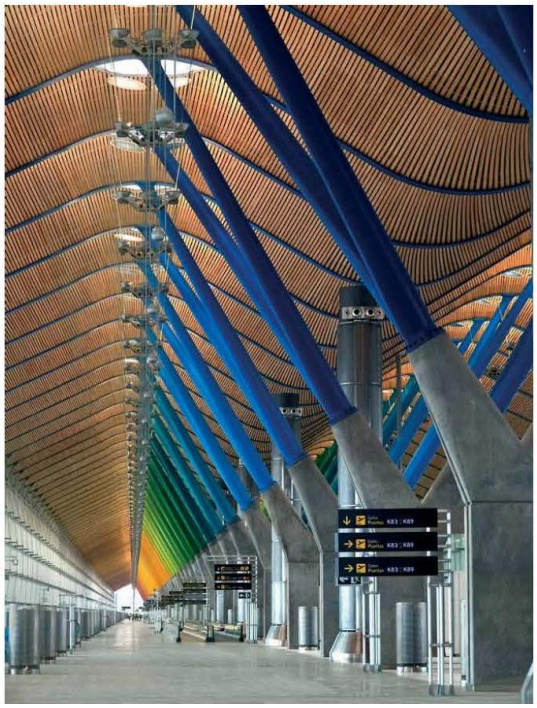
Madrid Barajas Airport

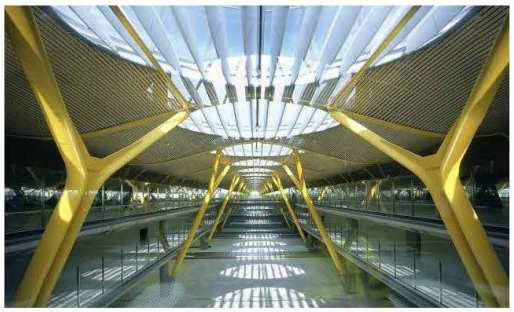
The terminal, which is the biggest in Spain, was commissioned to enable Barajas International Airport to compete with major hub airports within Europe. The core building comprises a sequence of parallel buildings separated by a linear block allowing landscape and daylight to penetrate deep into the interior.

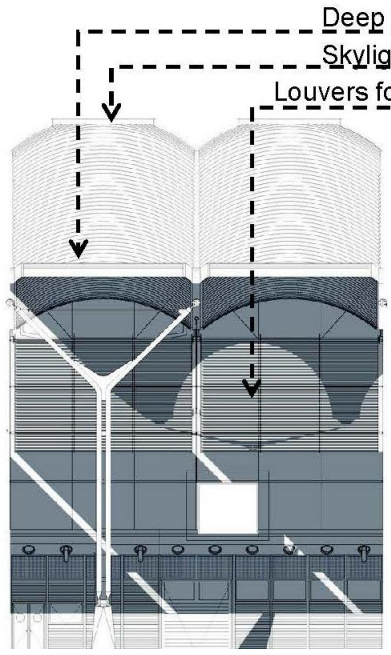


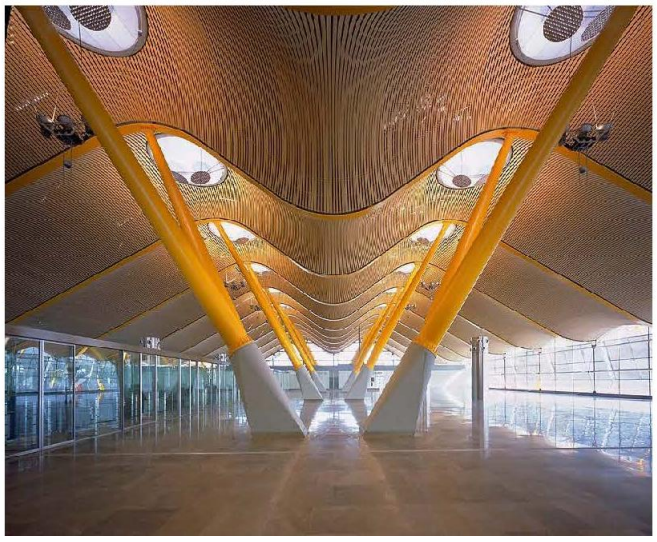
Pedestrian circulation to and from the parking area is concentrated along the face of the parking structure, creating an animated façade opposite the terminal. The layout of the arrivals hall creates clear and separate routes to the various modes of ground transportation, giving equal weight to public and private transport. The arrivals and departures forecourts as well as the train and metro station are covered by a standard module of the roof, which thereby encompasses the entire sequence of activities from drop-off to departure gates.

The built scheme for the main terminal offers an unencumbered; long-span envelope developed with Arup– with a flexibility of internal space conceptually similar to that of the practice's much earlier design for the Pompidou Centre in Paris. Departure and arrivals areas, check-in desks, commercial space, retail, offices, passenger lounges, back-up and other facilities are all contained within freestanding steel-framed structures inside the building and can be dismantled and reconfigured as future needs change.









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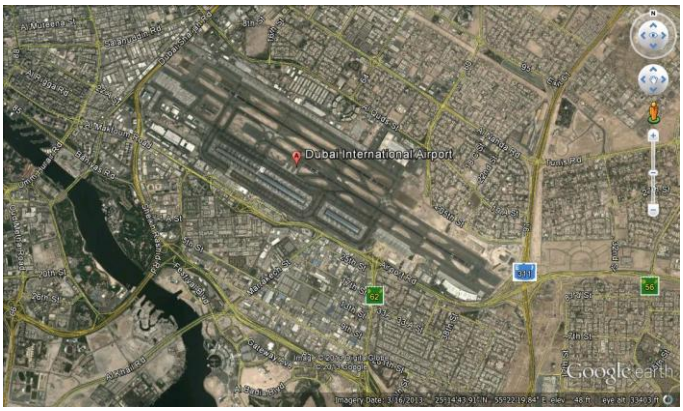
CHAPTER 4: Case studies of similar projects

4.1 DUBAI INTERNATIONAL AIRPORT



Airport type :Public

Owner :Government of Dubai

Operator :Dubai Airports Company

Serves:Dubai

Location :Al Garhoud, Dubai, United Arab Emirates

Hub for: Emirates, Flydubai, Emirates SkyCargo

Elevation :AMSL 19 m / 62 ft

Coordinates: 25°15′10″N 055°21′52″E

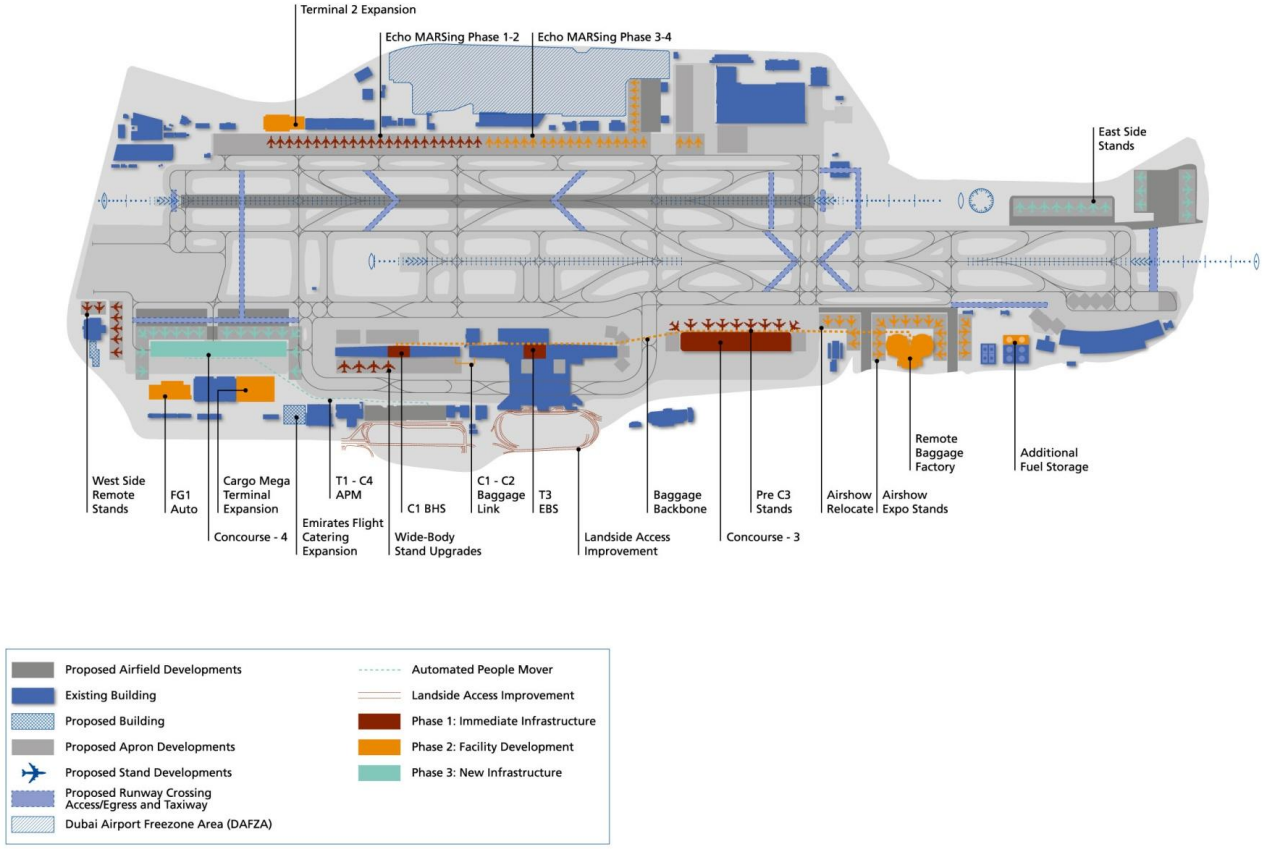
Dubai Airport is spread over an area of 8,640 acres (3,500 ha) of land. In 2012 DXB handled a record 57.7 million in passenger traffic, a 13.2% increase over 2011.

- This made it the 10th busiest airport in the world by passenger traffic.
- It is also the 3rd busiest airport in the world by international passenger traffic in 2012, surpassing Hong Kong International Airport in the global rankings'
- In addition to being an important passenger traffic hub, the airport was the 6th busiest cargo airport in world, handling 2.27 million tons of cargo in 2012.The total number of commercial aircraft movements was 344,245 in 2012.

Master Plan

Contractors

Aéroports de Paris International was contracted as project design consultant for terminal 3. They produced an innovative and ground-breaking design for the new terminal in the shape of an airplane wing. Design group Dar Al-Handasah Consultants were contracted to design the concourse 3 part of the project.



Aprons and taxiways

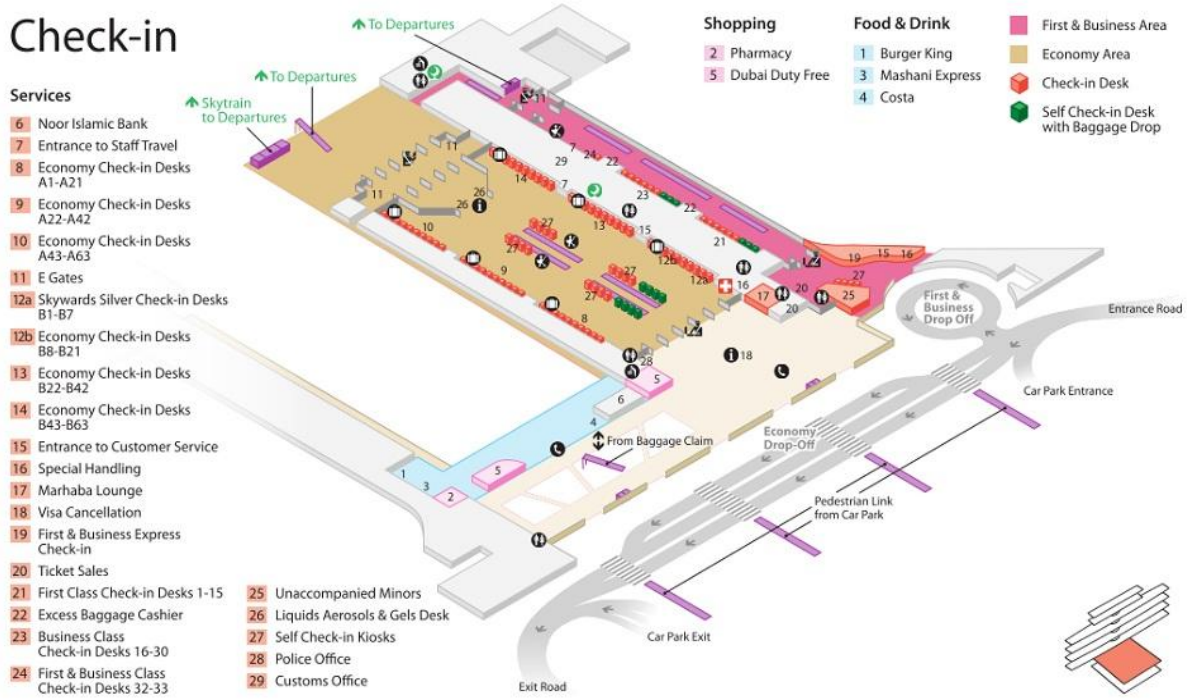
The apron area around the new concourse 2 was upgraded in a project completed in 2003; this new strengthened area provides for 27 wide-bodied aircraft stands. Five of these stands are reserved to accommodate the A380.

Taxiways were strengthened. Although most think this is unnecessary, the Dubai civil aviation authority thought it best to err on the side of caution.

"Dubai Airport required a specialist facility to handle flowers."

In addition, work on other taxiways in the area was expanded in order to complete the work associated with the newly commissioned second runway. Other apron space around terminal 2 was also extended to provide additional remote parking stands for taxiing aircraft, which is an advantage in such a busy airport where ground movements of aircraft have to be coordinated with the same precision as air traffic control does in the air.

Check-in



Services

- 6 Noor Islamic Bank
- 7 Entrance to Staff Travel
- 8 Economy Check-in Desks A1-A21
- 9 Economy Check-in Desks A22-A42
- 10 Economy Check-in Desks A43-A63
- 11 E Gates
- 12a Skywards Silver Check-in Desks B1-B7
- 12b Economy Check-in Desks B8-B21
- 13 Economy Check-in Desks B22-B42
- 14 Economy Check-in Desks B43-B63
- 15 Entrance to Customer Service
- 16 Special Handling
- 17 Marhaba Lounge
- 18 Visa Cancellation
- 19 First & Business Express Check-in
- 20 Ticket Sales
- 21 First Class Check-in Desks 1-15
- 22 Excess Baggage Cashier
- 23 Business Class Check-in Desks 16-30
- 24 First & Business Class Check-in Desks 32-33
- 25 Unaccompanied Minors
- 26 Liquids Aerosols & Gels Desk
- 27 Self Check-in Kiosks
- 28 Police Office
- 29 Customs Office

Shopping

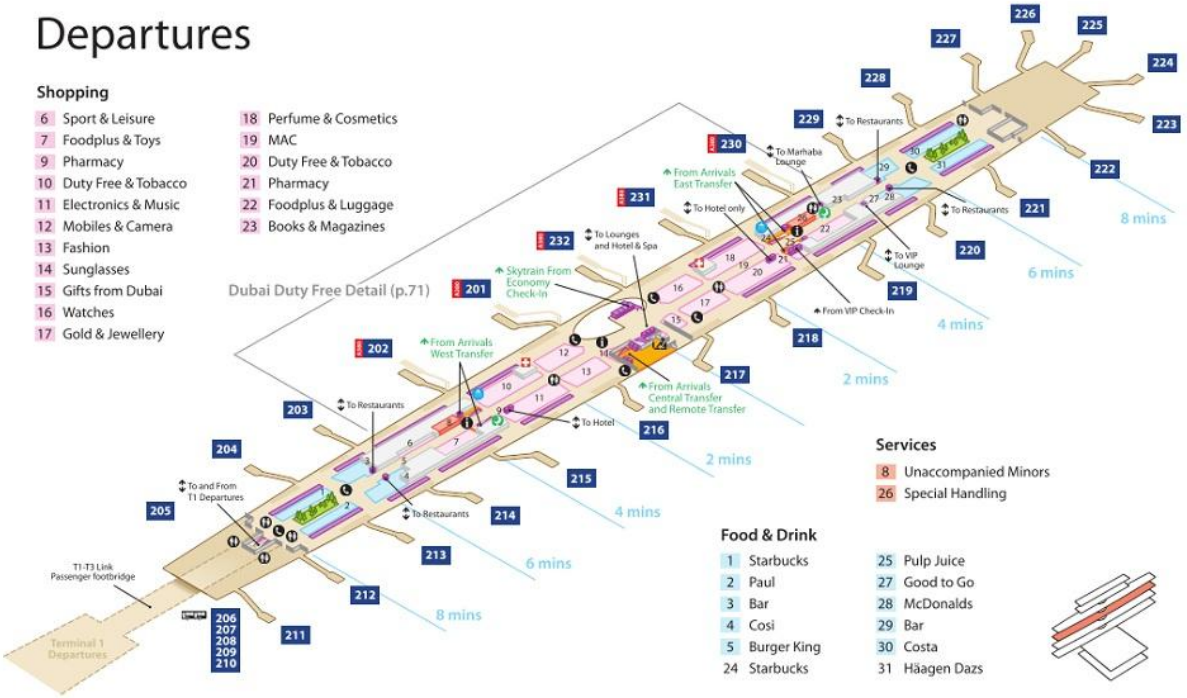
- 2 Pharmacy
- 5 Dubai Duty Free

Food & Drink

- 1 Burger King
- 3 Mashani Express
- 4 Costa

First & Business Area
Economy Area
Check-in Desk
Self Check-in Desk with Baggage Drop

Departures



Shopping

- 6 Sport & Leisure
- 7 Foodplus & Toys
- 9 Pharmacy
- 10 Duty Free & Tobacco
- 11 Electronics & Music
- 12 Mobiles & Camera
- 13 Fashion
- 14 Sunglasses
- 15 Gifts from Dubai
- 16 Watches
- 17 Gold & Jewellery
- 18 Perfume & Cosmetics
- 19 MAC
- 20 Duty Free & Tobacco
- 21 Pharmacy
- 22 Foodplus & Luggage
- 23 Books & Magazines

Dubai Duty Free Detail (p.71)

Services

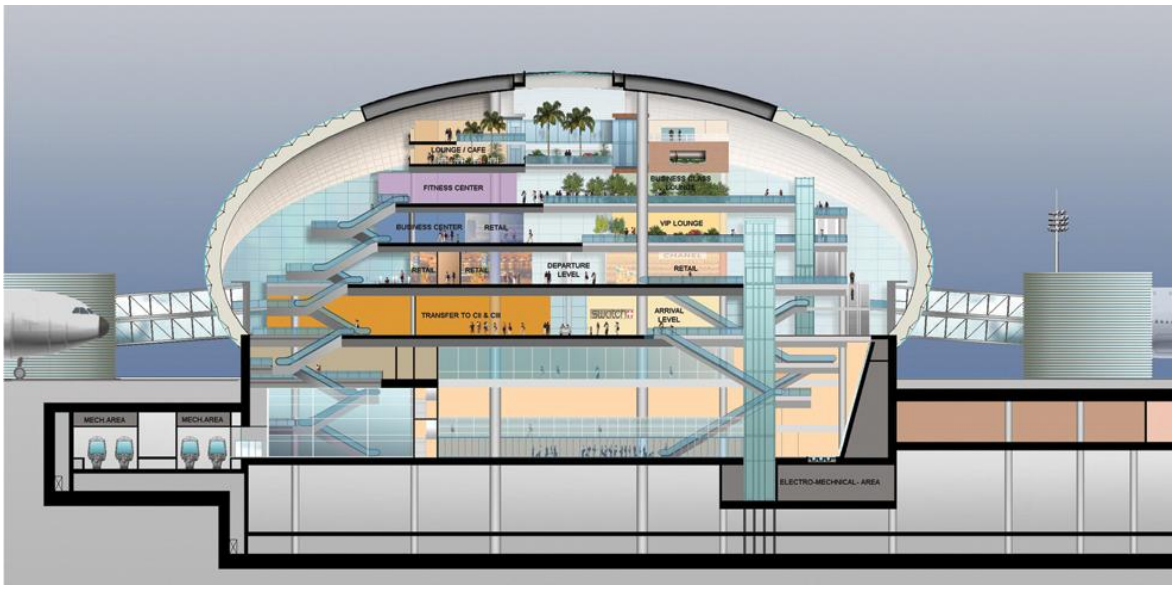
- 8 Unaccompanied Minors
- 26 Special Handling

Food & Drink

- 1 Starbucks
- 2 Paul
- 3 Bar
- 4 Cosi
- 5 Burger King
- 24 Starbucks
- 25 Pulp Juice
- 27 Good to Go
- 28 McDonalds
- 29 Bar
- 30 Costa
- 31 Häagen Dazs

Structure

It’s of post slab structure with huge cantilevered slab.



4.2 KANSAI INTERNATIONAL. AIRPORT

Kansai International Airport is an international airport located on an artificial island in the middle of Osaka Bay, 38 km (24 mi) southwest of Ōsaka Station.

Project Name: Kansai Airport

Architect: Renzo Piano

Location: Osaka, Japan

Date of starting: 1987

Date of completion: 1994

Cost: $20 billion

Area: 511 hectare artificial island in Osaka bay

Construction system: Steel and Glass

Style: High-tech Modern

Form: Stretched linear, vertically stacked and segregated form

The island is 4 km (2.5 mi) long and 2.5 km (1.6 mi) wide, was proposed. Engineers needed to overcome the extremely high risks of earthquakes and typhoons. Datum is 5 m.

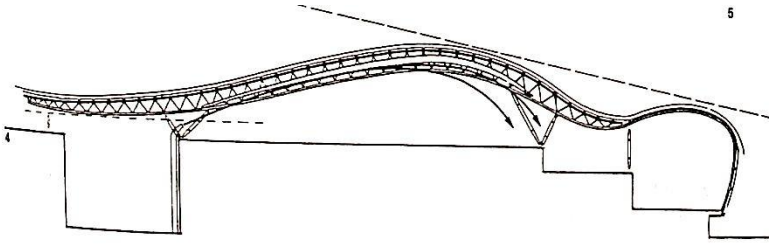
- The total cost of Kansai Airport so far is $20 billion. This includes land reclamation, two runways, terminal and facilities.
- Sink rate of the island for taking heavy load has fallen from 50cm- 7cm

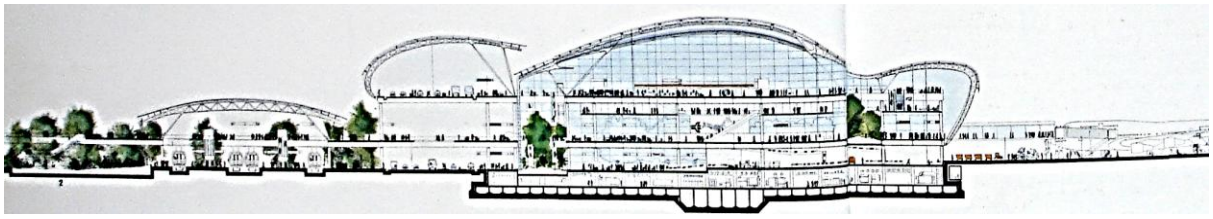
The passenger terminal is designed by **Renzo Piano** Building Workshop (Renzo Piano and Noriaki Okabe) and has a gross floor space of 296,043 square meters /3,186,580 sq ft. It is the longest airport terminal in the world, at a total length of 1.7 km (1.1 mi) from end to end.

- Multilevel nature terminal.
- The terminal is a four-storey BUILDING
- possible extension in to the sea

Geometry of terminal

- Conceptually the boarding wing was given a radius of 4-6 km inclined at 68.2 degree.
- Clad is a curving carapace of stainless steel, dark glasses
- Outer space is like a bubble blown up of the interior space.
- Curves are derive from many trial and error.
- When we see the building from the air side it seems like progeny and mother ship, because of hugeness of terminal then planes.





Series of space under a roof, geometrical solution of the building take form of a curve.

- Molded around the movements **guide the passenger.** some of the curves symbols the flow of air, provide scale and structure, the line of truss lead a person to the boarding bridge, three curves achieve extraordinary organic quality having synthesis between roof wall ceiling .

- curves are designed in away so that it does not interrupt the **visual clarity** from terminal to airside.
- Curves are also holding the structure and other servicees.

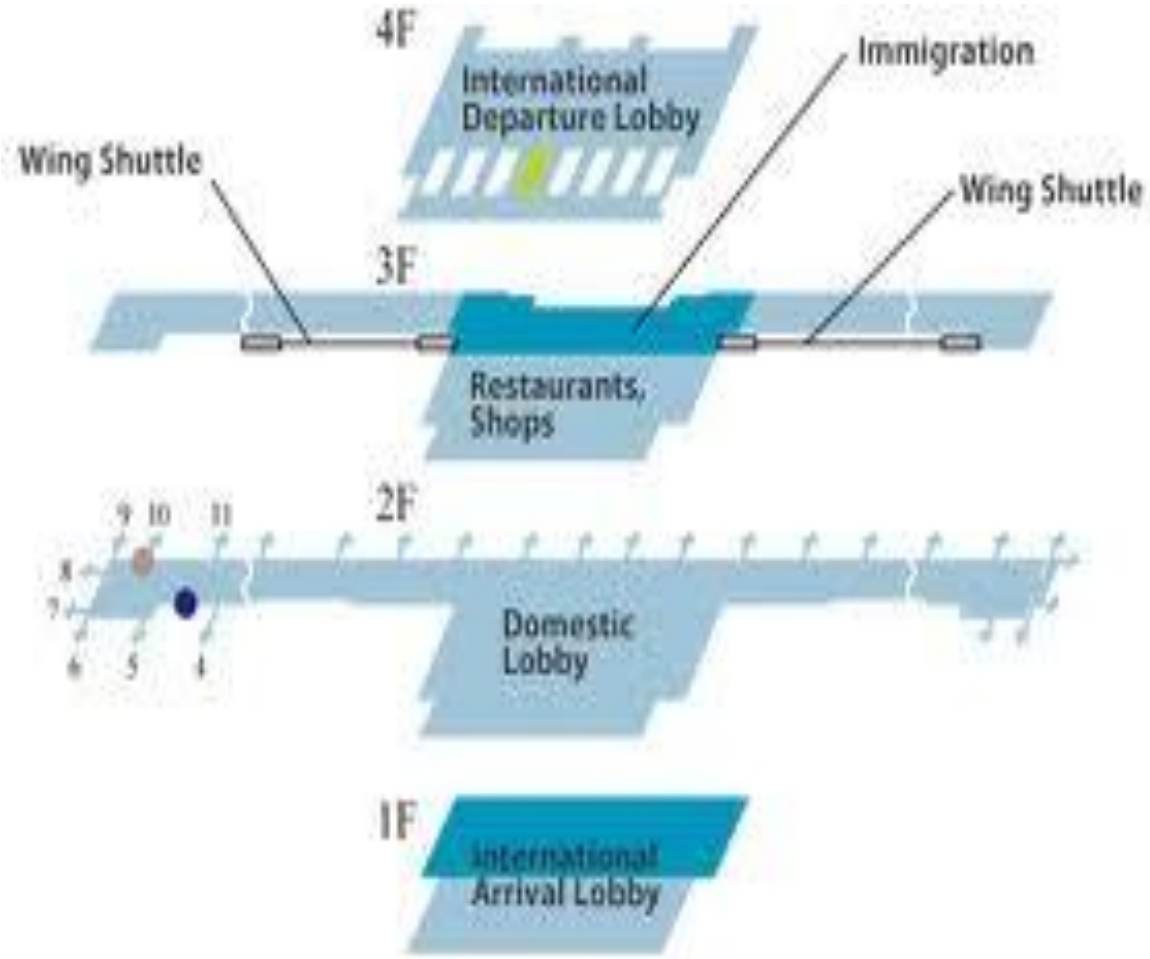
CIRCULATION

Ground floor: international arrival

1st floor : domestic arrival and departure.

2nd floor: immigration,restaurent

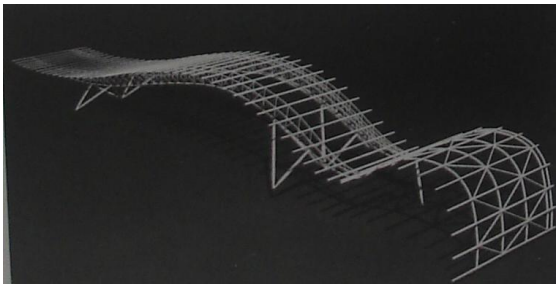
3rd floor: international departure



- all planes connected with boarding wings in first floor,
- land side is connected with three levels Drop off and passenger entry in the top floor outside the international departure,
- ground floor having canyon and international arrival, most of the arrived passenger take the train using the existing station via foot bridge.
- Arrival passenger of domestic passenger check in ,baggage taking in first floor and international passenger use the top floor

Structural analysis

- Building made quickly- joint work shop peter rice and Tom Berker, Rengo Peano, relatively cheaply in a island.
- **Cantilever** end of main trusses and over hanging roofs were upon the departure and shortened at **4 meter long.**
- Also the flanged box section over the main truss was replaced **by I sections and extra cross beam** hidden carefully by the suspended roof.
- There are asymmetrical curves 4m at their deepest. **Span 82.4 m between** supports,
- 6m cantilever at the land side, external vertical columns, and the structure can be named as melting as their principle members are fused together.
- Exception is the boarding wing which is a slender curve that tie the ribs that act as the diaphragms of a lattice shell structure
- The steel of boarding wings were fabricated in Britain and shipped to japan

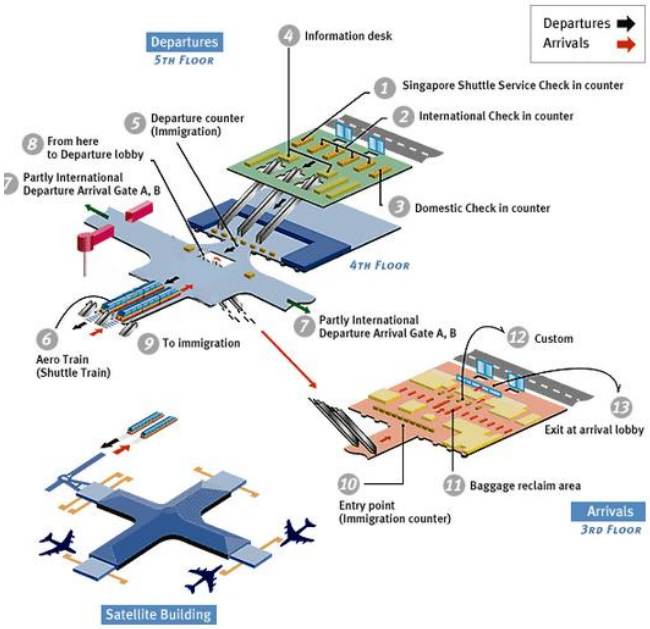


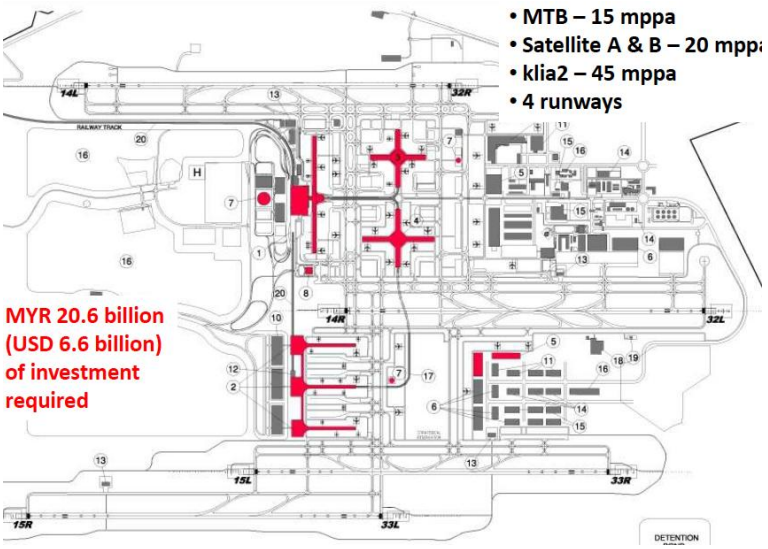
4.3 KUALALAMPUR INTERNATIONAL AIRPORT (KLIA)

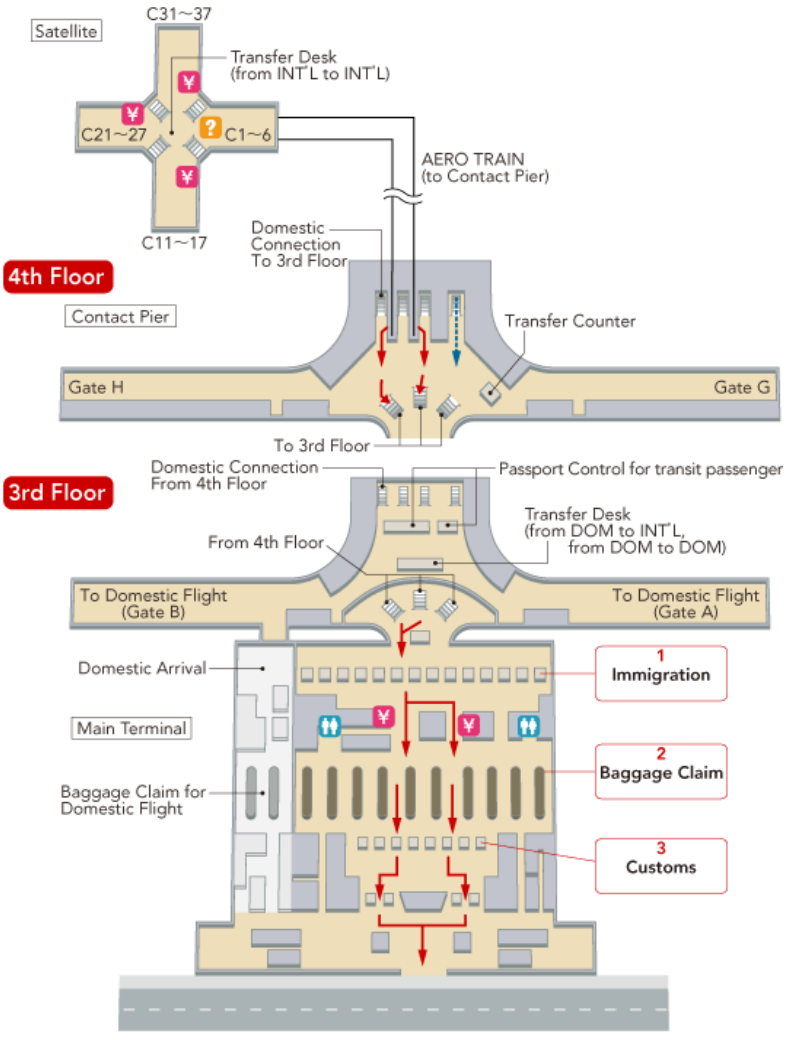
Kuala Lumpur International Airport is one of the major airports of South East Asia. It is located approximately 45 kilometres (28 mi) from city centre. The airport has the capacity to handle 70 million passengers and 1.2 million tonnes of cargo a year. It was ranked the 11th busiest airport in the world.

KLIA opened in 1998. Designed by Japanese architect Kisho Kurokawa in partnership with a local firm, KLIA's style is so weirdly eclectic that it couldn't be mistaken for any other airport in the world. In the international departures hall, a series of Islamic-style domes—hyperbolic paraboloids —are held aloft by strange, chubby columns that taper toward the top. Even the long transfer hallways, with wooden ceilings pierced with tiny spotlights, possess unmistakable character.

Circulations







People Mover System or the Aerotrain

The KLIA main terminal building (MTB) and its **satellite building are well connected by an automated people mover called Aerotrain**. **Each 250-person capacity train can transport 3,000 passengers per hour** in each direction at up to 56 km/h (35 mph). These three-car **driverless trains run every five minutes on elevated rail and under the taxiways.** The **journey takes under two minutes.**

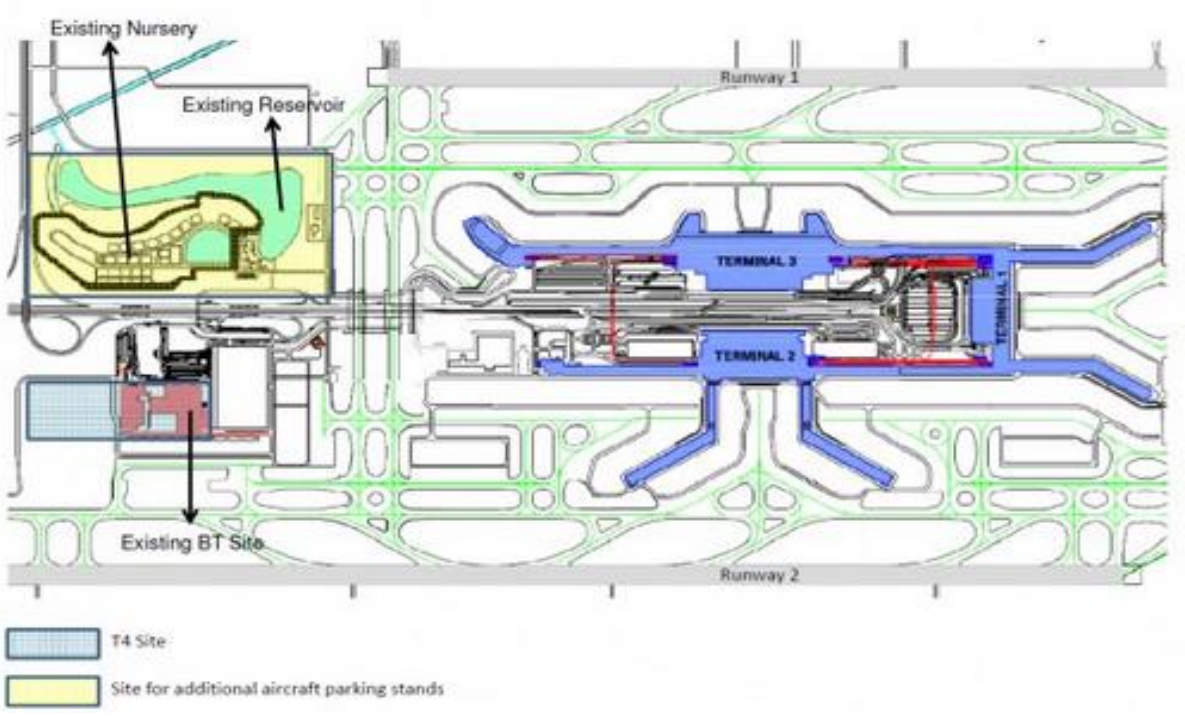


4.4 CHANGI INTERNATIONAL AIRPORT

- It is the **fifth busiest airport in the world** And the **second busiest in Asia**
- A major **aviation hub in Southeast Asia**
- Changi Airport has **three passenger terminals** with a total annual **handling capacity of 66 million passengers**
- **handling 1.85 million tonnes of cargo**
- The airport **has won over 430 awards since1981**
- **Interior spaces were prioritized more to ensure quality spaces rather than the outer look of the airport**

People Mover System or the Sky Train connection T1,T2 and T3

Inter-terminal transportation

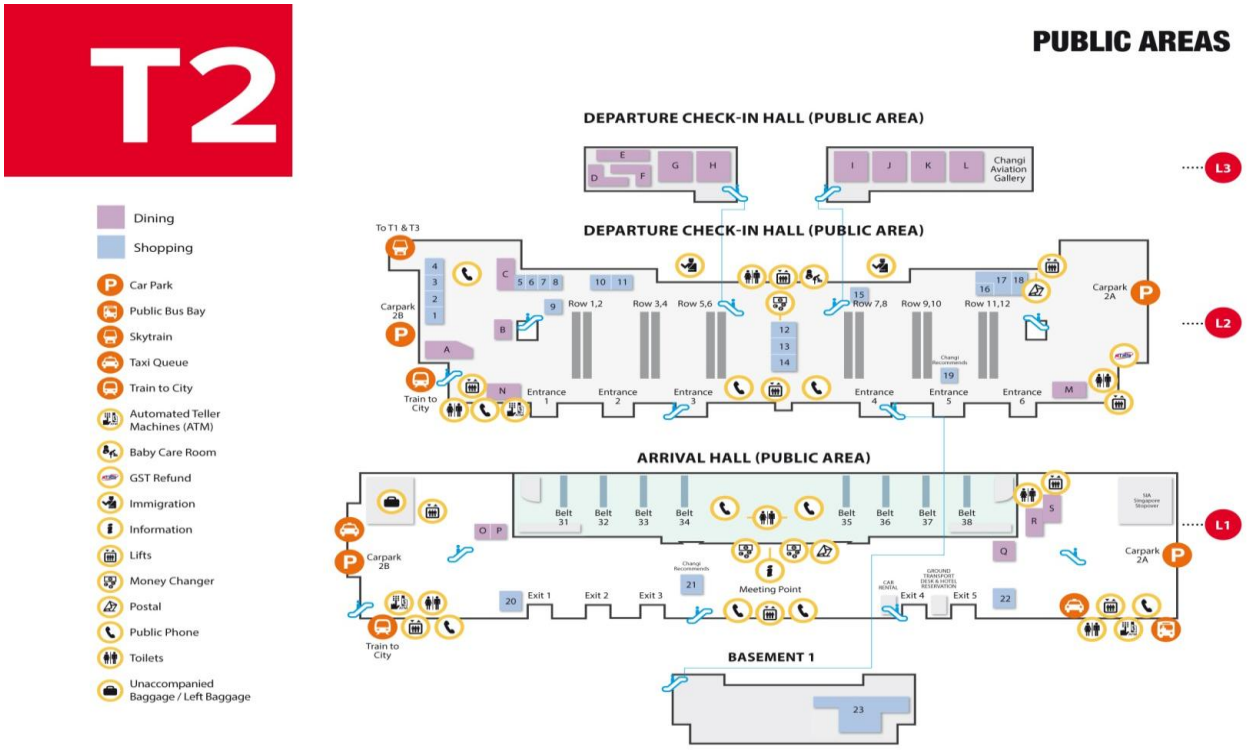


Terminal 2

Terminal 2 opened on 22 November 1990 as part of **Phase II in the original airport master plan.** it is located adjacent to Terminal 1 towards the south, and heralded the opening of the original skytrain system **linking the two terminals via the landside**.

The fourth storey of the terminal houses the Civil Aviation Authority Singapore and some other important

The lighting inside guides the passenger to the gates and lounges.

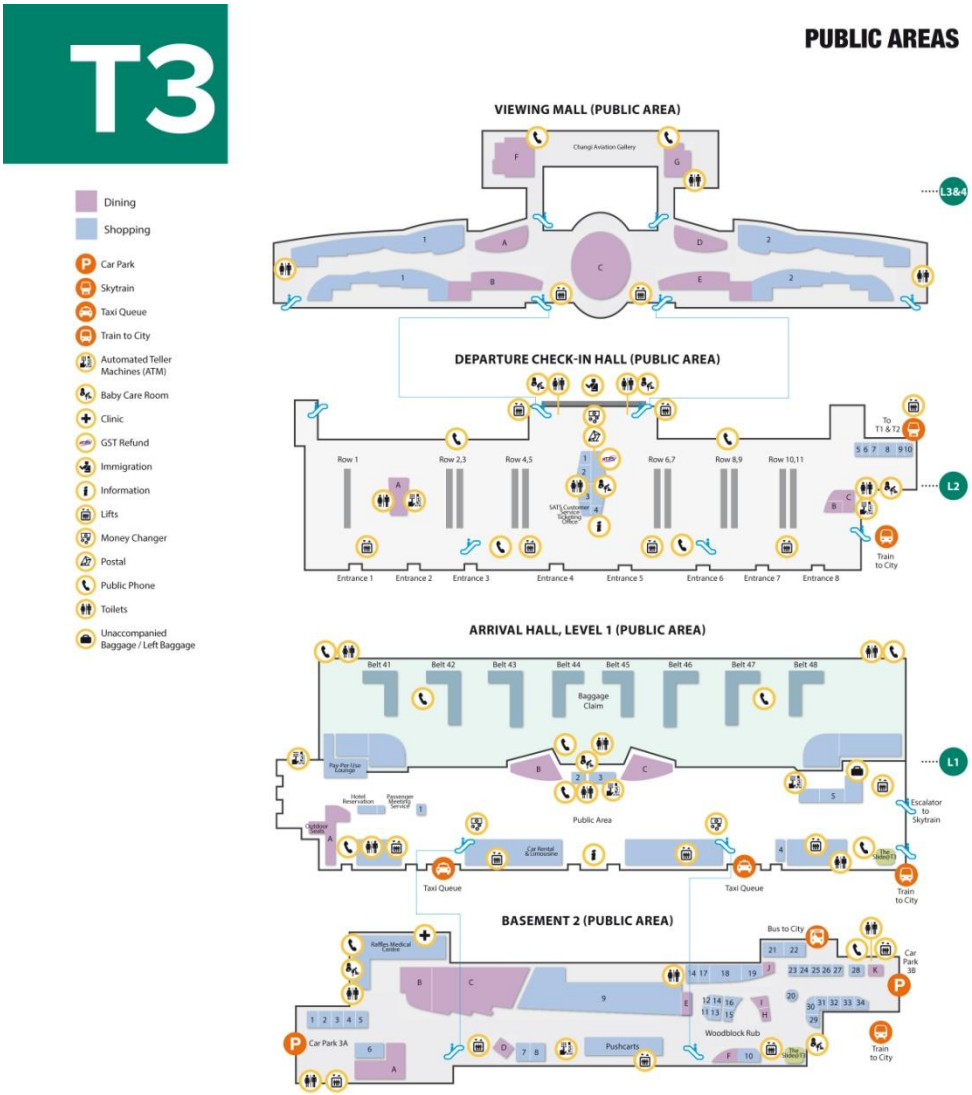


Terminal 3

One of the terminal's **most spectacular features is an overhead light modulation system** that consists of glass skylights and **thousands of aluminium louvers**.

During the day**, the sensor-driven louvers limit the amount of direct sunlight** entering the space by filling it with diffused light. At night, artificial light reflects off the louvers to provide a uniform pattern of illumination.

This **sophisticated technology helps minimize lighting and cooling costs** while also adding aesthetic appeal -


T3
PUBLIC AREAS
Dining
Shopping
Car Park
Skytrain
Taxi Queue
Train to City
Automated Teller Machines (ATM)
Baby Care Room
Clinic
GST Refund
Immigration
Information
Lifts
Money Changer
Postal
Public Phone
Toilets
Unaccompanied Baggage / Left Baggage
VIEWING MALL (PUBLIC AREA)
Changi Aviation Gallery
L3&4
DEPARTURE CHECK-IN HALL (PUBLIC AREA)
Row 1
Row 2,3
Row 4,5
Row 6,7
Row 8,9
Row 10,11
To T1 & T2
L2
Train to City
Entrance 1
Entrance 2
Entrance 3
Entrance 4
Entrance 5
Entrance 6
Entrance 7
Entrance 8
ARRIVAL HALL, LEVEL 1 (PUBLIC AREA)
Belt 41
Belt 42
Belt 43
Belt 44
Belt 45
Belt 46
Belt 47
Belt 48
Baggage Claim
L1
Public Area
Escalator to Skytrain
Taxi Queue
Taxi Queue
Train to City
BASEMENT 2 (PUBLIC AREA)
Bus to City
Car Park 3B
Car Park 3A
Pushcarts
Woodblock Rub
Train to City


ARRIVAL

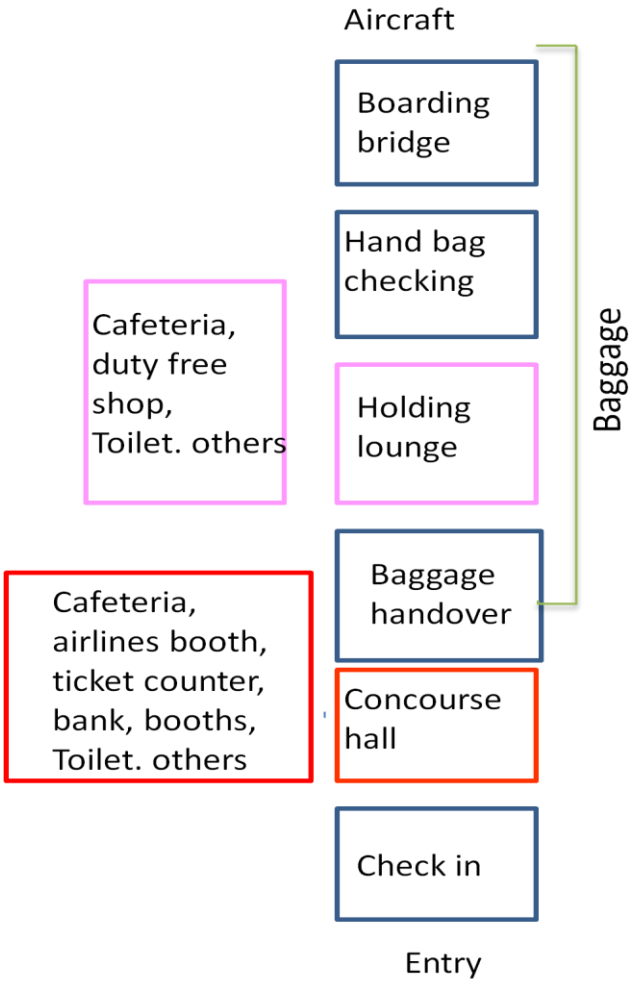
4.5 HAZRAT SHAH JALAL INTERNATIONAL AIRPORT

International Departure

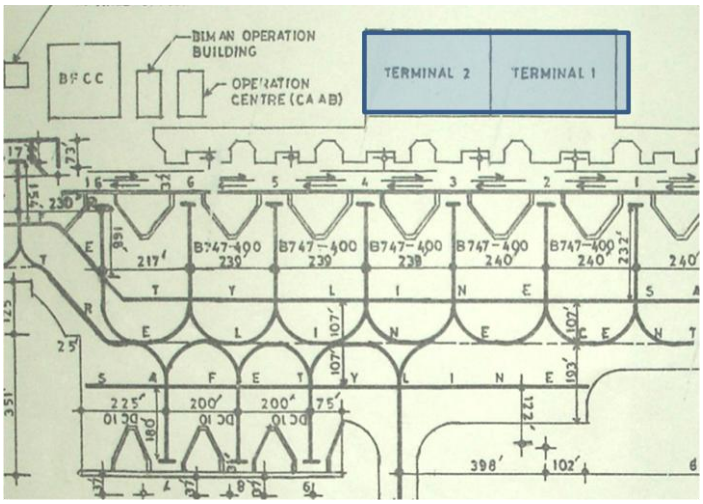
Located in the 1st floor. There is no provision for visitors. As a result, visitors stay outside creating a lot of problems, hampering the vehicular circulation, passengers' circulation and all other outside activities.

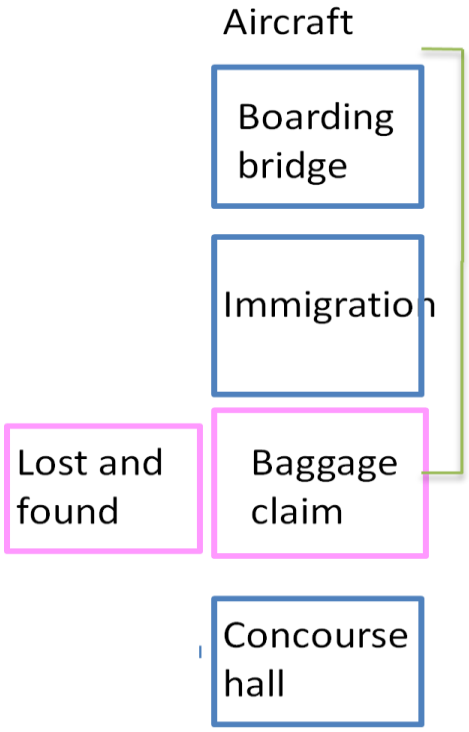
Departure lounge contains-

- Shops
- Restaurants
- Banks
- Snack bars
- Newspaper stands
- Telephone kiosks
- Post- office
- Air-lines offices
- Toilets



International Arrival





Runway

A feasibility study is underway to decide about adding a parallel, second runway by 2014. The project has been taken to cope with the rising air traffic, and take pressure off the lone runway, to double the capacity of the airport. CAAB predicts that the airport's traffic will surpass 10 million passengers and freight. Currently, the airport can handle 10 flights an hour, 1 per 6 minutes. However, 60% of the airport's 2000 acre land remains unutilized.

Runways			
Direction	Length		Surface
	m	ft	
14/32	3,200	10,500	Concrete / Asphalt

Aprons

HSIA has basically 3 aprons-

- # General apron in front of the terminal building, which contains five B-747 aircraft, this is adjacent to domestic apron which contains three ATP/F – 28 air-crafts.
- # Cargo apron in one side of the general apron or international apron. It contains maximum two DC-10
- VVIP apron on other side of the general apron contains ATP aircraft.

Airlines in HSIA

Airlines	Destinations
Air Arabia	Sharjah
Air India	Delhi, Kolkata
Bangkok Airways	Bangkok-Suvarnabhumi
Biman Bangladesh Airlines	Abu Dhabi, Bangkok-Suvarnabhumi, Chittagong, Dammam, Delhi, Doha, Dubai, Hong Kong, Jeddah, Kathmandu, Kolkata, Kuala Lumpur, Kuwait, London-Heathrow, Muscat, Riyadh, Rome-Fiumicino, Singapore, Sylhet
China Eastern Airlines	Kunming
China Southern Airlines	Guangzhou
Dragonair	Hong Kong
Druk Air	Paro, Kolkata, Bangkok-Suvarnabhumi
Emirates	Dubai
Etihad	Abu Dhabi
Flydubai	Dubai
Jet Airways	Delhi, Kolkata, Mumbai
Kuwait Airways	Kuwait
Malaysia Airlines	Kuala Lumpur
Maldivian	Chennai, Malé
Mihin Lanka	Colombo
NovoAir	Chittagong, Cox's Bazar, Jessore, Sylhet
Pakistan International Airlines	Karachi
Qatar Airways	Doha
RAK Airways	Ras Al Khaimah
Regent Airways	Chittagong, Cox's Bazar, Jessore, Kuala Lumpur , Sylhet
Saudia	Dammam, Jeddah, Medina, Riyadh
Singapore Airlines	Singapore
Thai Airways International	Bangkok-Suvarnabhumi
Tiger Airways	Singapore
Turkish Airlines	Istanbul-Atatürk
United Airways	Bangkok-Suvarnabhumi, Barisal, Chittagong, Cox's Bazar, Dubai, Jeddah, Jessore, Kathmandu, Kolkata, Kuala Lumpur, Muscat, Rajshahi, Saidpur, Sylhet

CHAPTER 5: Programme and Development

International Departure Lounge

Public Lounge Total area 2,75,606 sq feet

Facilities included are

- Shopping and Dine area 1,92,890 sq feet
- Aircraft Exhibition Area 81,717 sq feet

Luggage Check in Lounge Total Area 3,86,226 sq feet

Check in counter number in total **120**

Each counter takes 200 sq feet with the queuing area

Total working area for luggage check in 24,000 sq feet

Facilities available are

- Sitting Capacity for 2000 people
- Shopping
- Restaurants and other eating facilities
- Travel taxes
- Money exchange
- Post office, Telephone booth
- Internet access point
- Drug store, Flower shop, Gift shop
- Toilets etc.

Immigration total area 1,48000 sq feet

Total immigration desk number 140

Facilities included are

- Sittings for 100 peoples
- Wash room facilities
- Visa investigation offices

- Passport control offices
- Medical check up offices
- Customs office, security etc

Common lounge area for both departing and arriving passengers

Total Gate lounges 120

Each gate lounge covers 10,000 sq feet area

So total area for gate lounges 12, 00,000 sq feet

Total area with circulation around gate lounges 26, 78, 548 sq feet

This area includes

- Café/ bar
- Shopping area
- Wash rooms
- Prayer room
- Electric walker
- Internet access points etc

Total area for Lounges with shopping and dining 20, 00, 00 sq feet

This area includes

- Passenger waiting lobby
- Duty free shops
- Bars/ cafeteria
- Waiting area
- Prayer room
- Cinema hall
- Hall room
- Cyber lounge
- Gymnasium
- Indoor game lounge
- Cyber game lounge

Luggage Check out Lounge Total Area 3, 86,226 sq feet

Conveyor Belt 50

Facilities available are

- Sitting Capacity for 2000 people
- Shopping
- Restaurants and other eating facilities
- Money exchange
- Communication booth (Telephone booth, internet etc)

International Arrival Lounge

Public Lounge Total area 2,75,606 sq feet

Facilities included are

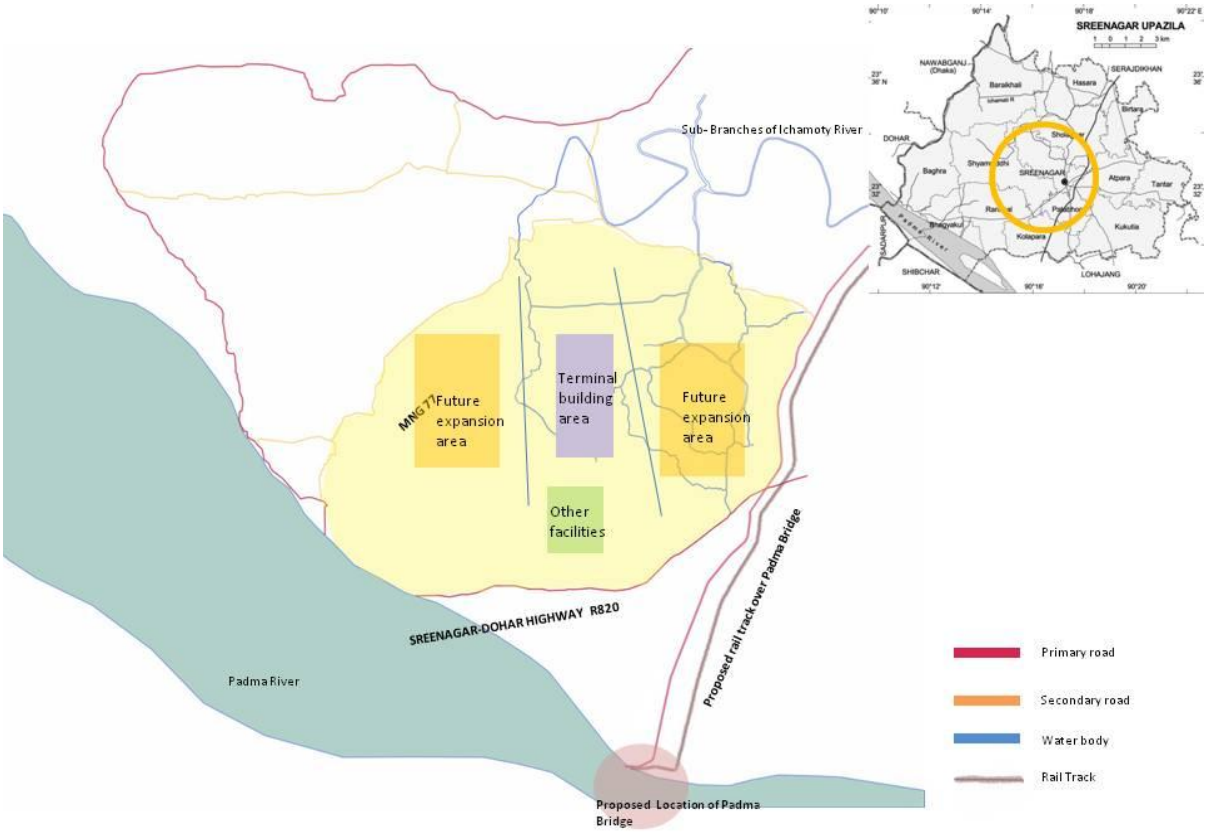
- Shopping and Dine area 1,92,890 sq feet
- Aircraft Exhibition Area 81,717 sq feet
-

Grand Total Area 43,52,212 sq feet

CHAPTER 6: Conceptual Analysis and Design Development

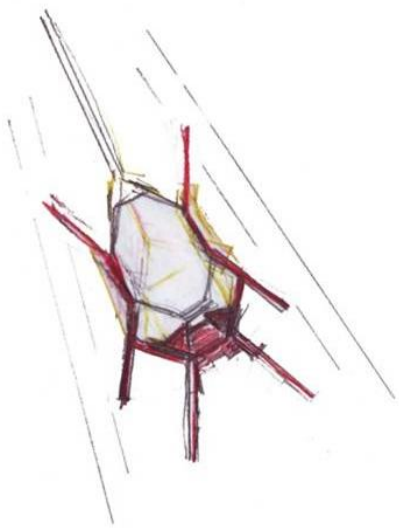
6.1 Initial Planning Concept

This was my initial planning, the runways were placed after studying the wind direction and air funnel area calculation. The basic layout of the airport was decided. The terminal is placed in between the two runways so that the maximum use of the terminal building can be ensured. Plus this will also help to reduce the time required for taxing in and taxing out.

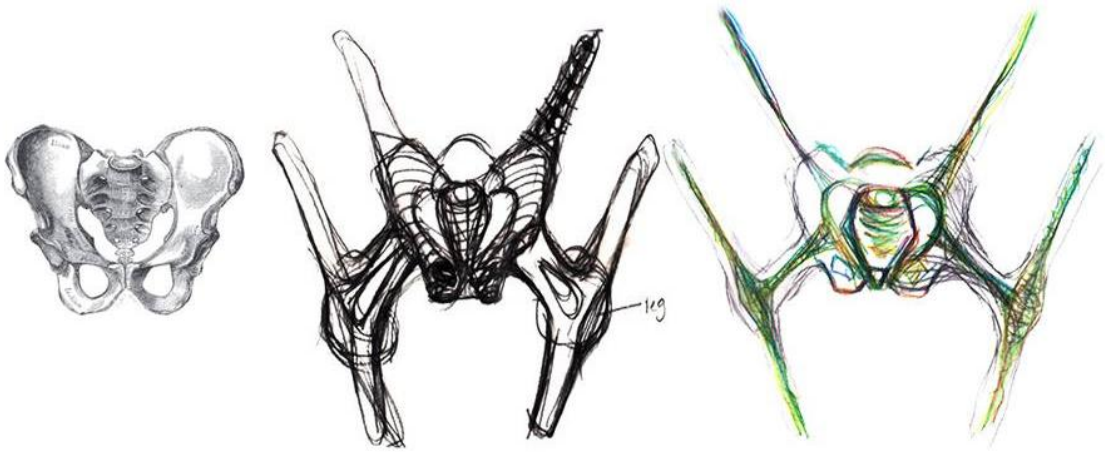


The runways are kept almost in the middle of the whole site so that the runways can get the maximum safety area and air funnel area. The future extension is possible on the other two sides of the runway. If needed parallel runway can also be placed.

6.2 The initial conceptual sketches of the terminal

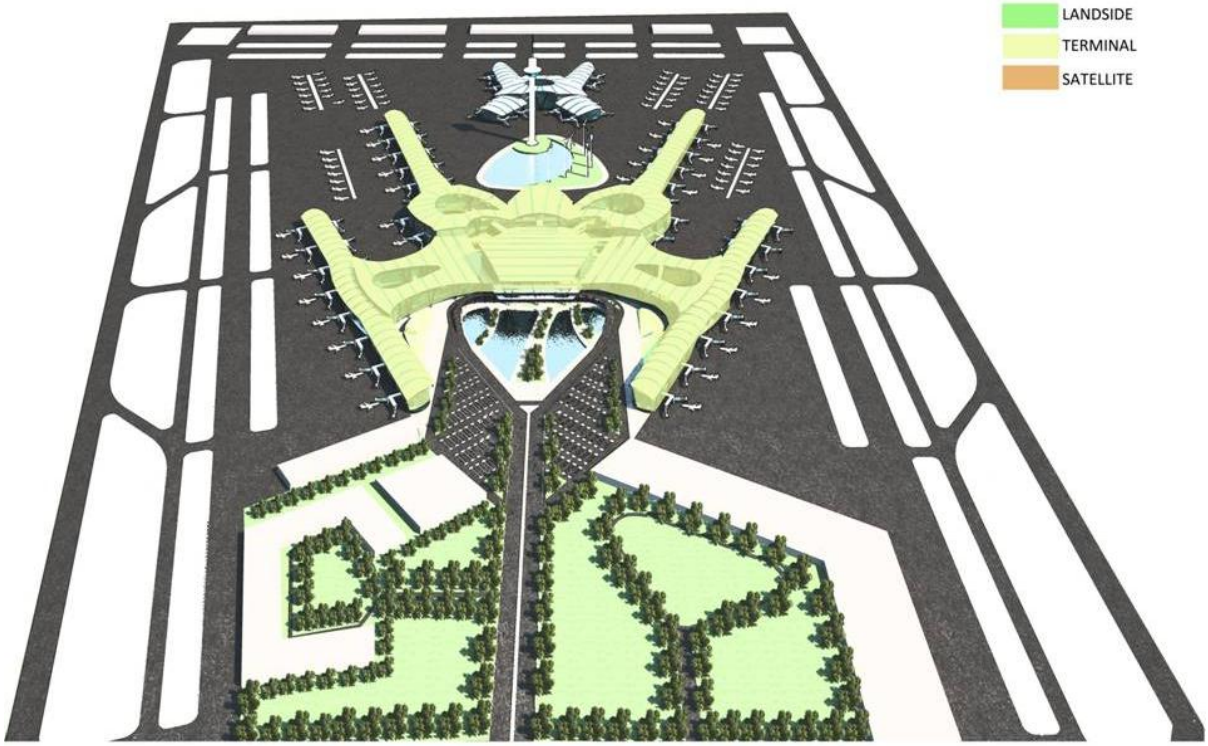


6.3 Pelvic bone as design inspiration



Due to the functional requirement 4 linear elements came up connecting to the terminal building. It resembled like pelvic bone, which connects the backbone and the leg bones of our body.

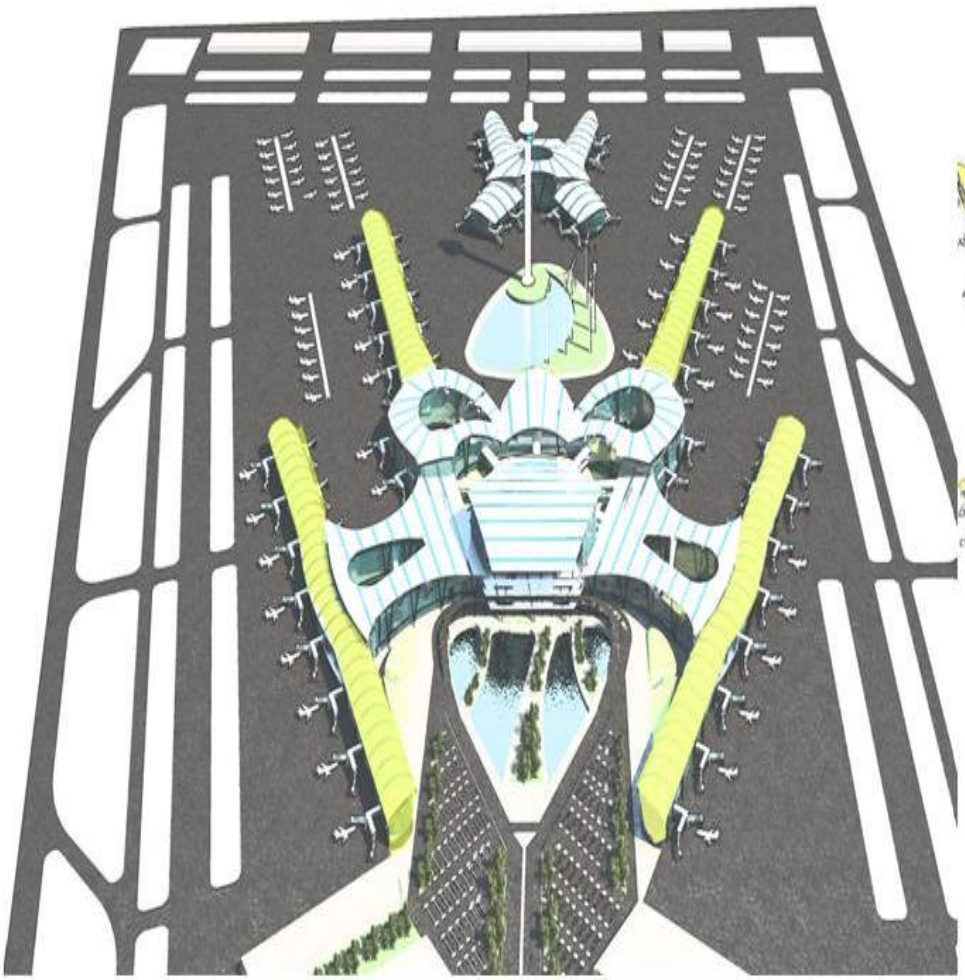
6.4 Basic Zoning Layout of the airport

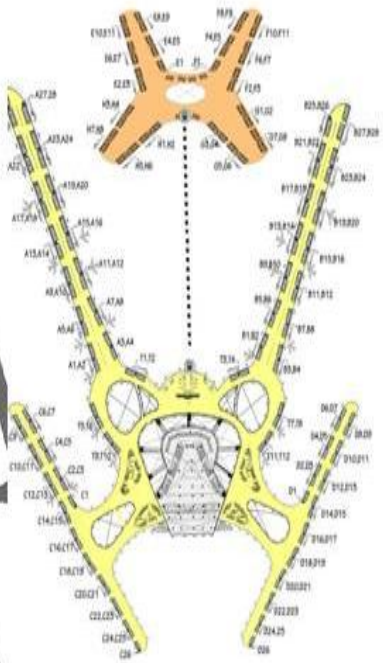


6.5 Finger Piers

I followed finger pier principal in designing the terminal building. It is economical to build, efficient in terms of use of land, possible to centralize resources.

Enough scope for future growth, easy in surveillance, easy in luggage handling, possible to maintain high security and provide high quality amenities and services.



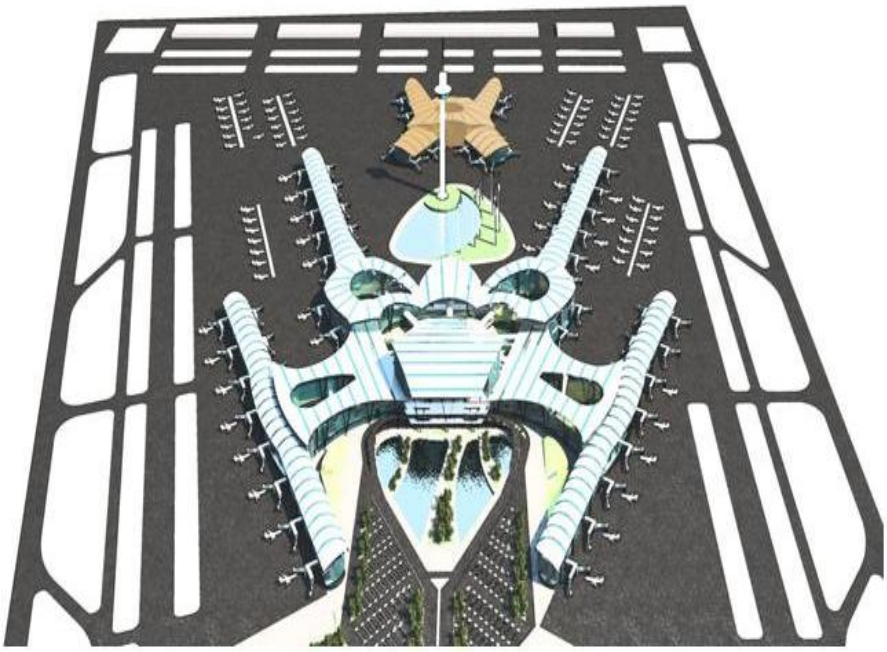


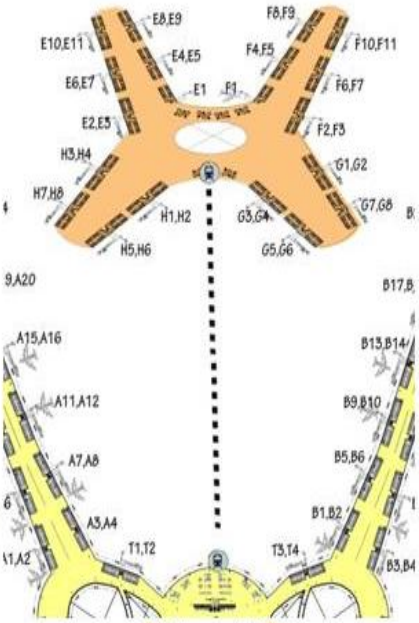
6.6 Satellite Terminal

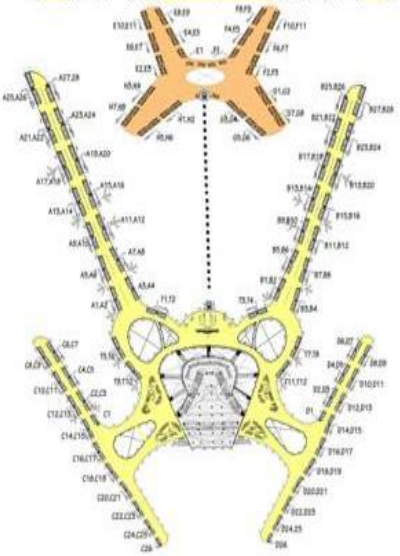
Satellite terminal building principal was also added. I am calling it Hajj Terminal because o its special use during Hajj. It will open opportunities for new aircrafts of any size and shape to board passengers and will ensure easy taxiing in and taxiing out.

Special jumbo aircraft and the future coming more developed aircraft can get special facilities in this satellite terminal.

There is a people mover system specially designed to reach this terminal. It will take 2 min to reach from the main terminal to the satellite terminal building. To give a clear idea the picture of people mover system of Kualalampur International Airport is shown below.





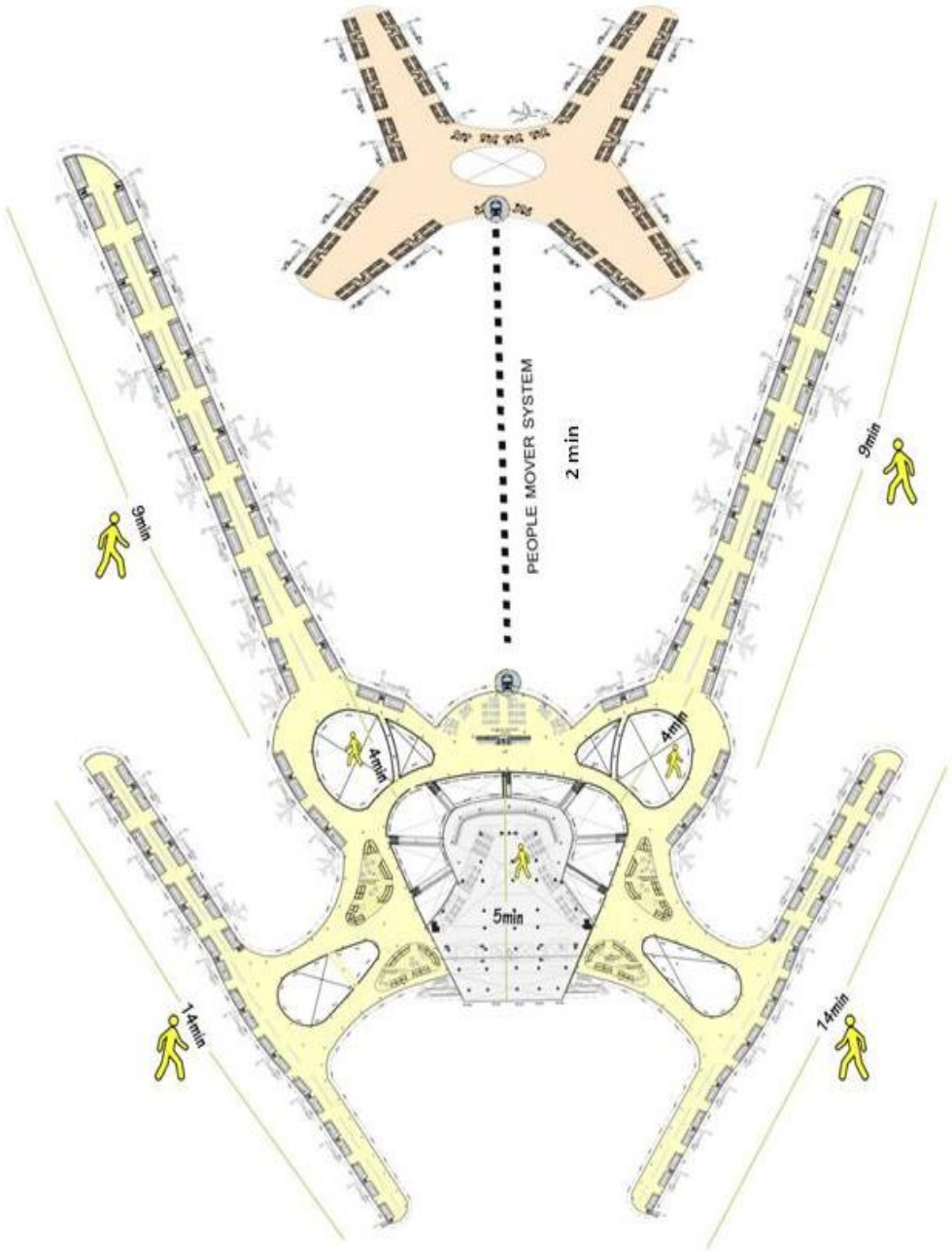


6.7 Walking Distance

The piers length of the main terminal building is based on walking distance.

The walking distance measure denotes the distance that can be travelled by walking in a fixed amount of time. The standard measure for walking distance is

80 meters = one minute walking time.



6.8 Easy Orientation

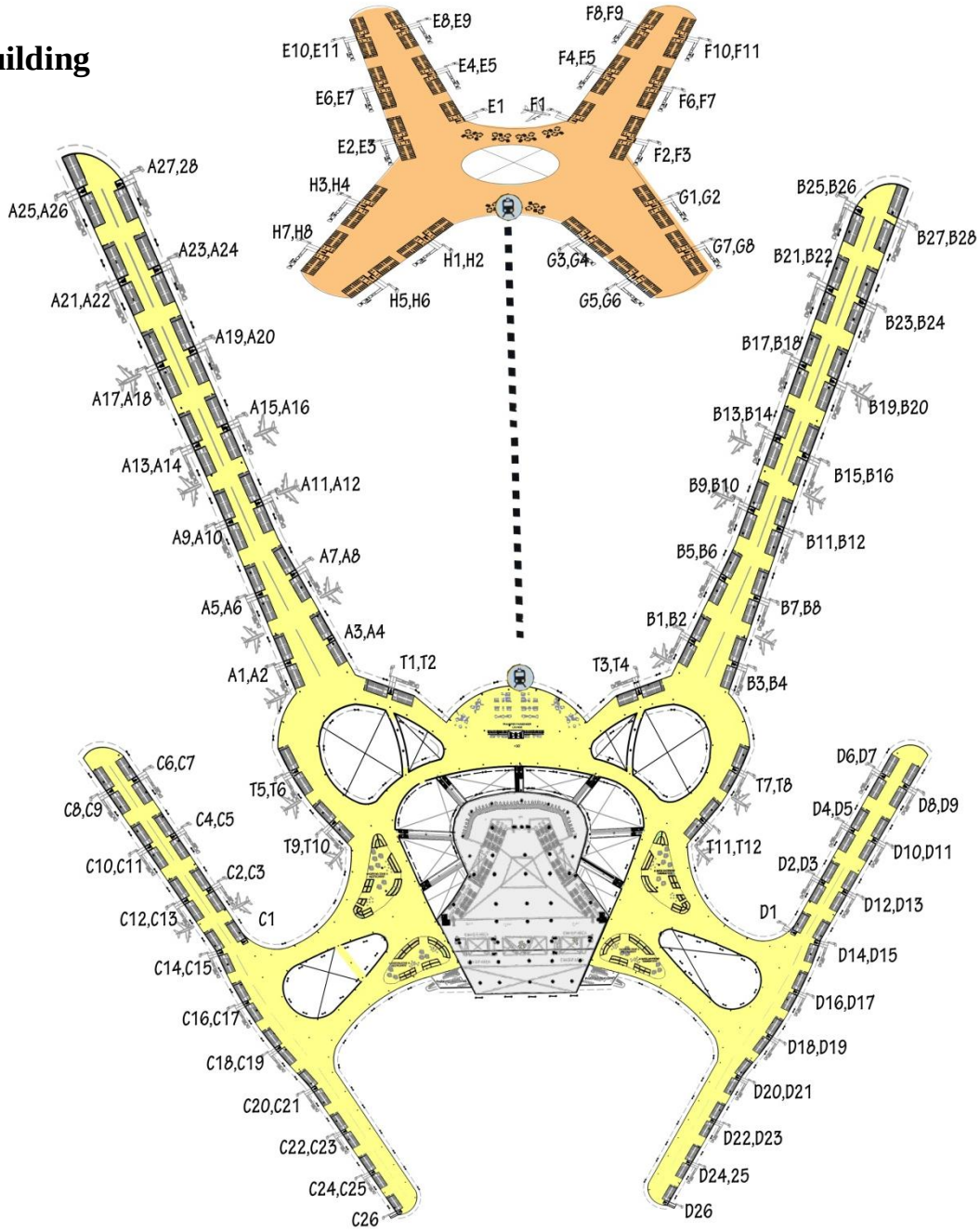
- Naming Finger Piers
- Ease of way finding

Main Terminal Building

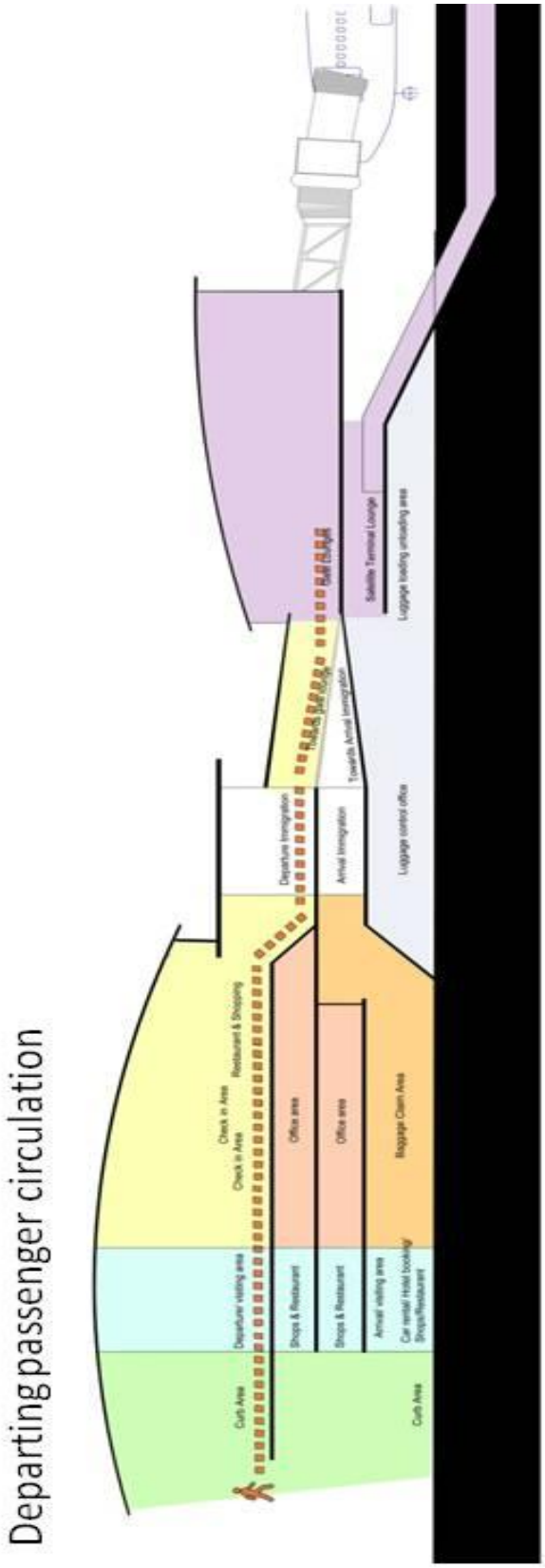
- **Pier A**
- **Pier B**
- **Pier C**
- **Pier D**

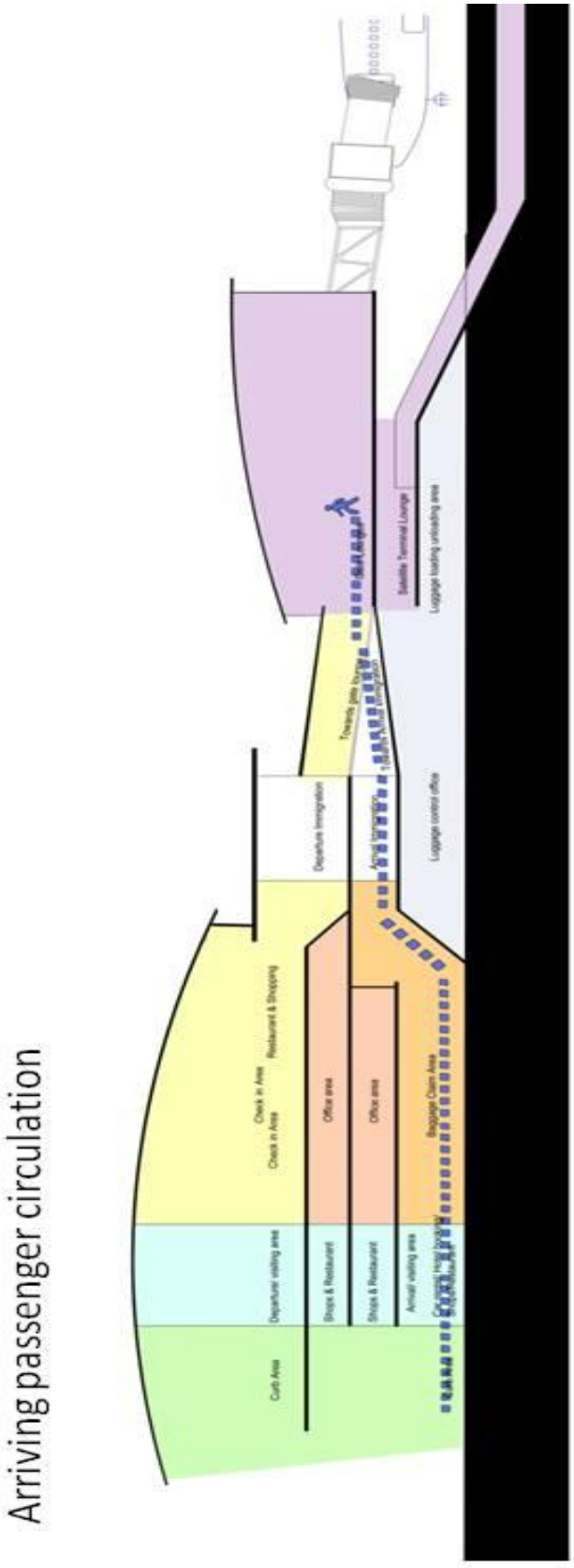
Satellite Terminal

- **Pier E**
- **Pier F**
- **Pier G**
- **Pier H**

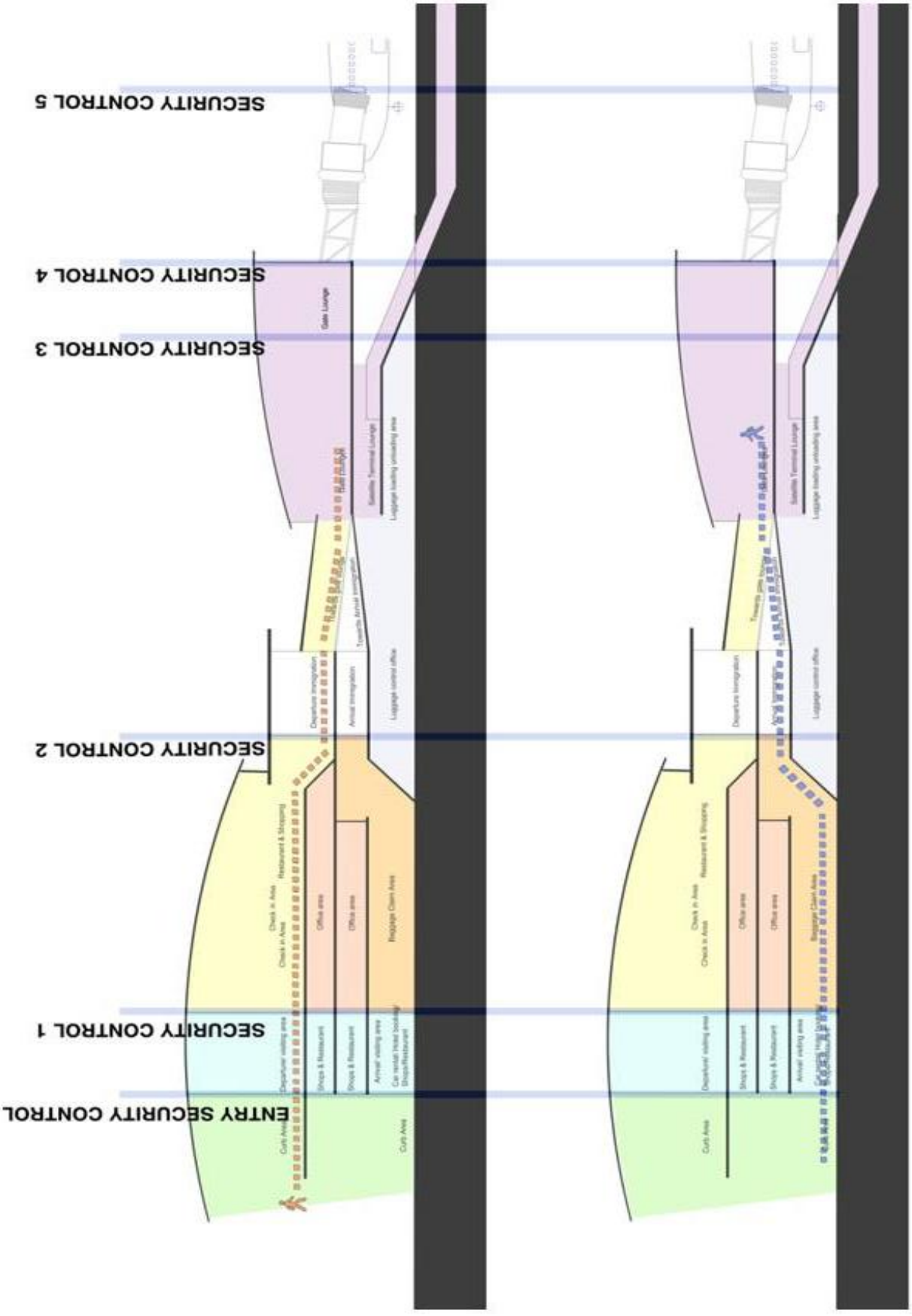


6.9 Passenger Circulation Diagram

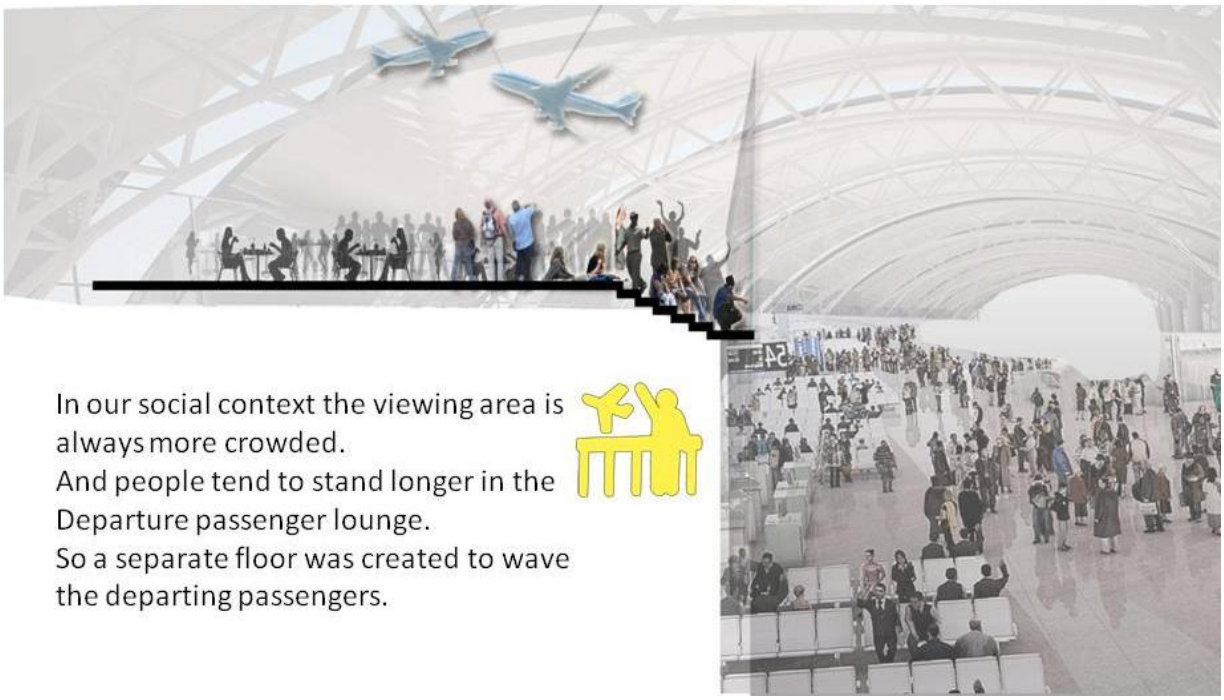




6.10 Six Layers of Security Screening Diagram



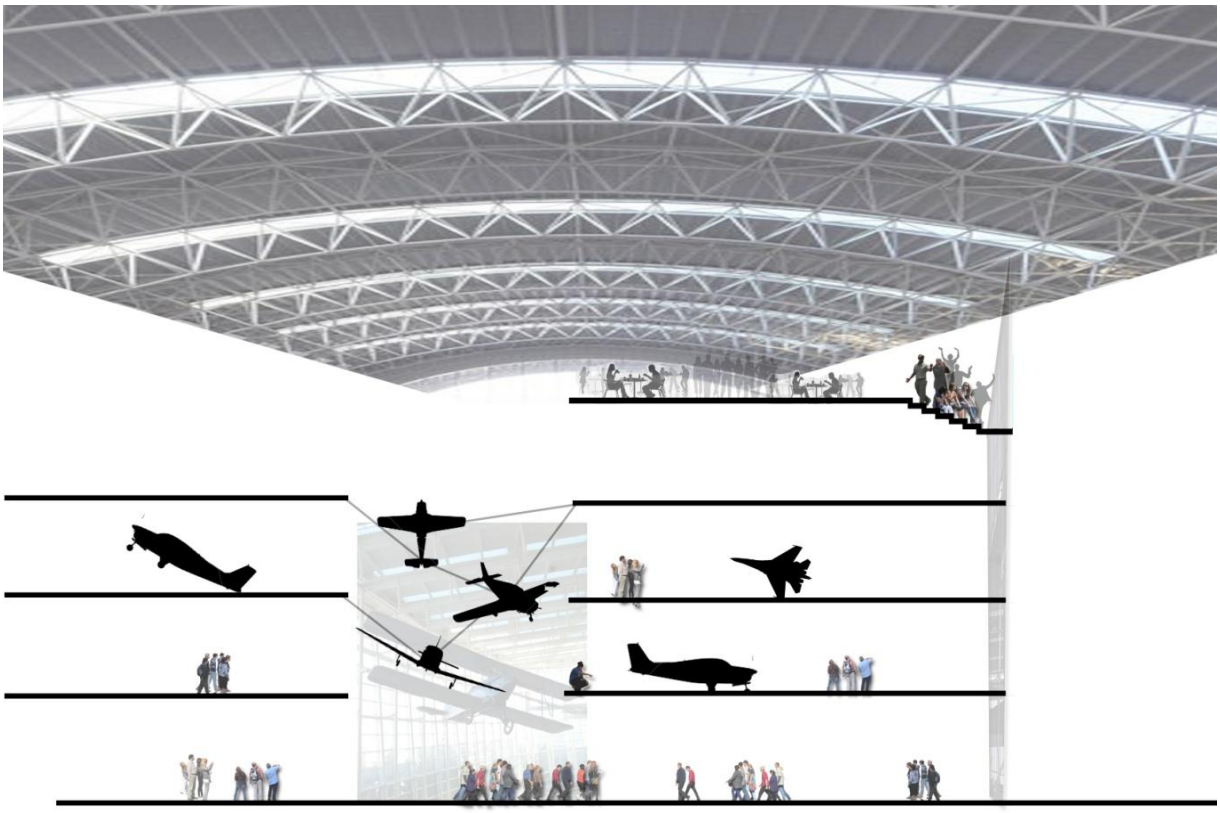
6.10 Viewing Area to the Departure Lounge



In our social context the viewing area is always more crowded.
And people tend to stand longer in the Departure passenger lounge.
So a separate floor was created to wave the departing passengers.

6.11 Aircraft Exhibition Area

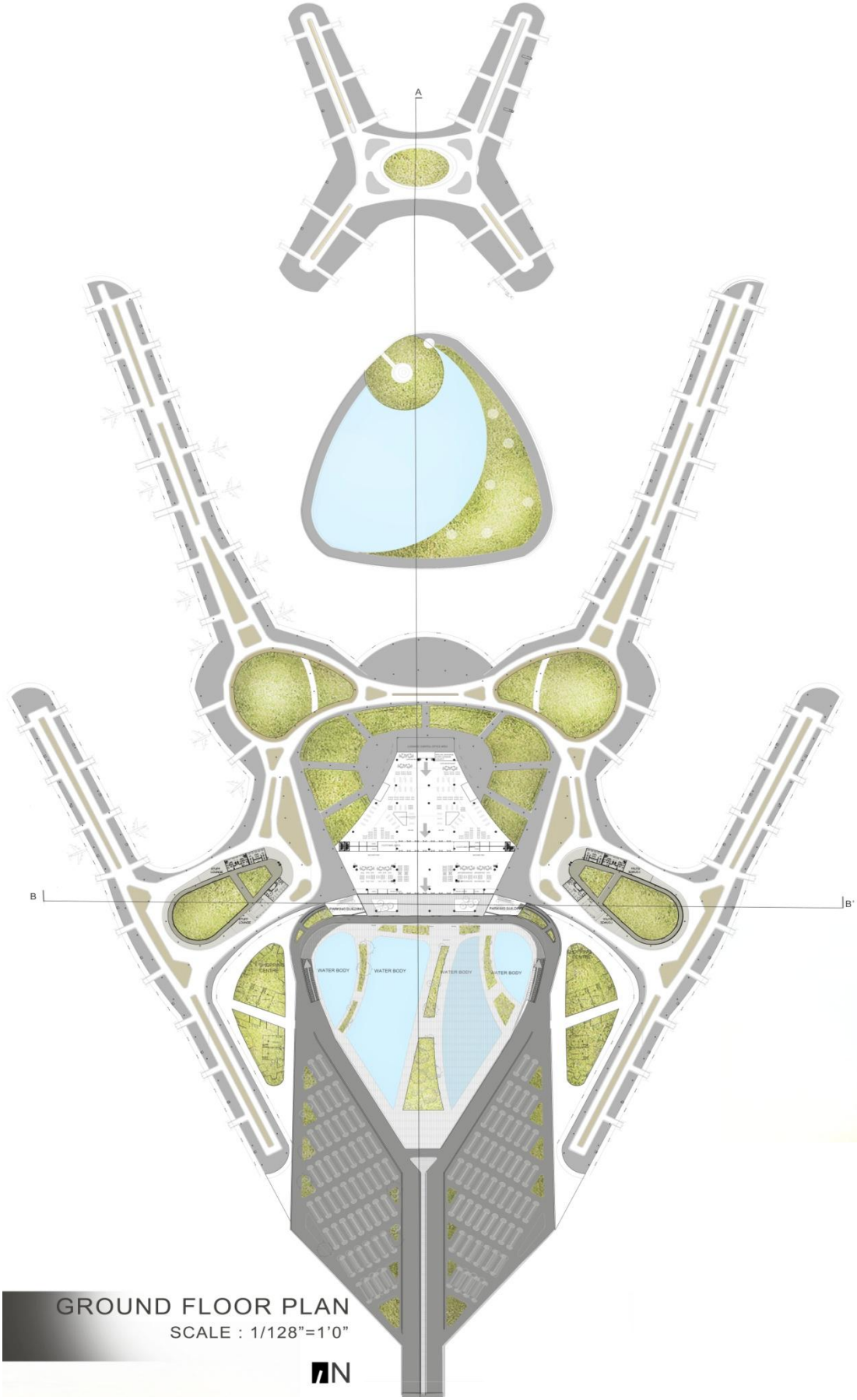
Sectional diagram of aircraft exhibition area

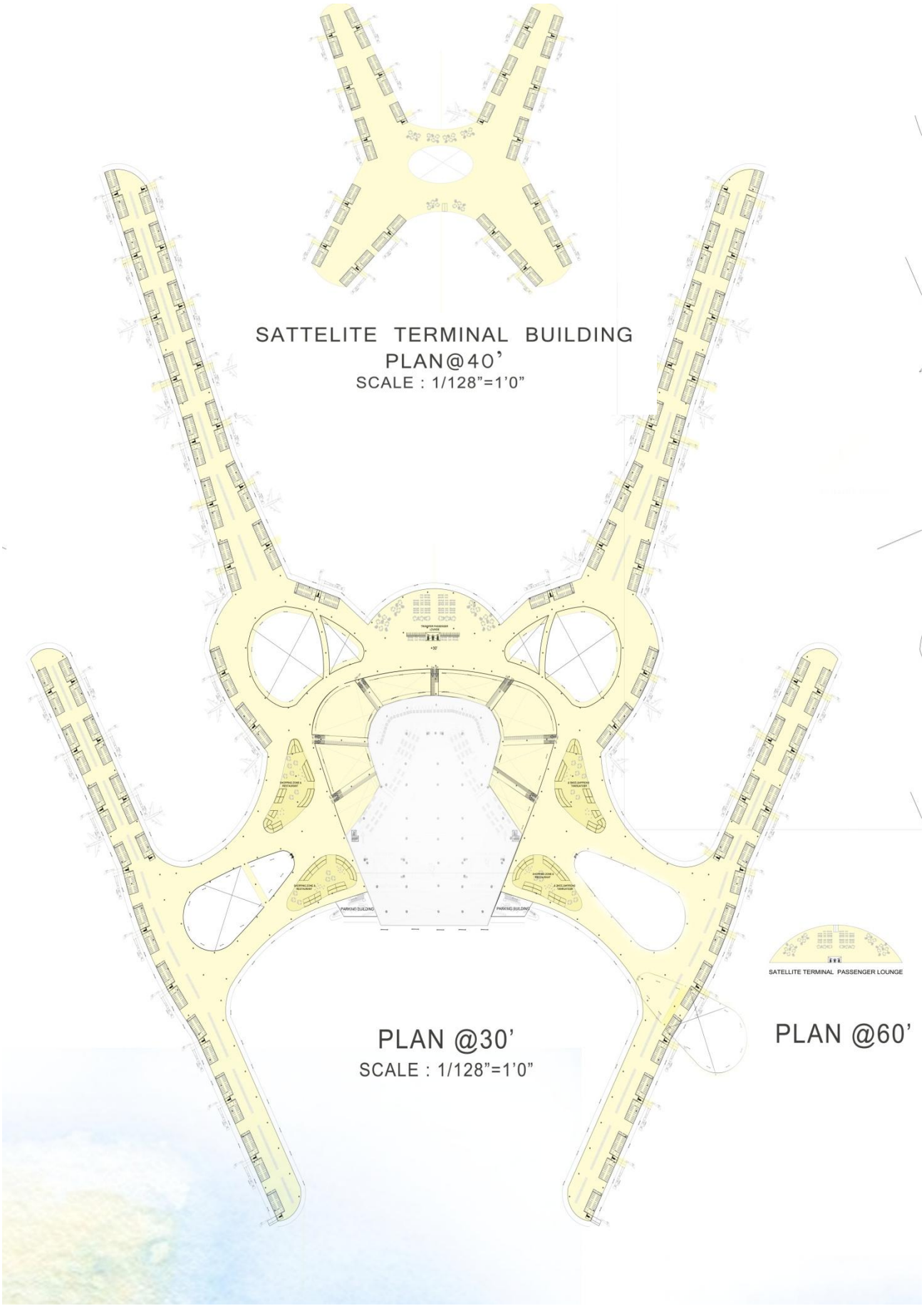


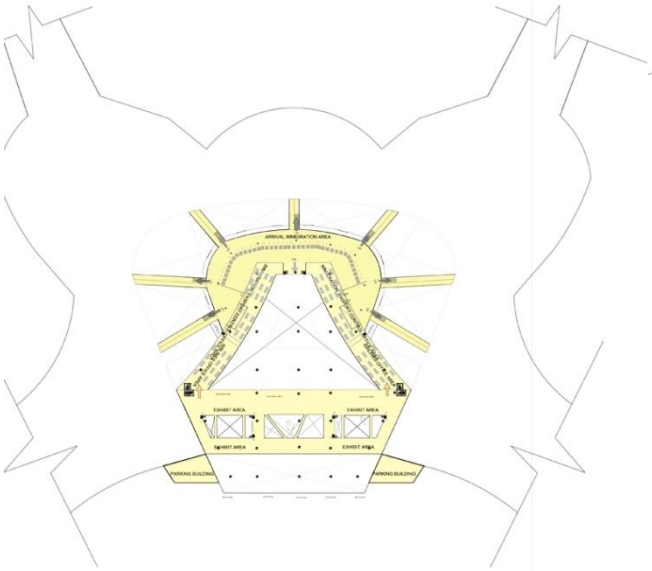
Aircraft Exhibition Area

Airport Image

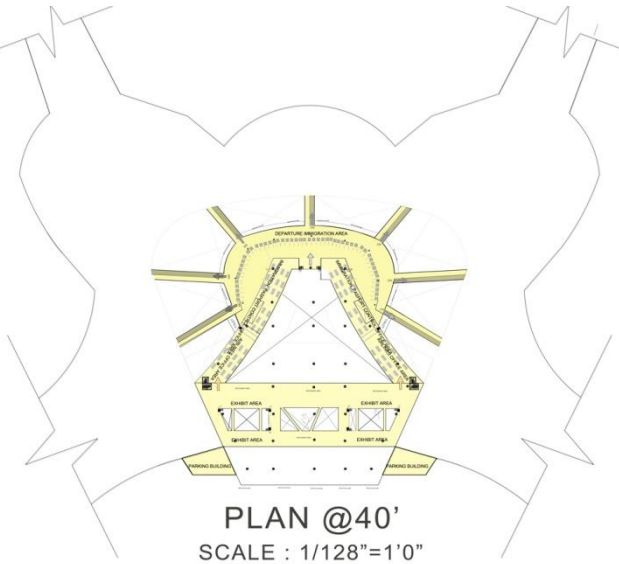
6.12 Floor Plans




SATTELITE TERMINAL BUILDING
PLAN@40'
SCALE : 1/128"=1'0"
PARKING BUILDING
PARKING BUILDING
SATELLITE TERMINAL PASSENGER LOUNGE
PLAN @30'
SCALE : 1/128"=1'0"
PLAN @60'



PLAN @20”
SCALE : 1/128”=1’0”



PLAN @40’
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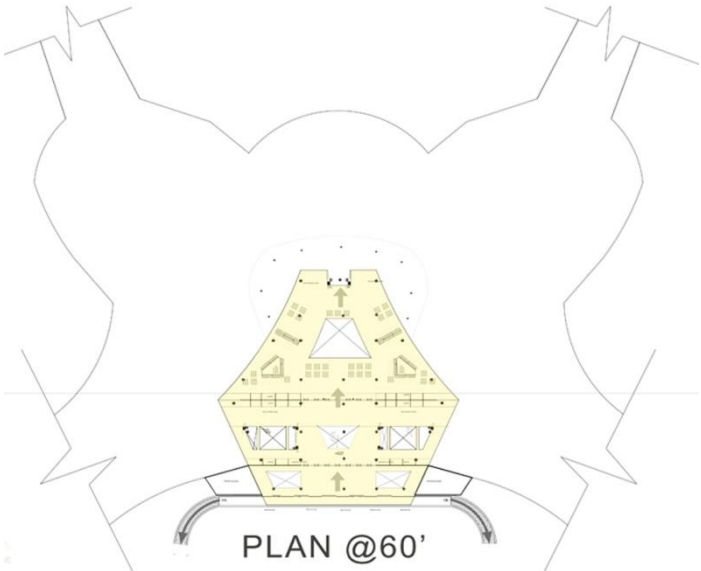
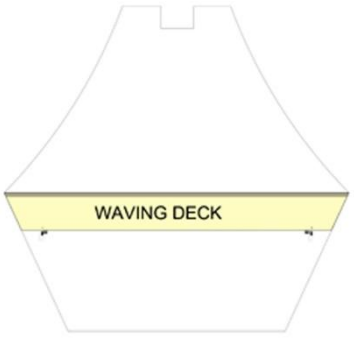
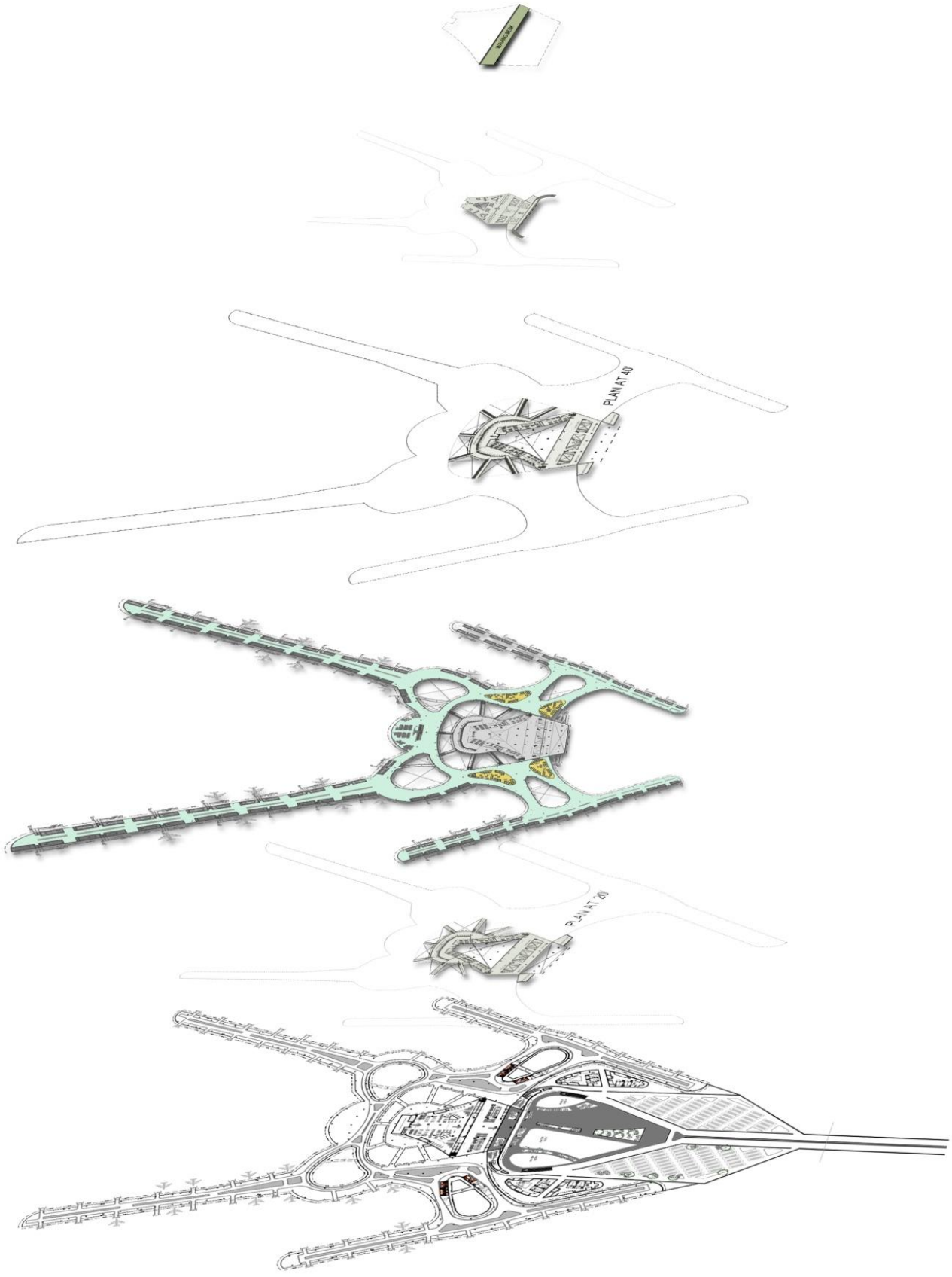


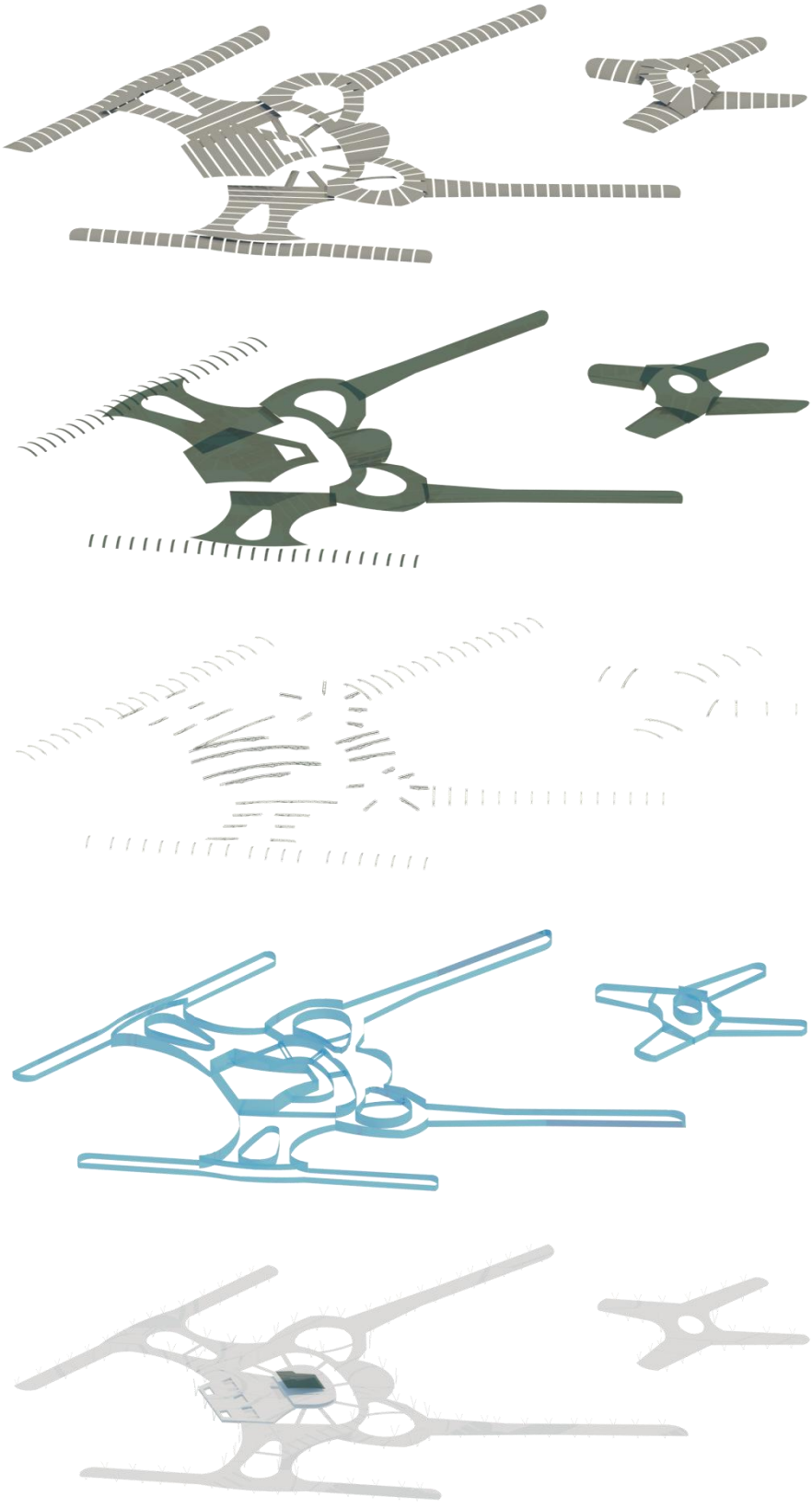
PLAN @60’



PLAN @80’
SCALE : 1/128”=1’0”

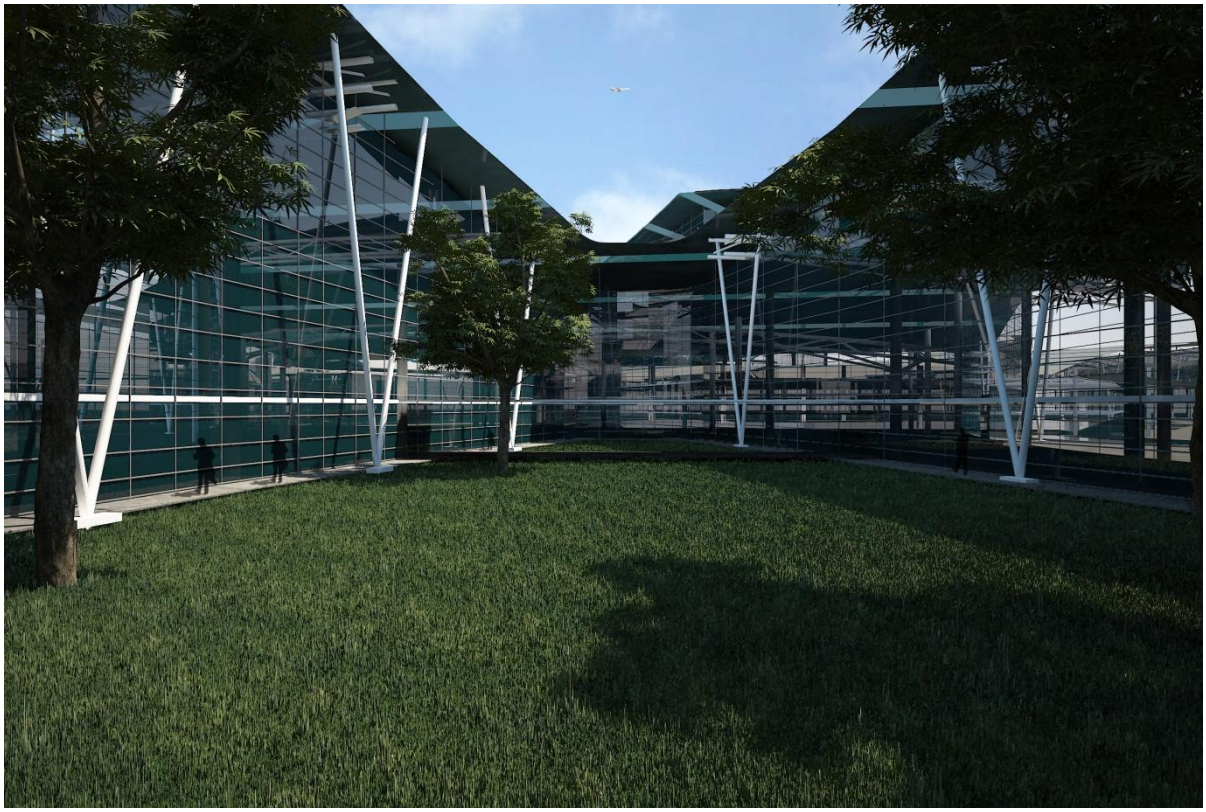

PLAN AT 40
PLAN AT 20

6.13 Structural Layout



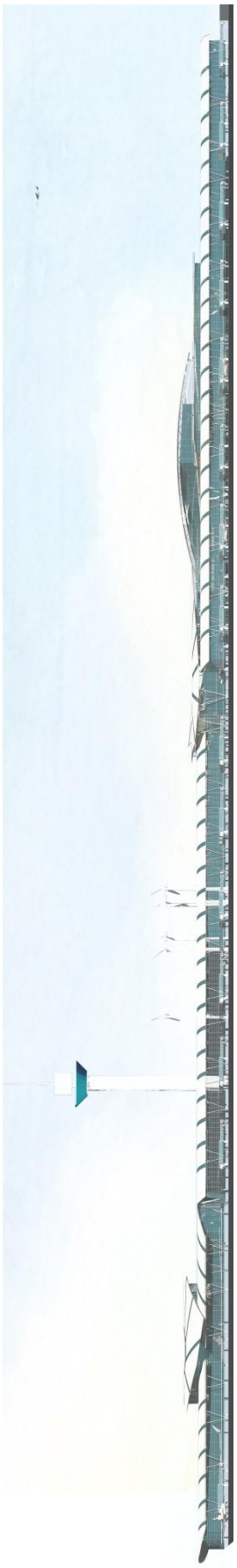
Basic Structural Member

View from Green Ares



6.14 Elevations and Sections

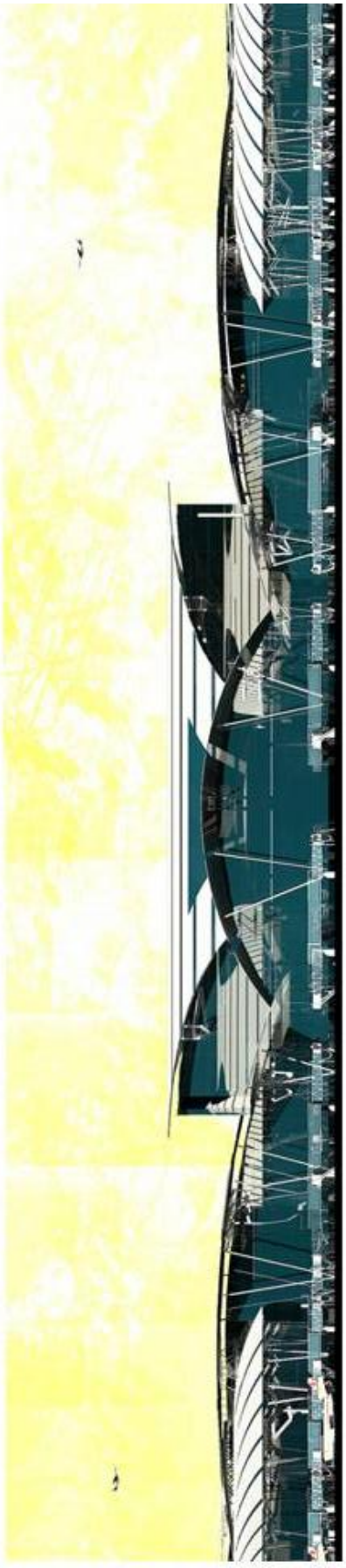
Front Elevation



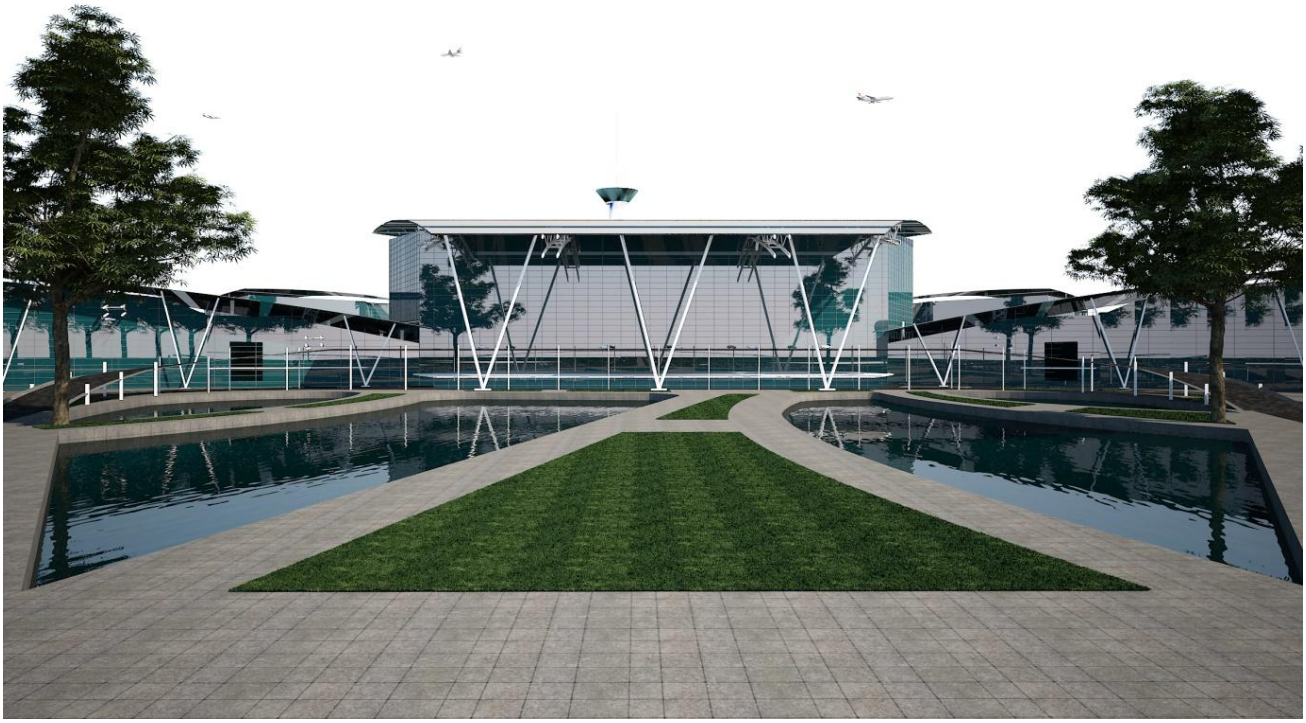
Longitudinal Elevation

Longitudinal Section

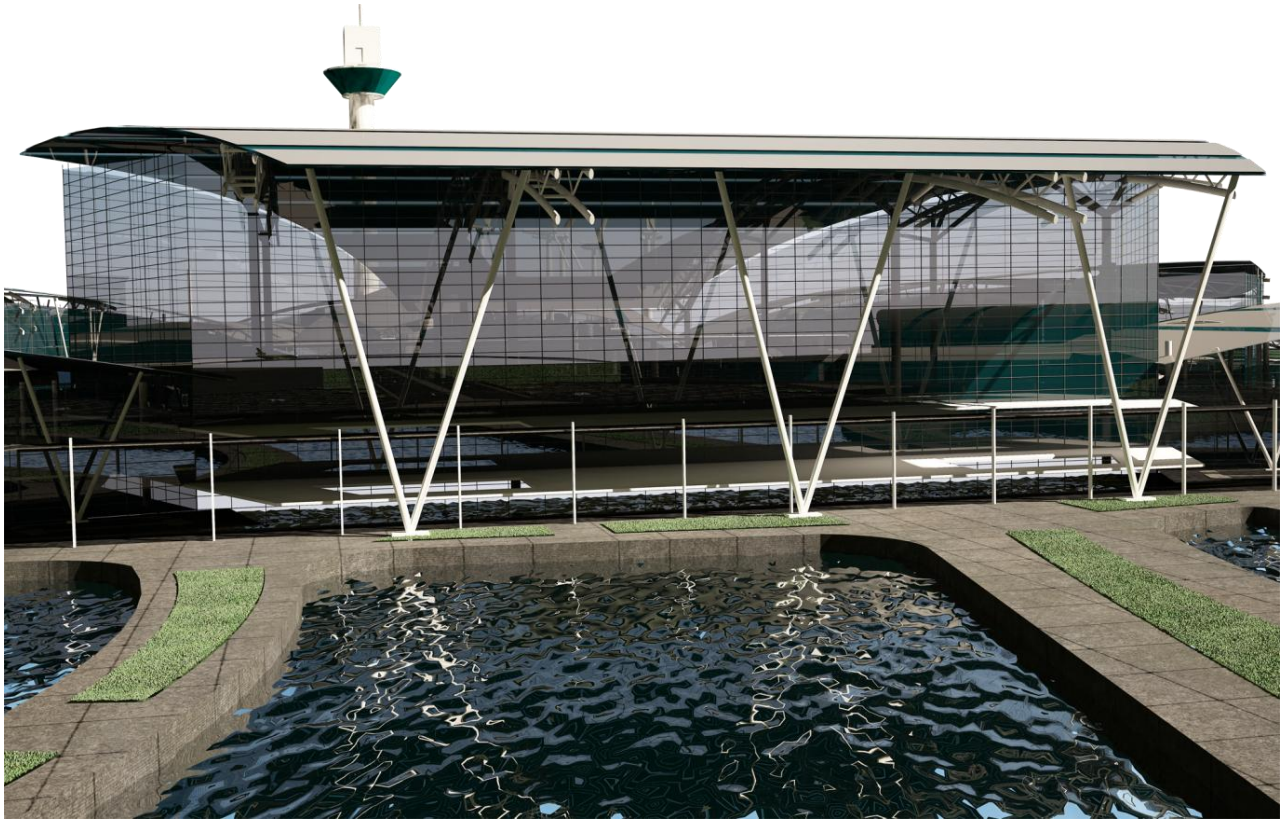
Back Elevation



6.15 Images



Front side

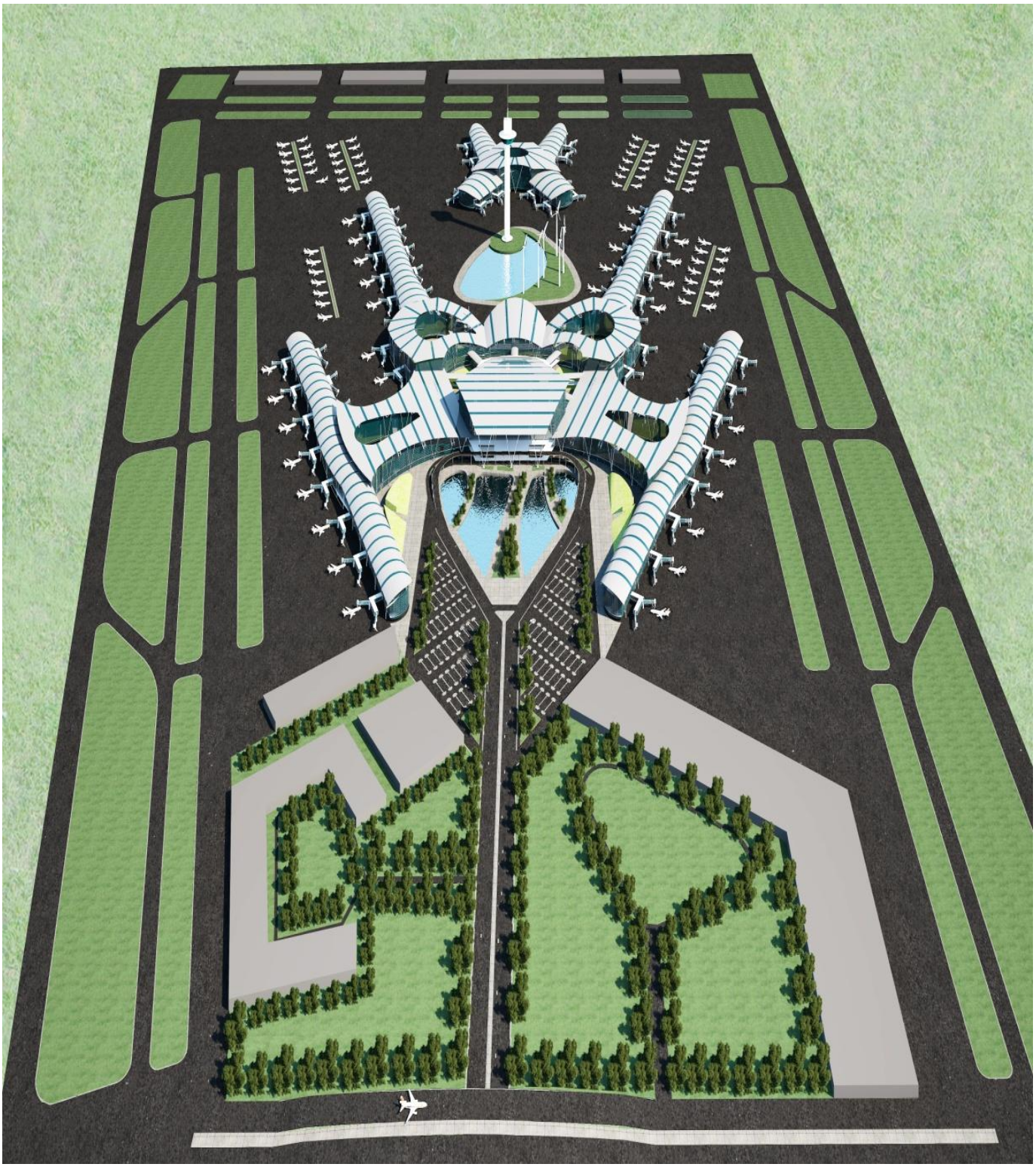


Front side Perspective view

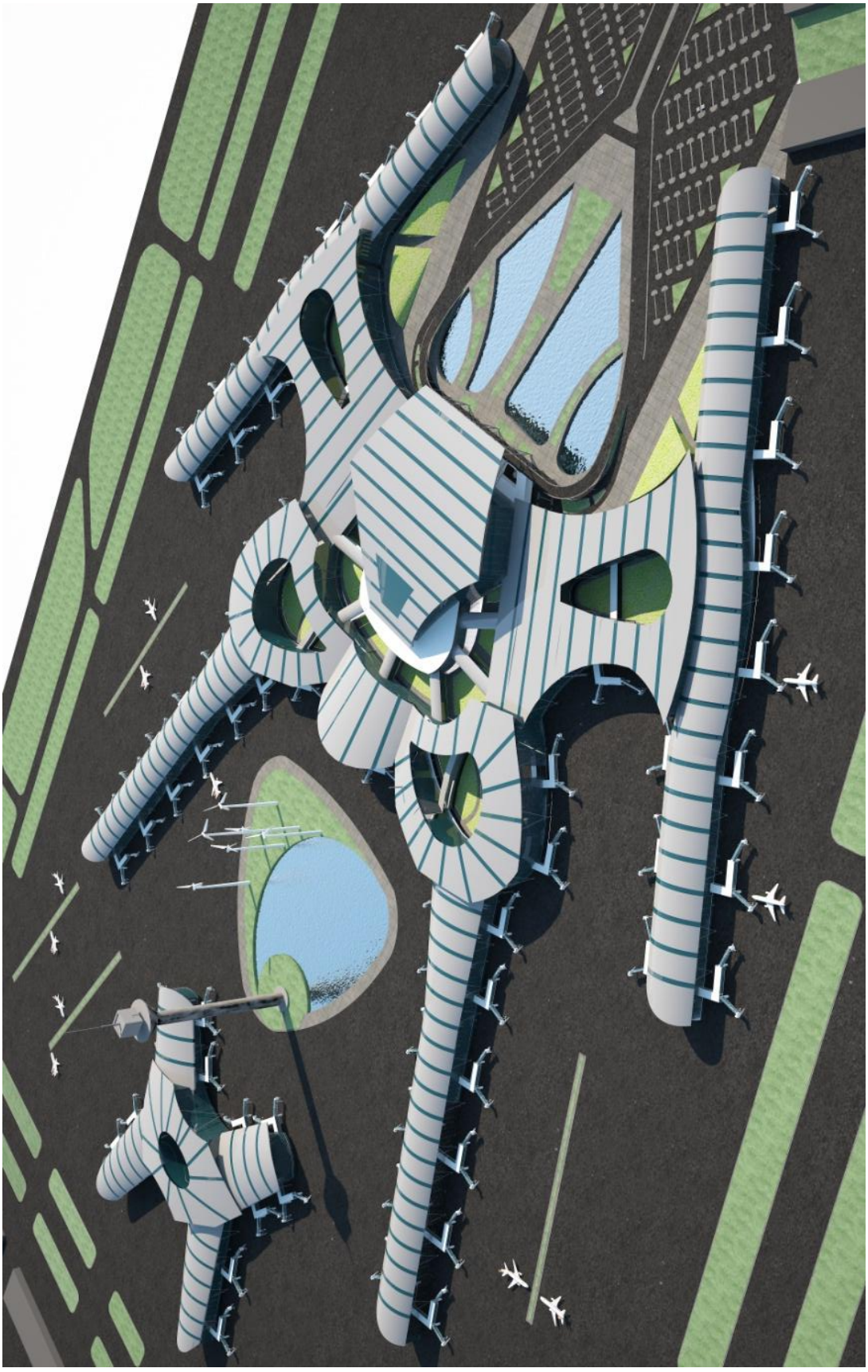
Inside view of Pier Section

Inside view of Gate Lounge

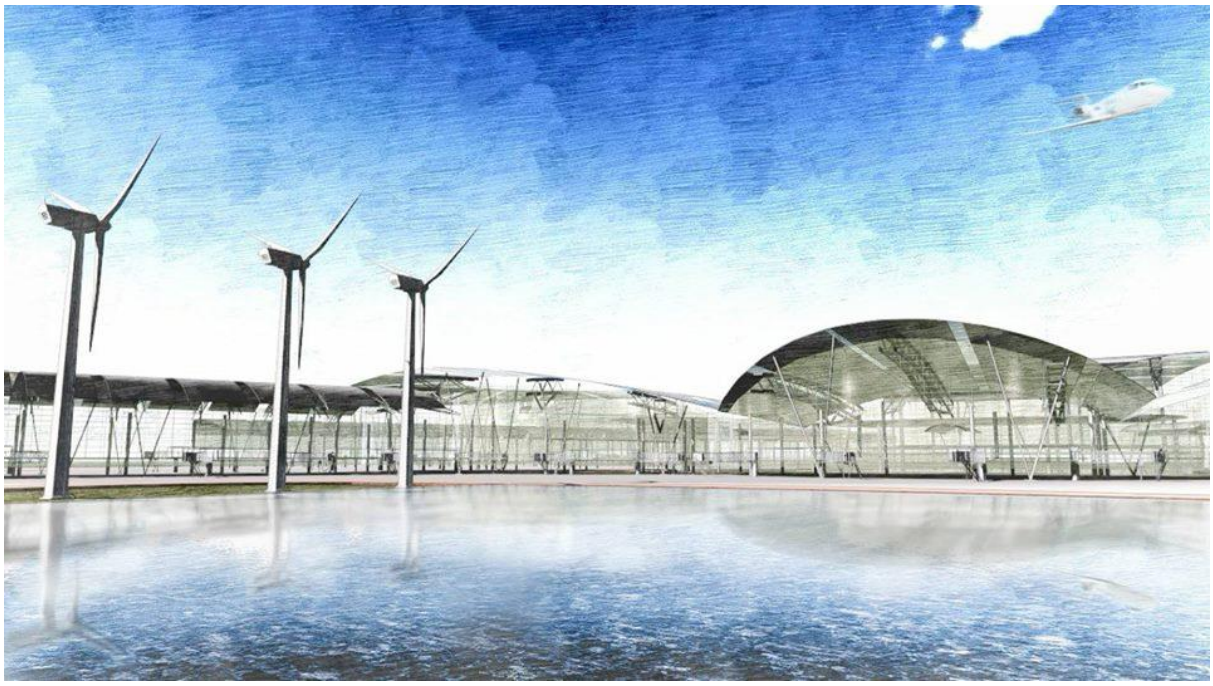
Image of the Airport , Birds eye view



Perspective view



Perspective view



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- www.vandelande.com/Baggage-Handling/Early-Bag_Storage
- www.vandelande.com/Baggage-Handling/Early-Bag_Sorting