THESIS REPORT ON

“INTERNATIONAL AIRPORT,NAVI MUMBAI,PANVEL.”

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF:

BACHELOR OF ARCHITECTURE

BY

PRIYA SUKHWANI

1150101057

THESIS GUIDE

AR. MOHIT AGRAWAL

AR. RAMAKANT

SESSION

2019-20

TO THE

SCHOOL OF ARCHITECTURE AND PLANNING

BABU BANARASI DAS UNIVERSITY

LUCKNOW.

CERTIFICATE

SCHOOL OF ARCHITECTURE AND PLANNING
BABU BANARASI DAS UNIVERSITY, LUCKNOW (U.P.).

I hereby recommend that the thesis entitled, "**NAVI MUMBAI INTERNATIONAL AIRPORT.**" under the supervision, is the bonafide work of the student and can be accepted as partial fulfillment of the requirement for the degree of Bachelor's degree in architecture, School of Architecture and Planning, BBDU, Lucknow.

Prof. Mohit Kumar Agarwal
Dean of Department

Prof. Sangeeta Sharma
Head of Department

Recommendation

Accepted

Not Accepted

External Examiner

External Examiner

BABU BANARASI DAS UNIVERSITY, LUCKNOW (U.P.).

Certificate of thesis submission for evaluation

1. **Name : Priya Sukhwani**
2. **Roll No. : 1150101057**
3. **Thesis Title: INTERNATIONAL AIRPORT, NAVI MUMBAI, ULWE PANVEL, MH.**
4. **Degree for which the thesis is submitted: Bachelor's Degree in Architecture**
5. **Faculty of University to which the thesis is submitted: Yes/No**
6. **Thesis preparation guide was referred to preparing the thesis. Yes/No**
7. **Specifications regarding thesis format have been closely followed. Yes/No**
8. **The content of the thesis have been organized based on the guidelines. Yes/No**
9. **The thesis has been prepared without resorting to plagiarism. Yes/No**
10. **All the sources used have been cited appropriately. Yes/No**
11. **The thesis has not been submitted elsewhere for a degree. Yes/No**
12. **Submitted 3 hard bound copies plus one CD Yes/No**

……………………………………….	……………………………………….
(Signature of the supervisor)	(Signature of the Candidate)
Name:	Name:
	Roll No.:

ACKNOWLEDGEMENT

I would like to take this opportunity to thank my beloved thesis guide **Ar. Mohit Agrawal and Ar. Ramakant**, who have always helped me and have give me brilliant ideas. I highly appreciate all the help they have given to me. Their concerns about the many problems involved in acquiring land for **AIRPORT** or for the expansion of existing ones have encouraged me to conduct this study as a means of presenting more explicitly the difficulties of **AIRPORT** in metropolitan areas.

I would like to thank the Dean **Prof. Mohit Kumar Aggarwal** and thesis coordinator **Ar. Urvashi Tewari** without whose help and co-ordination this thesis may not have been possible. I also want to thank all my faculty members for the guidance that helped successfully integrating the research aspects of the project throughout this thesis.

I am grateful to my family for standing with me throughout and finally my heartiest thanks to my friends**: pragya yadav, ankita singh, shilpi, nida hameed** and all my classmates who have been helpful throughout the five years of my graduation stage.

Priya sukhwani

ABSTRACT

- An **airport** is an aerodrome with facilities for flights to take off and land. Airports often have facilities to store and maintain aircraft, and a control tower. An airport consists of a landing area, which comprises an aerially accessible open space including at least one operationally active surface such as a runway for a plane to take off.

- An airport encompasses a wide range of activities which have different and often conflicting requirements. Yet these activities are interdependent so that a single activity may limit the capacity of the entire complex. The airport project requires intensive study and careful considerations from various points of view because it is a building in which the major priority is security of the airport.

- This thesis revolves around the planning of airport from the very primary stage to the final stage. It starts with the classification of the airport and follows to the planning of the airport which includes Airport system plan, Airport site selection, Airport master plan, etc. Airport architecture shows the important facts about the airport which are important aspects for an airport such as sitting area, utilization of space, passenger flow, etc. To calculate the various spaces in the terminal building there are different design formulas by which we calculate the number of spaces like check-in desks, queueing area, passport control, etc.

- To understand these various aspects of the airport an international case study is attached of Hong Kong International Airport. It mainly shows the passenger flow in the airport.
- Airport designing is a very vast topic as it has totally different design criteria from all other buildings. It holds all the type of architectural services and also has additional services like baggage handling system. So it will help us to gain the knowledge of these services on a larger scale.

INDEX

INTRODUCTION . .

INTRODUCTION TO AIRPORT ....

An **airport** is an aerodrome with extended facilities, mostly for commercial air transport. Airports often have facilities to store and maintain aircraft, and a control tower. An airport consists of a landing area, which comprises an aerially accessible open space including at least one operationally active surface such as a runway for a plane to take off or a helipad, and often includes adjacent utility buildings such as control towers, hangars and terminals. Larger airports may have fixed-base operator services, airport aprons, taxiway bridges, air traffic control centres, passenger facilities such as restaurants and lounges, and emergency services. Eg- Indira Gandhi International Airport, London Heathrow Airport., etc

I.G.I. TERMINAL 3

LONDON HEATHROW T5

- **TYPES OF AIRPORTS (AAI)**

1. INTERNATIONAL AIRPORTS : These are declared as international airports and are available for scheduled international operations by Indian and foreign carriers. Presently, Mumbai, Delhi, Chennai, Kolkata, Hyderabad, Bangalore, Nagpur, Cochin, Thiruvananthapura,Ahmedabad,Amritsar,Guwahati,Jaipur,Goa, Calicut,Srinagar,Portblair,Lucknow,Varanasi,Tiruchirapalli,Mangalore,Coimbatore, Bhubaneswar and Imphal are in this category.
2. CUSTOM AIRPORTS: These airports have custom and immigration facilities for limited international operations by national carriers and for foreign tourist and cargo charter flights. These include Gaya, Patna, Madurai, Pune, Bagdogra, Chandigarh and Visakhapatnam.
3. DOMESTIC AIRPORTS : All other airports are covered in this category.

AIRPORT CONSISTS OF:

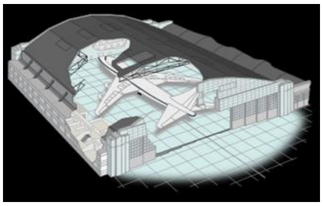
1.landing Area

2.runway - for Plane

for helipad

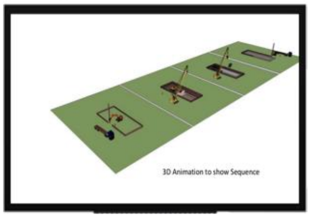
3.Control tower

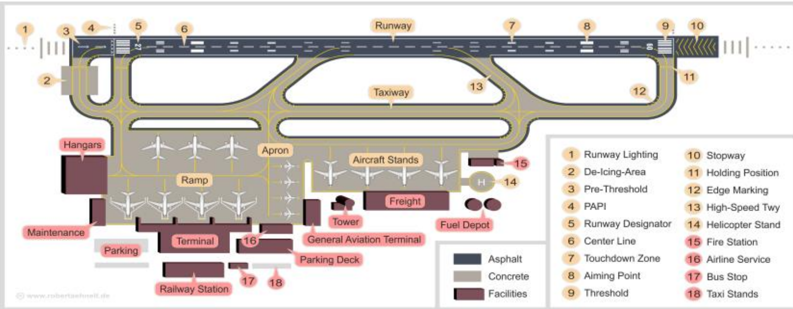
4.Hangars



CONSTRUCTION TECHNOLOGY

1. Sheet pile temporary shaft.
2. Dewatering
3. Water pollution prevention



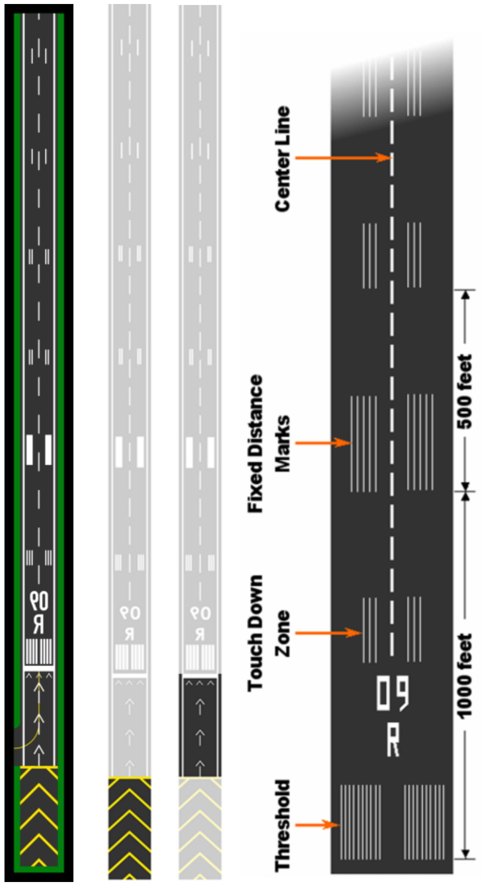


RUNWAYS

Runway dimensions vary from as small as 245 m (804 ft) long and 8 m (26 ft) wide in smaller general aviation airports, to 5,500 m (18,045 ft) long and 80 m (262 ft) wide at large international airports built to accommodate the largest jets, to the huge 11,917 m × 274 m (39,098 ft × 899 ft) lake bed runway

SECTIONS OF A RUNWAY

The runway thresholds are markings across the runway that denote the beginning and end of the designated space for landing and takeoff under non-emergency conditions.



Runway markings

AIM

1.The aim of reserch is to know about international and Domestic Airport.

2.To know the factors that increase its connectivity with world to reserch about new trending and modernizing technologies which help to make airport smart and susitanable.

OBJECTIVE

1. To study the services.
2.Clearly identify the present and future role of the airport.
3 .To create an iconic airport in Navi Mumbai.
4.To design a well-planned international airport for the expansion of the air transportation, keeping in view the international standards with the modern facilities.
5. To provide transit node for the International and Domestic route,
6.To sustain tourism,sector,buisiness, market,and Industrial development.
7. To provide high degree of safety and services to the air travelers.
8. To help the process of decentralization from the capital city.

The following facilities are essential for departing passengers:

Check-in facilities

Security clearence gates

SCOPE AND LIMITATION

1.Proposed airport design to bring an iconic image to the city Navi Mumbai and for international recognition in aviation.

2.The study of the project and the design formulation has been done for the fulfillment of the B.arch final yr.

3.Need for reserch application by keeping in mind the potential and need of a futuristic airport.

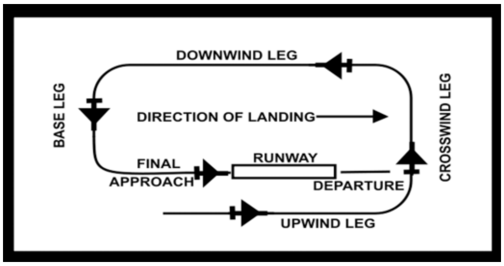
NEED FOR THE PROJECT

Enhancement in aviation facilities in mumbai is absolutely essential for keeping the leadership of maharashtra in attracting Foriegn Direct Investment thereby creating a place of pride for itself and add to the prosperity of its people. Therefore a second Airport in the mumbai region had become imperitive,as the esisting airport at mumbai, is fast reaching saturation level.

SELECTION OF SITE FOR AIRPORT

1.Air traffic potential
2.Adequate access
3.Sufficient airspace
4.sufficient land
5.Atmospheric and meteorological conditions
6.Availibilty of land for expansion
7.Availability of utilities
8.Development of surrounding area
9.Ground accessibility
10.Presence of other airports
11.Regional plan
12.Soil characteristics
13.surrounding obstructions
14.use of Airport.

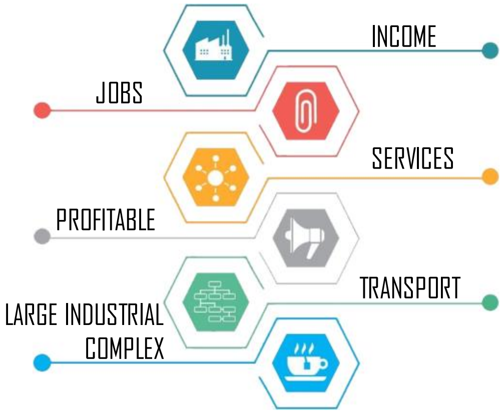
TRAFFIC PATTERN



At all airports the use of a traffic pattern is possible.
They may help to assure smooth traffic flow between
departing and arriving aircraft. This pattern is a circuit consisting of five "legs" that form a rectangle (two legs and the runway form one side, with the remaining legs forming three more sides).
Each leg is named ,and ATC directs pilots on how to join
and leave the circuit. Traffic patterns are flown at one
specific altitude, usually 800 or 1,000 ft (244 or 305 m)
above ground level (AGL). Standard traffic patterns are
left-handed, meaning all turns are made to the left.

MAJOR PROBLEM FACED DURING DESIGNING OF AIRPORT

1.Reqired heavy funds during provision and maintenance.
2.Highly dependent on weather conditions compared to other modes.
3.Required highly sophisticated machinery
4.Adds to outward flow of foreign exchange.
5.Purchace of equipments,airbuses etc.
6.Safety provisions are not adequated.
7.Providing a support system during the flight is complicated.



AIRPORT ORGANIZATIONS

INTERNATIONAL AIRPORT AUTHORITYOF INDIA

The international airport authority of India (IAAI) was set up in april, 1972 for the operation, management, planning and development of all international airports. However, the facilities of air traffic control, aeronautical communication and navigation are provided to these international airports by the civil aviation department.

NATIONAL AIRPORT AUTHORITY OF INDIA

The National Airport Authority (NAA) was established on june1, 1986 through an act of parliament and it is managed by a board consisting of chairman, four fulltime members and eight part-time members.

An airport complex usually is city's introduction for tourists and frequent travellers. Airport complex generally comprises of various spaces such as fixed base operator services, airport aprons, taxiways, runways, ATCT, hangers, cargo handlers, cargo terminal and passengers' facilities such as terminals, concourses which includes various counters, restaurants, lounges, emergency facilities, etc.

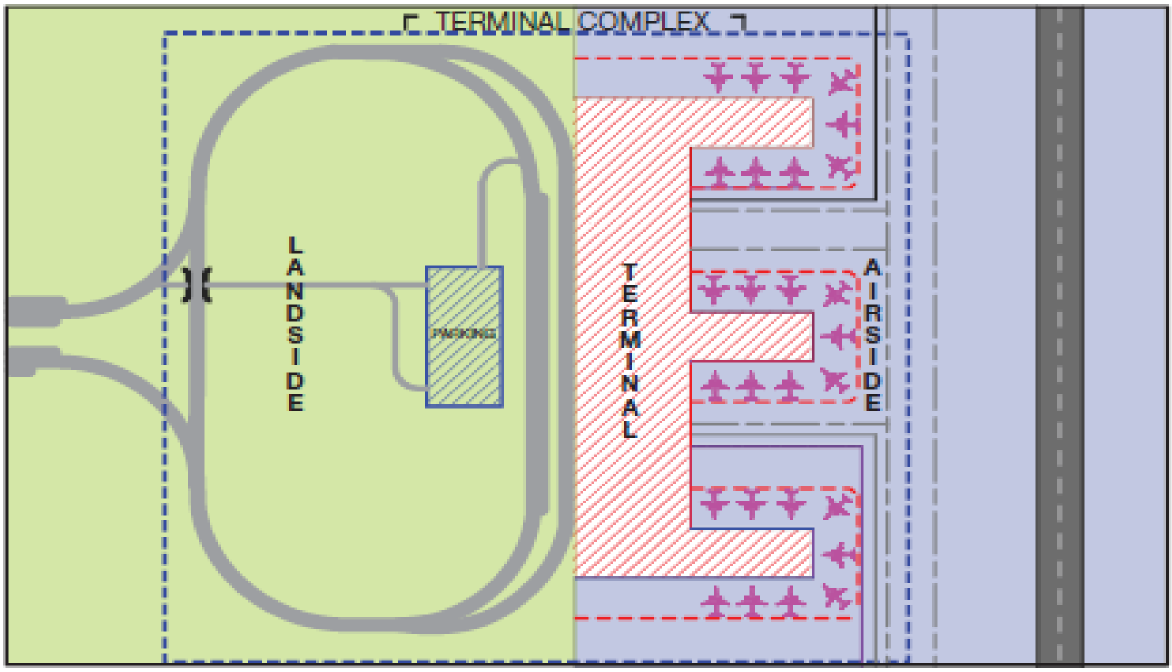
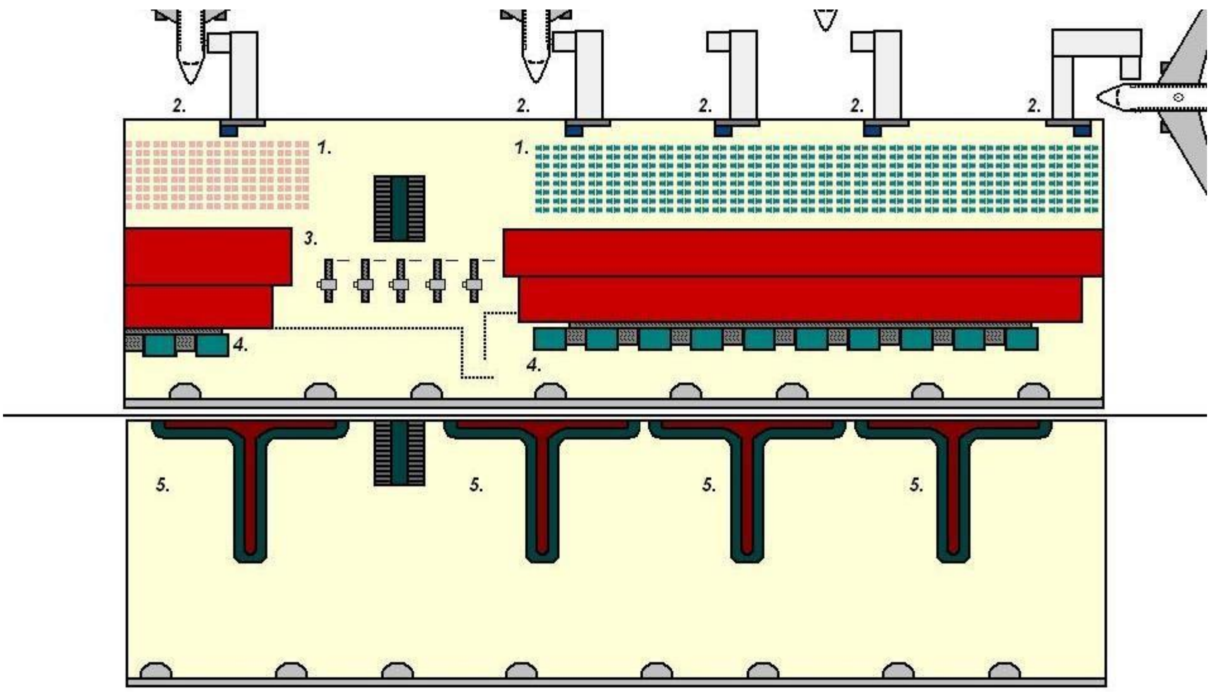


Figure 1. A typical Terminal complex



1. Departures lounges
2. Gate and Jet Bridges
3. Security Clearance Gates
4. Baggage Check-in
5. Baggage Carousels

Figure 2. Typical design of Terminal building

Source: Airport Passenger Terminal Planning and Design Volume 1

Role of airport infrastructure in national economy

(CIDCO, 2014) Airports are nuclei of economic activity producing national economy. The quality of aviation infrastructure is main component of the whole tourism and transportation network, and ultimately contributes to country's international flow of foreign investment.

About 97% of tourists arrive by air and tourism is India's second most foreign exchange earner.

Also, the cargo industry in India share a major value, cargo accounts about for 35% of total exports in India. Better cargo handling facilities usually leads to better and enhanced levels of imports and exports, especially of capital generating goods and high value items. Better cargo handling facilities usually leads to Airports also can be said as a window for the world. Passengers all around the world naturally form their first perspective about a nation by functioning of its airport. Airports are to be the pride for nation thus the quality and services of airport are to be maintained on regular basis.

Various kinds of transportation can be linked to the airports, as this may enhance the passengers flow exiting terminals and can omit congestions produced

Growth of Indian Aviation

(CIDCO, 2014) The passenger traffic in India is growing at a much healthier rate because of the economic growth witnessed in the country in recent phase which resulted in increase of air travel both domestic and international. Domestic Air traffic evaluated a time period of about 20 years (from 1991 to 2011) which suggests that it grew are an annual average rate of 10.4%, at the same time international passenger traffic grew at about 9.4%. Operators and experts have estimated the air traffic to have an average growth rate of about 10% till 2031.

The MoCA have estimated and forecasted that about 448 million domestic passengers and 237 million international passengers are to be carried by 2031-32. Also, the cargo industry in 1990-91 witnessed the growth rate of about 8.6% and would increase up to 10-11% by 2031- 32.

Philosophical Approach to Airport

An airport as mentioned earlier is the gateway or an expression of the city, or a country, and for some passengers such as transit ones the airport is all what they know about that particular city. Architecturally, an airport holds significant importance since it has the ability to give a uniqueness to the region where it is situated.
For e.g.

- (technology, Incheon International Airport (ICA/RKSI), n.d.) Incheon International Airport, Seoul has looked for Korean Architecture as concept for terminal, similar to this Changi Airport, Singapore has redeveloped its Terminal 1 to reflects Singapore's Garden City; and Ngurah Rai International Airport, Bali has retained several parts of Balinese temples architecture façade.

Figure 4 Mumbai's T2 Terminal, Concept of Peacock Feathers Source: GVK

- (technology, Indira Gandhi International Airport (DEL/VIDP) Terminal 3, n.d.) In India, New Delhi's Indira Gandhi International Airport has its design philosophy relied upon Indian culture, such as in its choice of art. The Mudra wall, an installation comprising convex and copper plates forming a backdrop to around sex feet high statues of palm, each forming classical dance mudra. Similar concept has been used in CSMIA Mumbai, It consists of art wall which depicts various religions and their respective art forms.

Figure 5 Incheon International Airport, South Korea

Source: Wikipedia

(Harrison, 2015) The terminal facilities depend on 6 principles on experience design for its passengers:

1. Principle of Incompatibility: The principle of incompatibility states it is impossible to satisfy time sensitivity and engagement criteria for a given passenger simultaneously.
2. Principle of Time Sensitivity: The Principle of time sensitivity states due to differences in passengers' sensitivity to time, passengers those are time-sensitive will occupy smaller passenger footprint, while passengers those not sensitive to time will occupy larger terminal footprint.
3. Principle of Engagement: The Principle of engagement states that as there are differences in degrees of passenger engagement in the airport environment, passengers those engaged will occupy a larger terminal footprint while the passengers not engaged will occupy a larger footprint.
4. Principle of Retail Expansion: The Principle of retail expansion states total space in the terminal building that is provided for retail expansion should be in proportion to the size of engaged and non-time sensitive passenger segment.
5. Principle of Efficiency: The Principle of efficiency states in order to maximize the returns on passenger footprint invested, the total dwell time for passengers that do not engage in the retail environment need to be minimised.
6. Principle of Proficiency: The Principle of proficiency states that future terminal design need be optimised towards efficient processing rather than retail expansion

Types of Aircraft Fleet

(ICAO, ICAO Aerodrome Reference Code, n.d.) The ICAO has introduced two-part categorisation of aircraft types. The first is the numeric code based on Reference Field Length for which there are four categories and the other one is letter code based on a combination of aircraft wingspan and outer main gear wheel span.

Code Number	Aeroplane Reference Field Length	Typical Aeroplane
1	<800m	DE HAVILLAND CANADA DHC-6/ PIPER PA-31
2	800m but < 1200m	ATR42/ BOMBARDIER Dash 8 Q300
3	1200m but < 1800m	SAAB 340/ BOMBARDIER Regional jet CRJ-200
4	1800m and above	BOEING 737-700/ AIRBUS A-320

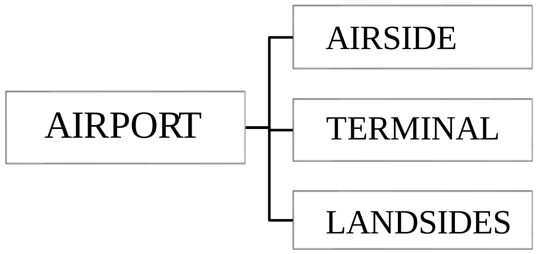
Table 1 Numeric code based on Reference field length

Code Letter	Wingspan	Outer main gear wheel span	Typical Aeroplane
A	< 15m	< 4.5m	PIPER PA-31/ CESSNA 404 Titan
B	15m but < 24m	4.5m but < 6m	BOMBARDIER Regional jet CRJ-200/ DE HAVILLAND CANADA DHC-6
C	24m but < 36m	6m but < 9m	BOEING 737-700/ AIRBUS A-320/ EMBRAER ERJ 190-100
D	36m but < 52m	9m but < 14m	B767/ AIRBUS A-310
E	52m but < 65m	9m but < 14m	B777/ B787 Series/A330
F	65m but < 80m	14m but < 16m	BOEING 747-8/ AIRBUS A-380-800

Table 2 Letter codes based on wingspan and outer main gear span

Classification of Airport Components

Airport complex can be classified into three activities: Access Interface, Processing, Flight interface which are also called landside, terminal and airside components.



The Primary elements to consider when deigning landside components are stated below:

- Curb front pedestrian facilities
  - Sidewalk—adjacent to terminal
  - Curb islands
  - Pedestrian crosswalks
  - Curb side baggage check-in
- Curb front vehicle lanes
  - Loading/unloading lanes
  - Bypass lanes
  - Through lanes
- Parking
  - Terminal passenger parking
  - Remote passenger parking
  - Off-airport parking
  - Valet parking
  - Employee parking (FAA, airlines, tenants, staff)
  - Rental car parking
  - Cell phone lots
- Entry/exit roadways
  - Primary terminal access and exit roadways
  - Recirculation roadways
  - Service roads/loading docks
- Commercial vehicle/transit staging areas

- Taxi and bus holding areas
- Ground transportation centres

- Rail transit
  - Platform configuration
  - Station location

The Primary elements to consider when deigning Terminal components are stated below:

- Programmatic parameters
  - LOS performance standards
  - Demand/capacity assessment
- Terminal facility requirements
  - Ticketing/check-in
  - Passenger screening
  - Holdrooms
  - Concessions
  - Baggage claim
  - Circulation
  - Airline offices and operations areas
  - Baggage handling
  - Baggage screening system
  - International facilities—Federal Inspection Services
  - Support areas
  - Special requirements
  - Building systems
- Functional relationships
- Flow sequences
  - Passengers
  - Visitors
  - Employees
  - Baggage
  - Deliveries
  - Waste removal

  - Passenger movements
    - People mover systems
    - Passenger wayfinding and signage
- Terminal concept development
    - Domestic and international terminals
    - Concourse configurations
    - Centralized and decentralized terminals
    - Single vs. multi-level terminals
    - Flexibility and efficiency
    - Common-use terminal equipment
    - Swing gates

<u>The Primary elements to consider when deigning Airside components are stated below:</u>

- Aircraft manoeuvring
    - Taxiway requirements
    - Taxi lane requirements
    - Pushback areas
- Aircraft parking
    - Terminal gates
    - Remote aircraft parking positions
    - Wingtip clearances
    - Aircraft parking guidance systems
- Aircraft parking apron
    - Apron gradients
    - Hydrant fuelling – 400 hertz power
    - Preconditioned air
- Apron service roads
    - Tail-of-stand
    - Head-of-stand
- Ground service equipment
    - Staging
    - Movement/manoeuvrings
    - Storage

- Aircraft servicing
- Security and emergency response
- Environmental
  - Fuel spillage
  - Waste disposal
- Blast Fences
  - Public and employee protection
- Aircraft parking

7. Passengers Movement

Passengers travelling by aircrafts can be distinguished in two different conditions:

- Business Travellers
  a. Will be familiar with aircraft timings.
  b. Spends time in airline lounges.
  c. Will arrive in airport close to flight departure time
- Leisure Travellers:
  a. Will arrive in advance time in airport.
  b. Have time to explore.
  c. Uses wider range of terminal facilities.
  d. Generate larger numbers of well-wishers and greeters.

These passengers flow for both arriving and departing are derived in figure 7 and 8.

8. Factors contributing to the Growth of the Aviation Sector

(Phukan, 2015) The Aviation sector of India has changed from an Over-Regulated and Under-Managed Sector, to Open, liberal and Investment-friendly sector. Some Major Factors Contributing to this are:

- Higher household Incomes
- Strong economic growth
- Entry of Low-Cost Carriers
- Increased FDI Inflows in domestic airlines
- Increased tourist Inflow
- Surging cargo movement
- Cutting edge Information Technology Interventions
- Focus on regional connectivity
- Modern Airports

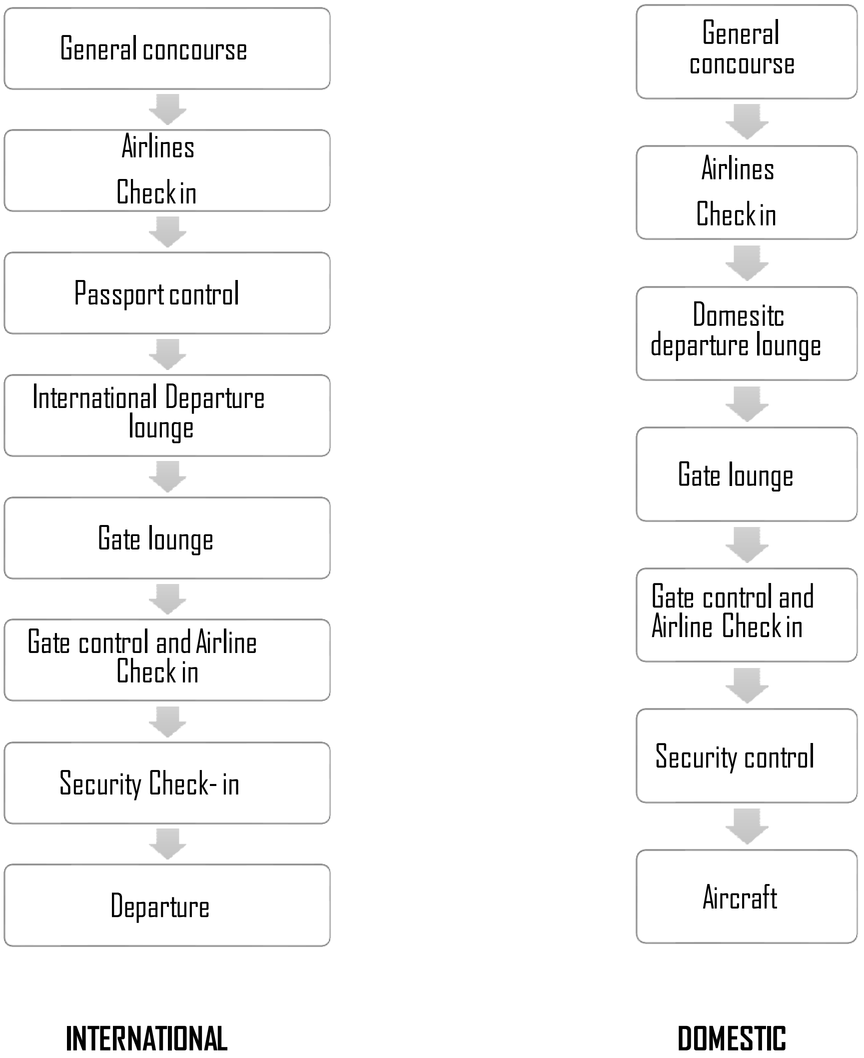


Figure 6 Flow of Departing passengers

Some Major Threats

- A global economic slowdown negatively impacts leisure, optional and business travel.
- The continuous rise in the price of fuel is a major threat.
- A terrorist attack anywhere in the world can negatively impact air travel.
- Government intervention can lead to new costly rules.

Problems facing the Aviation Sector

- High operational costs
- High cost of aviation turbine fuel
- High service tax and other charges
- Shortage of maintenance facilities
- High foreign exchange rate

- Congestion at airports

Lack of qualified pilots and technical manpower etc.

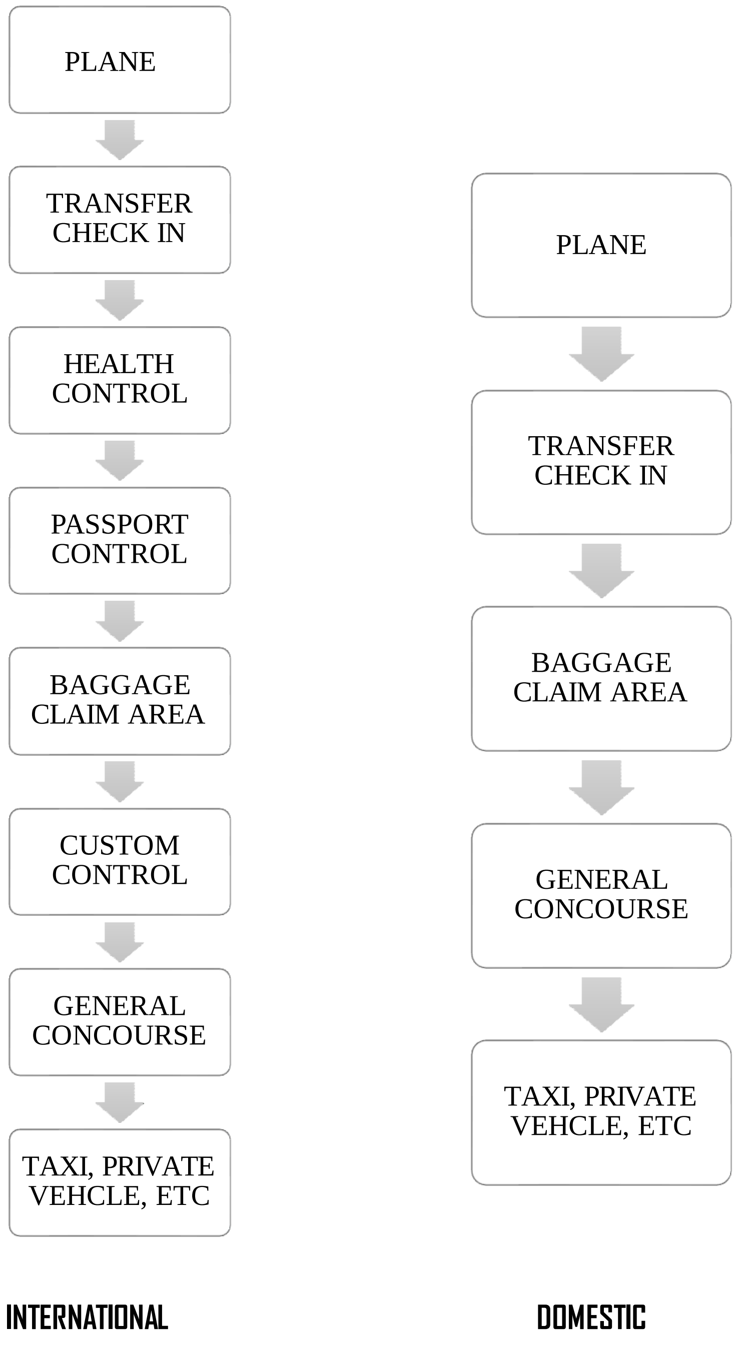


Figure 7 Flow of Arriving Passengers

AIRPORT AUTHORITY OF INDIA

Indian airports were managed by Civil Aviation Department, Government of India, till the creation of International Airports authorityof India (IAAI) in 1972 and National Airports Authority (NAA) in 1986. In 1995 Airports Authority of India (AAI) was established by merging both IAAI and NAA by an Act of Parliament The Airports Authority of India Act in 1994 – for better and efficient management of all airports in India by a single Authority

भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA

ABOUT NAVI MUMBAI

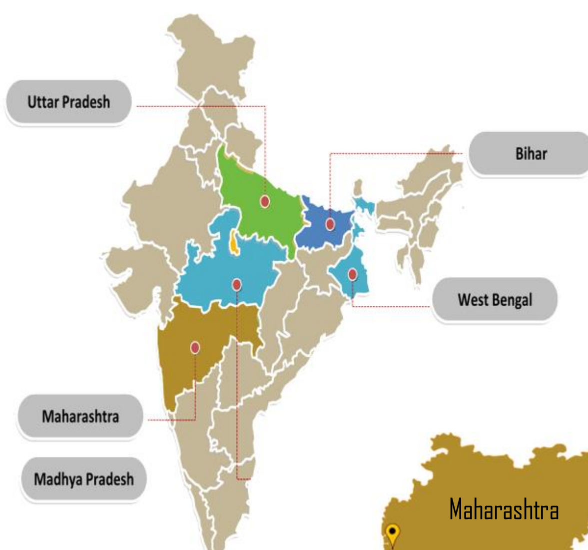
Mumbai is the capital city of the Indian state of Maharashtra. According to United Nations, as of 2018,Mumbai was the second most populous city in India Mumbai is the centre of the Mumbai Metropolitan Region, the sixth most populous metropolitan area in the world with a population of over 23.64 million. including Navi Mumbai and Thane.

Navi Mumbai,also known by its former name New Bombay,located in the eastern trans harbour of Mumbai. The city is divided into two parts, North Navi Mumbai and South Navi Mumbai

- 45% of Land is reserved for green zones and open to sky activity.
- Navi Mumbai has well planned layout along with ample supply of good quality buildings with large floor plate.

SALIENT FEATURES OF THE CITY

- ✓ Total Area: 1615 Sq. km.
- ✓ High Access Corridor: City Center, Industrial, Log Knowledge & IT, Recreation & Sports, Entertainme
- ✓ World-class infrastructure & connectivity: within outside.
- ✓ Central spine express way & Metro Rail to link the with mega cities.
- ✓ Airport & Sea Port in the vicinity.
- ✓ Proximity to mega cities
- ✓ Benefit of sea coast, nature park, golf course.
- ✓ Capable to cater to both International & Domesti Market.



south mumbai is expected to be driven by 5 planned infrastructure projects

1. Mumbai trans harbour link
2. Navi mumbai airport
3. Navi mumbai Metro
4. Belapur -uran rail link

NAVI MUMABIA INTERNATIONAL AIRPORT

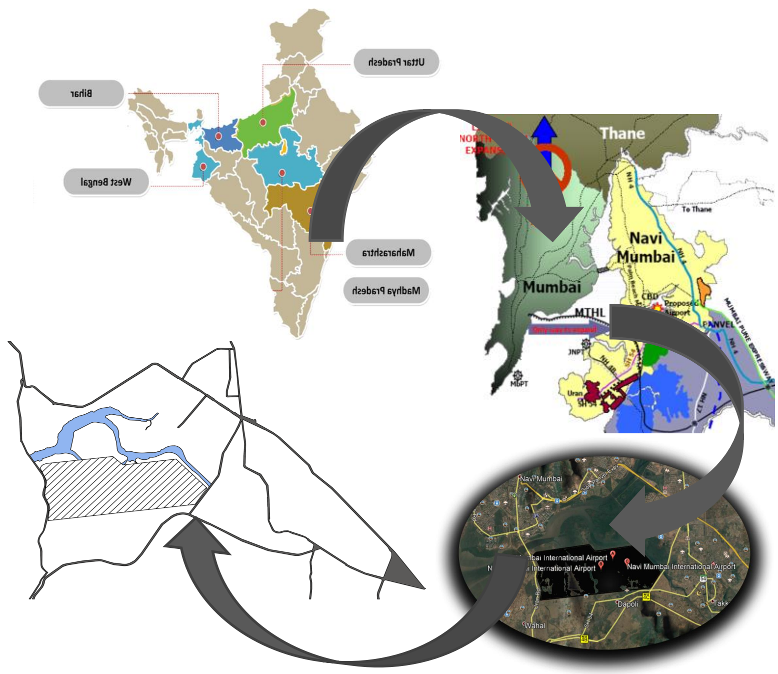
- Mumbai airport handled 36.6 million passengers in FY 15 – a growth rate of 13.7% as compared to FY14. (Growth in passenger traffic for the period April to October of FY 16 from the same period in FY 15 is 14.8%)
- Mumbai airport estimated to handle peak traffic of about 45 mppa
- Passenger traffic for Mumbai Metropolitan Region expected to cross 45 mppa in FY 2018 as per traffic forecast (Compounded Annual Growth Rate of 7.6% for the period FY 15 – FY 18)

NEED OF NAVI MUMBAI INTERNATIONAL AIRPORT

- ✓ Navi mumbai Airport is expected to be saturated by 2024-25
- ✓ Enormous domestic & foreign investment envisaged in MUMBAI
- ✓ Navi mumbai Airport would provide air connectivity to CSIA and would also serve the spill over traffic of existing MUMBAI Airport
- To explore opportunities in Aviation zone close to Airport for Aviation Industries Air-Cargo Facilities
- Creation of a Regional Airline Hub

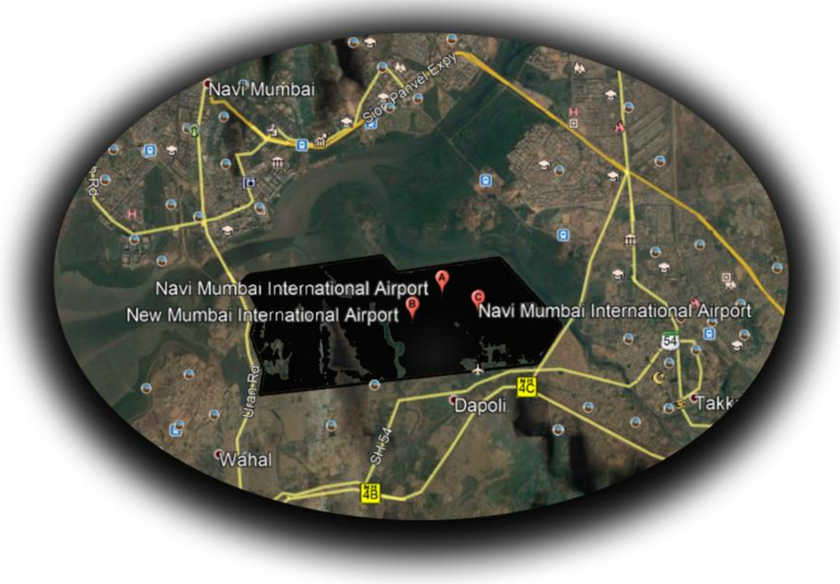
LOCATION OF SITE

The site of the proposed airport is located nearUlwe, Pargaon Dungi, Maharashtra.The site is situated approximately between. 18°59′40″N 073°04′13″E
Chinchpada, Kopar, Kolhi, Ulwe, Upper Owale, Waghivalivada, Vaghivali, Ganeshpuri, Targhar, and Kombadbhuje are the nearest village.



prominent among these is the fact that Navi Mumbai is expexted to absorb
the future growth in population,business and commercial activity of the region.The availability of physical and social infrastructure coupled with environmental friendly site with minimum
resettlement and rehabilitation makes the Navi Mumbai airport project technically and financially viable.The site of airport is located in an area of 1160 hectares accomodating two parallel runways for independent parallel operation with provision of full length taxi ways on either side of the runways.

Area ; 1160 hectare
dimensions of runway : 3700m x 60m with holding bays.
present site is majorly cidco ownwed and rest is private which
will be acquired for airport development.



GOOGLE EARTH IMAGE OF THE AIRPORT SITE ULWE PANVEL.

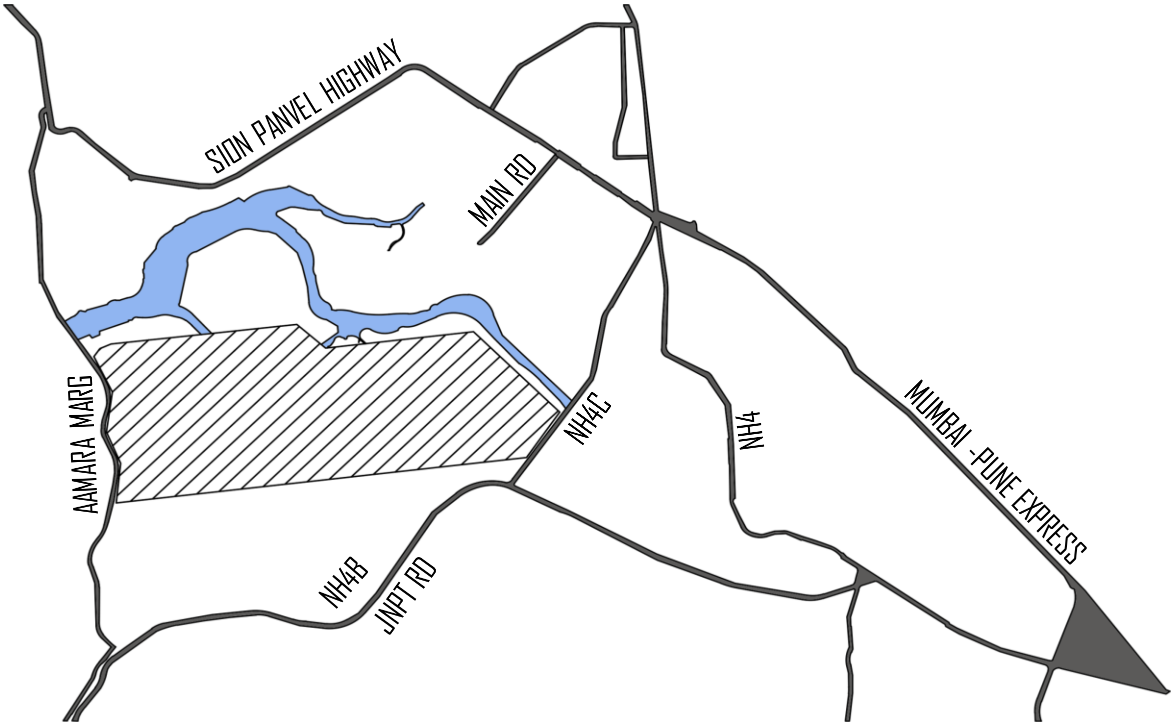
ABOUT SITE

The site for proposed Greenfield International Airport Ulwe panvel, Navi Mumbai covers an area of 7166.05 Acres (2900 ha) which is Govt land, which is barren and saline

The main workable area of the site for airport is 2866 Acres (1160 ha).

LENGTH – 6.04 KM

BREADTH – 2.25 KM



SITE

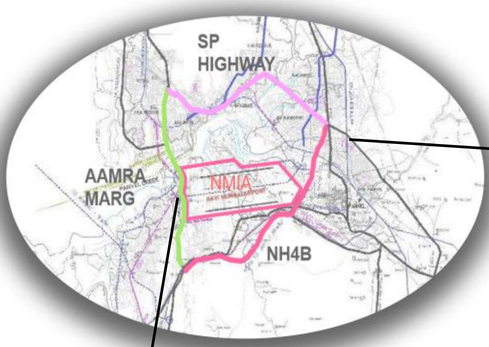
- SITE AREA-1160 Ha
  2866 ACRES
- 11.59 SQUARE KM
  11590000 SQ M
  124842960 SQ FT

SITE CONNECTIVITY

Accessibility

1.National Highways - NH4 and NH4B

2.State Highways - SH54,Sion-Panvel Highway(10 lane),Aamra Marg, Suburban Rail, Water Transport, Metro and BRTS.



GOOGLE EARTH MAP SHOWING SITE CONNECTIVITY

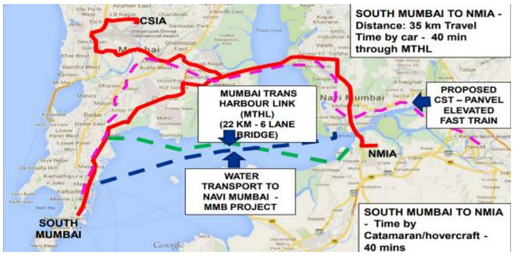
ROAD TO SITE

SITE VIEW

AAMRA MARG

ROAD CONNECTING SITE AND HIGHWAY

PROPOSED SITE CONNECTIVITY



Navi Mumbai will be well connected by railways and roadways from various cities and towns and so as Navi Mumbai International Airport.

MTHL line is proposed from cst to panvel, South Mumbai to CSIA.

EXIXTING SITE CONNECTIVITY

DISTANCE OF JUHU TO NAVI MUMBAI AIRPORT

DISTANCES:

Railwaystation:1.khandeshwar via NH548

Distance from auto: 8km

bus stand near by:

1.Panvel S.T. Bus Stand via Uran Rd.

Distance from auto:7.1km

nearest airport:

Chhatrapati Shivaji Maharaj International Airport

Site presently accessible by road through the 4 lane National Highway NH4B from east & 4 lane major arterial road namely Aamra Marg, from west. Bids for widening of both roads to 8 lanes with service lanes in award stage. • Main connectivity to Navi Mumbai from Mumbai - signal free Sion - Panvel expressway widened to 10 lanes, thereby providing accessibility to airport site of highest order.

site surrounding

The site surroundings comprises of rural settings and agricultural land.The land use in the surrounding area Primarily comprises of residential and agricultural practices. The details of site surroundings are as follows:

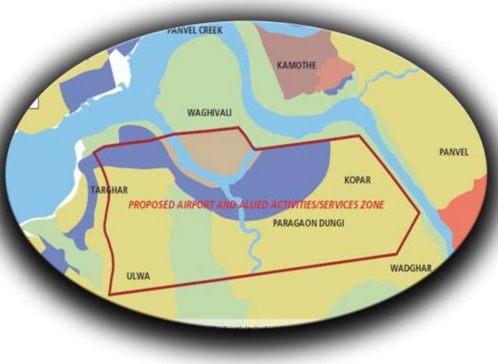
SOUTH - Ulwe,Belapur,kharghar,Dronagiri,Kamothe,old panvel,new panvel,kalamboli, Residential,commercial and industrial.

NORTH- Airoli,Ghansoli,Mahape,Thrbhe

ULWE RIVER flows from north to east, north to south

Archologically important place:

Elephant at a distance of 13km west.



Airport and allied activity/service zone

Residential zone

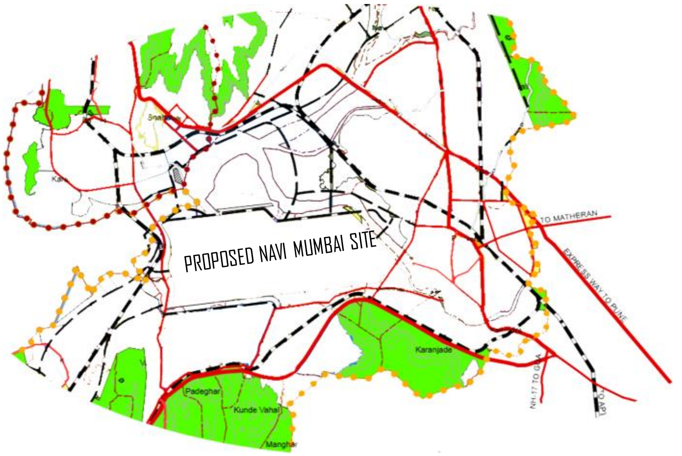
Commercial zone

Non development zone

Resource channel

VEGETATION

Landscaping at airports can affect tourism, business, and the overall feeling for visitors. With this in mind, landscaping should be aesthetically pleasing. However, it must also coincide with the airport's greater responsibility for aviation safety. The primary goal of airport landscape management is to reduce aviation wildlife species of concern being attracted to the airport environment and to eliminate the vertical intrusion of vegetation into aircraft operating airspace. The plant species found within the Airport Landscaping Standards apply only to management of vegetation in the built environment. Composition of plant species within the context of natural site conversions is not addressed within these standards.



nearest hill: Ulwe hill-RL 82mt within the site

Regional park

SITE CONSTRAINTS

The Navi Mumbai site has certain site constraints as detailed below which can be overcome easily by taking an appropriate action:-

1.Rehabilitation
2.Shifting of Extra High Tension (EHT) Line
3.Training & Diversion of River:
4 Reclamation:
5.Environment sensitive factors:

THE OPPORTUNITY

The Navi Mumbai Airport is proposed to be developed through Public-Private Participation(PPP).The growth in population in Navi Mumbai, rapid development of its Central Business District, coupled with major economic generators in the vicinity such as Special Economic Zone, Jawaharlal Nehru Port Trust. The Airport will act as a focal point for the emergency of a new trans-shipment centre in the South Asian region.

POWER SUPPLY

Electric energy will be supplied via 2 independent feeders from the national grid to two power stations, one located at the East side of the airport near the catering site and the second one at the West side between the West access road and the airfield maintenance area.

PROJECT ACTIVITIES

- Development of Airport in four phases
- Training of Gadhi river
- Diversion of Ulve river
- Shifting of EHT Lines
- Development of off-airport site
- Approach roads, railways, interchanges, water transport service to airport zone in the vicinity and far
- Re-settlement and Rehabilitation

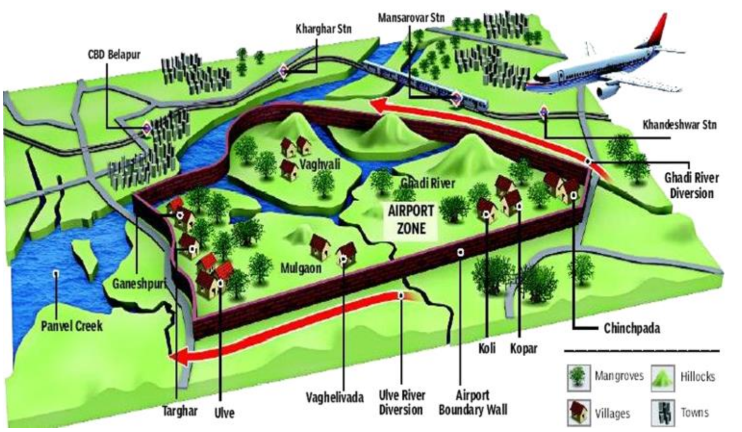
DISCRIPTION OF ENVIORNMENT.

1.50% of project area is open land,
2.Salt marshes cover another 25%,
3.10% under mangrove forest,
4.Rain fed agriculture occupies 7% area rest is man-made things in the project area.
5.Hilly terrain extending NW and is towards the SW end of the proposed runway.
6.Salt marshes more common in the Eastern region of the site of proposed airport than in the west.
7.Used for Prawn culture and are also man made.
8.Mangroves Avicennia marina more dominant species found here.
9.Agricultural Land rain fed agriculture in mansoon else barren land.

HILL CUTTING

The Airport Site encompasses a hill which needs to be flattened. Considereing the substantial time involved in flattering.of hill and land development of Airport.

The 60 metre mouth of the Ulwe River upstream will be widened to 200 metres. The river currently flows into Ghadi.



WATER

1. Two rivers are proposed for diversion
2. Diversion of rivers flowing through the area, work will involve training of river hydrology, erosion, flooding and cost implications.
3. Source of water vis-à-vis waste water to be generated along with treatment facilities to be proposed.
4. Examine the details of water requirement, use of treated waste water and prepare a water balance chart.
5. Rain water harvesting proposals should be made with due safeguards for ground water quality. Maximize recycling of water and utilization of rain water.
6. Examine soil characteristics and depth of ground water table for rainwater harvesting.

HYDROLOGY

Hydrological implications on sub surface water movements, flood planes, closure of creeklets and retraining of Ulwe and Gadhi Rivers.

SWOT ANALYSIS

A. STRENGTHS

Land available with CIDCO
- Site accessible by all modes of transport
- Availability of all basic supporting infrastructure
- Availability of townships to house airport working population
- Support from local population
- Provide alternative air-field in MMR
- Less Capital Cost.(Financially viable project)
- Attractive for development through Public and Private Partne rship

SITE INFRENCES

the Airport design should be based on the quality of the site, Based on the city,their need and the requirement and the future Growth of Aviation in the particular place.
1.Allow Natural lighting and sufficient landscape for the passanger to view.
2.Atmosphere
3.Noise/vibration level
4.Water quantity.

SOLID WASTE

1. Examine the location of solid waste treatment and disposal sites around the airport to avoid any bird menace.
2. Examine details of Solid waste generation treatment and its disposal.

DRAINAGE

More depth and width to Ulwe river while diverting it, ensure channeling of underground drainage system into rivers before flattening hills and filling up land for construction, build a canal connecting Gadhi and Ulwe rivers

B.WEAKNESSES

- Acquisition of 457 Ha. of land.
- Relocation of existing EHT line of Tata and MSEB.
- Diversion of Ulwe river and training of Gadhi river.
- Falls in CRZ area.
- Rehabilitation of Ten Settlements (15000 Population)

C) OPPORTUNITIES

- Will boost the development of Navi Mumbai and main land
- Create healthy competition between the two airports
- Relieve congestion at existing airport
- Better image of Mumbai in aviation field
- Increase business on State and National Level

TEMPERATURE

The Climate of Mumbai is a tropical, wet and dry climate. Mumbai's climate can be best described as moderately hot with high level of humidity. Its coastal nature and tropical location ensures temperatures do not fluctuate much throughout the year.

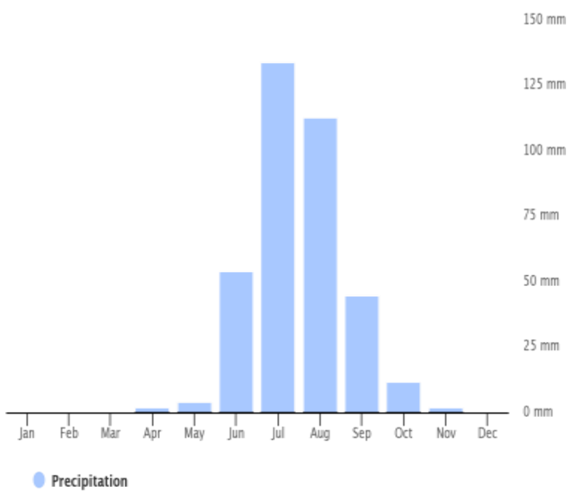
WIND DIRECTION

The wind rose for Navi Mumbai shows how many hours per year the wind blows from the indicated direction.

AVERAGE RAINFALL

The average rainfall of the area is represented by the following graph. The month of July receives the highest average annual rainfall of 134 mm.The month of April and November receives average annual rainfall of 2mm.

There is no rainfall in the month of January, February, March and December.

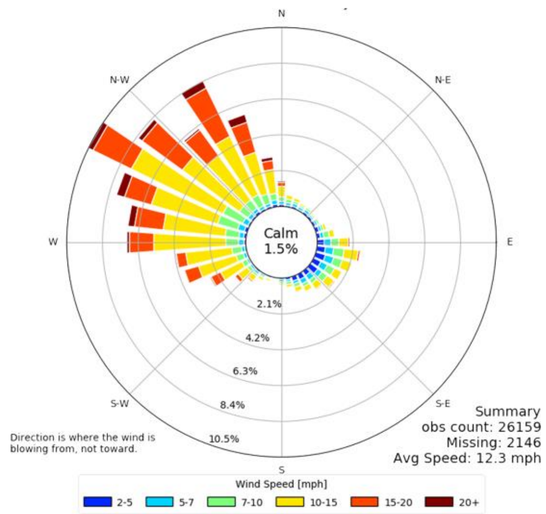


Average precipitation is 242.2 cm (95.35 inches).
Mumbai experiences three distinct seasons:
1. Winter (Nov to Feb or mid March) winter temperature 15 to 20 degree C
2.Peak Winter Months – Dec to Mid Feb with temperature range 12–19°C; 2. Summer (Feb/March to mid June and Sept to Nov) Avg temperature 30 to 27°C;
3.Peak Summer Months (Mid March to 1 June week), temperature shoots up to 30–40°C with humidity being approx 70–80%.

WIND SPEED

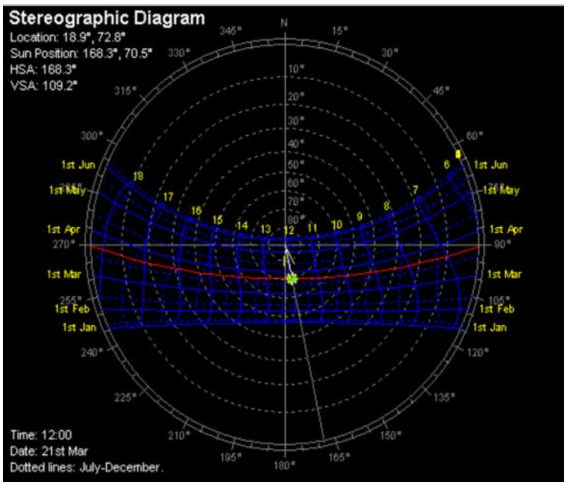
Annual average wind speed at Bhavnagar IMD station is 17.2 kmph. Winds are strong in the area. Highest mean wind speed (25.9 kmph) is observed in June whereas lowest wind speed (11.9 kmph) is observed in November & December.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	37.1 (98.8)	39.6 (103.3)	41.7 (107.1)	42.2 (108.0)	41.0 (105.8)	37.1 (98.8)	34.8 (94.6)	33.5 (92.3)	36.4 (97.5)	37.9 (100.2)	37.4 (99.3)	39.8 (103.6)	42.2 (108.0)
Average high °C (°F)	31.1 (88.0)	31.3 (88.3)	32.8 (91.0)	33.2 (91.8)	33.6 (92.5)	32.4 (90.3)	30.4 (86.7)	30.0 (86.0)	30.7 (87.3)	33.4 (92.1)	33.7 (92.7)	32.4 (90.3)	32.1 (89.8)
Average low °C (°F)	17.3 (63.1)	18.2 (64.8)	21.4 (70.5)	24.2 (75.6)	27.0 (80.6)	26.6 (79.9)	25.5 (77.9)	25.1 (77.2)	24.8 (76.6)	23.8 (74.8)	21.3 (70.3)	18.5 (65.3)	22.8 (73.0)
Record low °C (°F)	7.4 (45.3)	8.5 (47.3)	13.8 (56.8)	16.9 (62.4)	20.2 (68.4)	19.8 (67.6)	21.2 (70.2)	19.4 (66.9)	20.7 (69.3)	16.7 (62.1)	13.3 (55.9)	10.6 (51.1)	7.4 (45.3)
Average rainfall mm (inches)	0.3 (0.01)	0.4 (0.02)	0.0 (0.0)	0.1 (0.00)	11.3 (0.44)	493.1 (19.41)	840.7 (33.10)	585.2 (23.04)	341.4 (13.44)	89.3 (3.52)	9.9 (0.39)	1.6 (0.06)	2,373.4 (93.44)
Average rainy days	0.0	0.1	0.0	0.0	0.8	13.6	22.9	21.5	13.9	3.4	0.6	0.2	77.0
Average relative humidity (%)	69	67	69	71	70	80	86	86	83	78	71	69	75
Mean monthly sunshine hours	269.5	257.6	274.3	283.7	296.2	148.6	73.4	75.9	165.1	240.2	245.8	253.2	2,583.5



HUMIDITY

RH is highest during August (83% at 8:30 hour and 70% at 17:30 hour) and lowest during March (47% at 8:30 hour and 26% at 17:30 hour). RH is higher by 12 to 24% at morning 08:30 hour compared to evening 17:30 hour.



sun path diagram

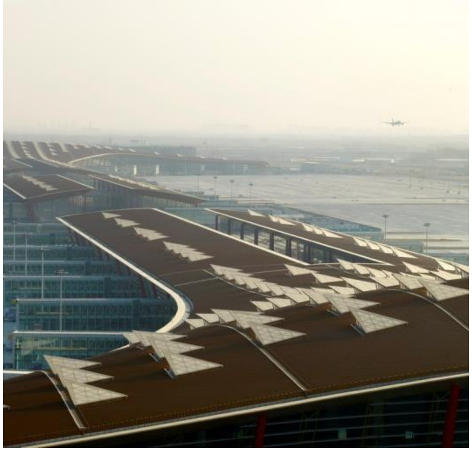
LITERATURE STUDIES

BEIJING CAPITAL INTERNATIONAL AIRPORT (T3) BEIJINGI,CHINA.

BEIJING CAPITAL INTERNATIONAL AIRPORT is the main international airport serving Beijing. It is located 32 km (20 mi) northeast of Beijing's city center, in an enclave of Chaoyang District and the surroundings of that enclave in suburban Shunyi District. The airport is owned and operated by the Beijing Capital International Airport Company Limited, a state-controlled company

Architects	Foster + Partners
Location	Beijing, China
Client	Beijing Capital International Airport Company Ltd.
Project Year	2008
Gross floor area	13,00,000 sq.m.
Aero bridges	72
Capacity	82 million ppa

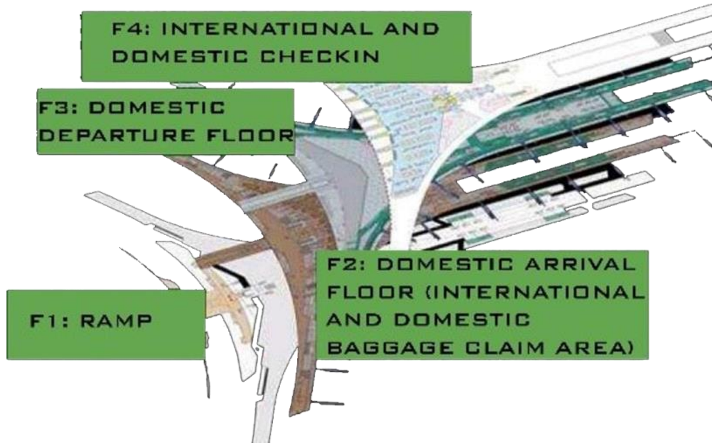
Beijing capital international airport is the second busiest airport in the world (in terms of passenger traffic). Terminal 3 of the BCIA is currently the second-largest airport passenger terminal building in the world. Its title as the world's largest was surrendered on 14 October 2008 to Dubai International Airport's Terminal 3, which has 1,713,000 m^2 (18,440,000 sq ft) of floor space.



PHILOSOPHY OFTHE TERMINAL BUILDING

As an interpretation of traditional chinese culture the roof of the airport has a dragon-like form. According to Norman Foster this is a building borne of its context. It communicates a uniquely Chinese sense of place and will be a true gateway to the nation. This is expressed in its dragon- like form and the drama of the soaring roof that is a blaze of „traditional" Chinese colours – imperial reds merge into golden yellows. As you proceed along the central axis, view of the red columns stretching ahead into the far distance evokes images of a Chinese temple.

There are two "Y" shaped passenger terminal buildings TERMINAL 3C and TERMINAL 3E. A finger shaped terminal building has been designed and placed between both the terminal - TERMINAL 3C and TERMINAL 3E. A ground transportation center (GTC) has been designed and is connected to terminal 3C.

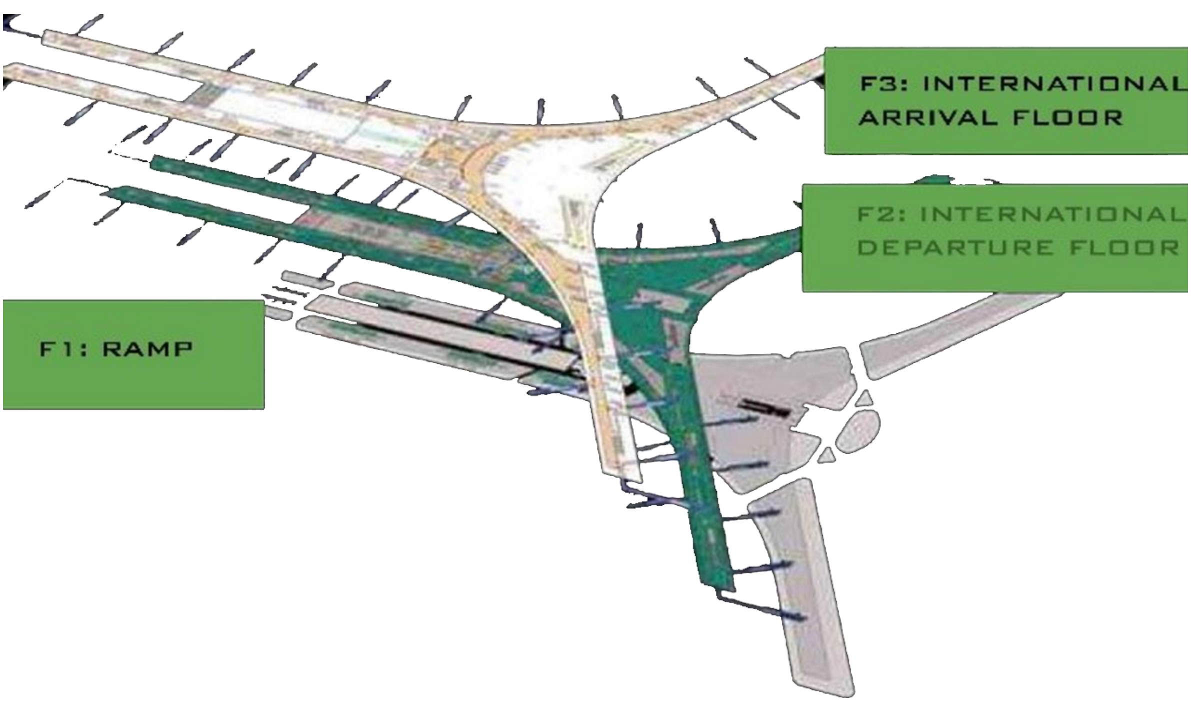


TERMINAL 3C

- T3C has 5 floor above ground and 2 floor underground.
- The first floor is the ramp.
- The second floor is used for domestic arrivals, baggage claim and transferring to Terminal 3D and Terminal 3E through an automatic people remover.
- The third floor is used for domestic departures and for some commercial regions.
- The forth floor is used for international and domestic check in.
- A total number of 11 check in stations, with 292 counters altogether, lie parallel from east to west.

TERMINAL 3E

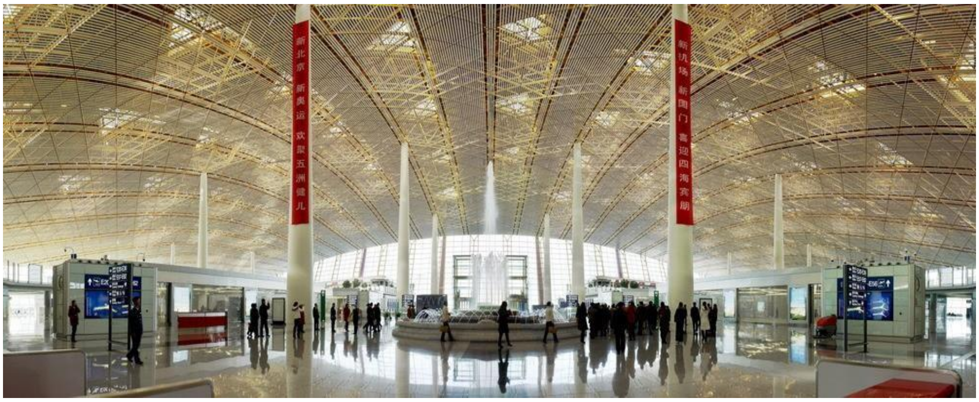
- The first floor is the ramp and automatic people mover.
- The second floor is for international departures, the customs and apm station.
- The third floor is for is for international arrivals.
- Its departure and arrival arrangement is the mirror image of the terminal 3C.



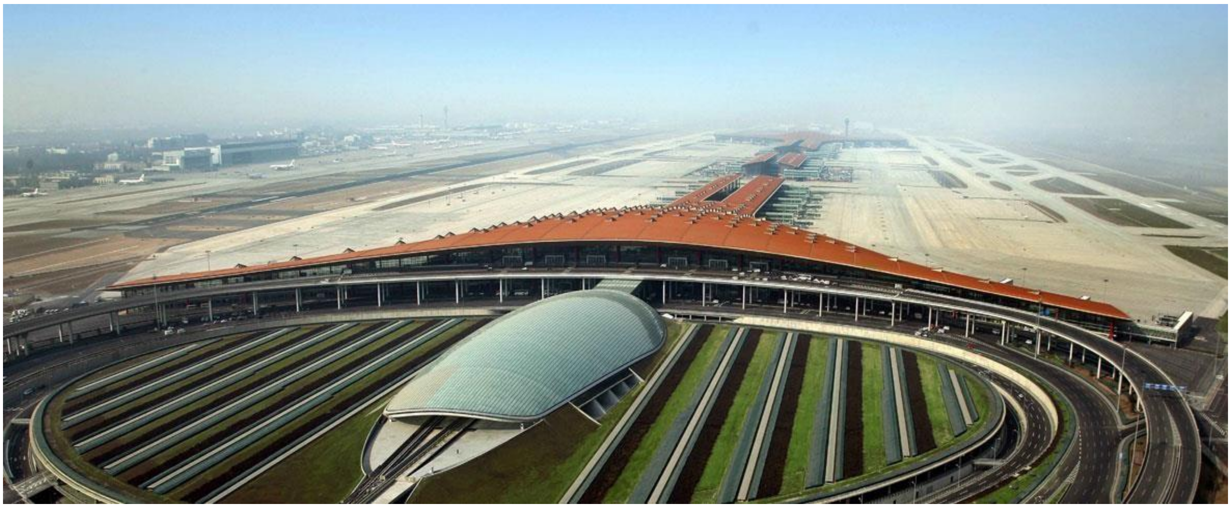
TERMINAL 3D

- The TERMINAL 3D is an extended finger of TERMINAL 3C, with a gross area of 91,000sq.m, 385 meter long south to north, and 108 meter wide from east to west.
- The first loor is the same as others.
- The second floor is for international departures and the customs.
- The third floor is for international arrivals.

The commercial shops, retail areas and food courts are spread in all the three terminals on all the floor accept arrival floors.



GROUND TRANSPORTATION CENTER (GTC)



- A ground transportation center is connected to TERMINAL 3C from the south ditrection.
- Ground transportation center has four floors.
- The two floors below ground are used for parking area.
- The first floor above ground is used as terminal for airport shuttles and intercity busses.
- The second floor is used for railway system.

ARCHITECTURAL FEATURES.

- Parallel lines going south-north wise are designed on the ceiling. This will assist passengers in identify directions.
- Glass walls are designed which allows natural light come into the building, reducing the requirement for lighting system.
- The glass walls are 15 degrees inclined towards outside of the building, to avoid the reflection from the glass and gives a better view of the airport to the passengers.
- The TERMINAL 3 buildings have a total number of 155 skylights on the roof.
- All skylights are facing southeast, this design can take advantage of the day light coming from southeast in the morning, and avoiding western exposure in the afternoon providing glare free natural light.

BAGGAGE HANDELING SYSTEM

- A baggage handling system with a total length of 68 kilometers is installed in TERMINAL 3 buildings.
- The system is able to process a maximum of 19200 units of baggage per hour.
- It can travel at a speed of 7 meters per second, which allow the baggage to be transferred from TERMINAL 3C to TERMINAL 3E in just 4.5 minutes.
- Each baggage is assigned to a single baggage holding plate, and scan the bar code of the baggage from 6 different directions.

CONNECTIONS BETWEEN THE TERMINAL BUILDINGS

- International departures and arrivals have to travel between TERMINAL 3C and TERMINAL 3E, with a distance around 2 kilometers.
- To reduce the passenger transportation, an automatic people mover (ATM) system is used .
- The ATM system in each direction is 2080mm, making three stops at TERMINAL 3C, TERMINAL 3E respectively.

- The interval between two consecutive ATM is 3 minutes.
- The total travelling time is 4 minutes for the whole trip.
- This system can transfer maximum of 4227 passengers per hour each direction.

- The single unifying roof canopy is perforated with skylights to aid orientation and bring daylight deep into the building. The color palette moves through 16 tones from red at the entrance at T3A through to orange and finally yellow at the far end of T3B. This establishes a subtle zoning system that breaks down the scale of the building and enables easy way finding. This palette is also applied north to south in the ceiling above the arrivals and departures halls, heightening the sense of curvature in the roof plane.

- Although the length from north to south is three and a quarter kilometers, the visual links between the three elements are maintained by strong sight lines as well as visual connections between the lower level and an open mezzanine level above. All spaces are naturally lit and the generous glazing and skylights maintain a link with the outside and its changing sky. Views along the central axis are marked by the distinctive red columns, which continue along the external edges of the building into the distance, evocative of traditional Chinese temples

HONG KONG INTERNATIONAL AIRPORT, HONG KONG

INTRODUCTION:

The airport was built on a largely artificial island reclaimed from Chek Lap Kok and Lam Chau. The two former islands that were leveled comprise about 25% of the surface area of the airport's 12.48 km² platform. It is connected to the northern side of Lantau Island near the historic village of Tung Chung, now expanded into a new town. Land reclamation for the airport added nearly 1% to the entirety of Hong Kong's surface area. It replaced the former Hong Kong International Airport (popularly known by its former name Kai Tak Airport), which was located in the Kowloon City area with a single runway extending into Kowloon Bay close to the urban built-up areas. The two runways have an ultimate capacity of over 60 aircraft movements an hour. At present there are 49 frontal stands, 28 remote stands and 25 cargo stands. Five parking bays at the Northwest Concourse are already capable of accommodating the arrivals of the next generation of aircraft.

HKGIA GOOGLE MAP

LOCATION:
Lap Kok, Hong Kong.
CLIENT:
Hong Kong.
ARCHITECTS:
AREA:
PASSENGER CAPACITY:
OPENED : PASSENGERS:
passengers

Located inChek

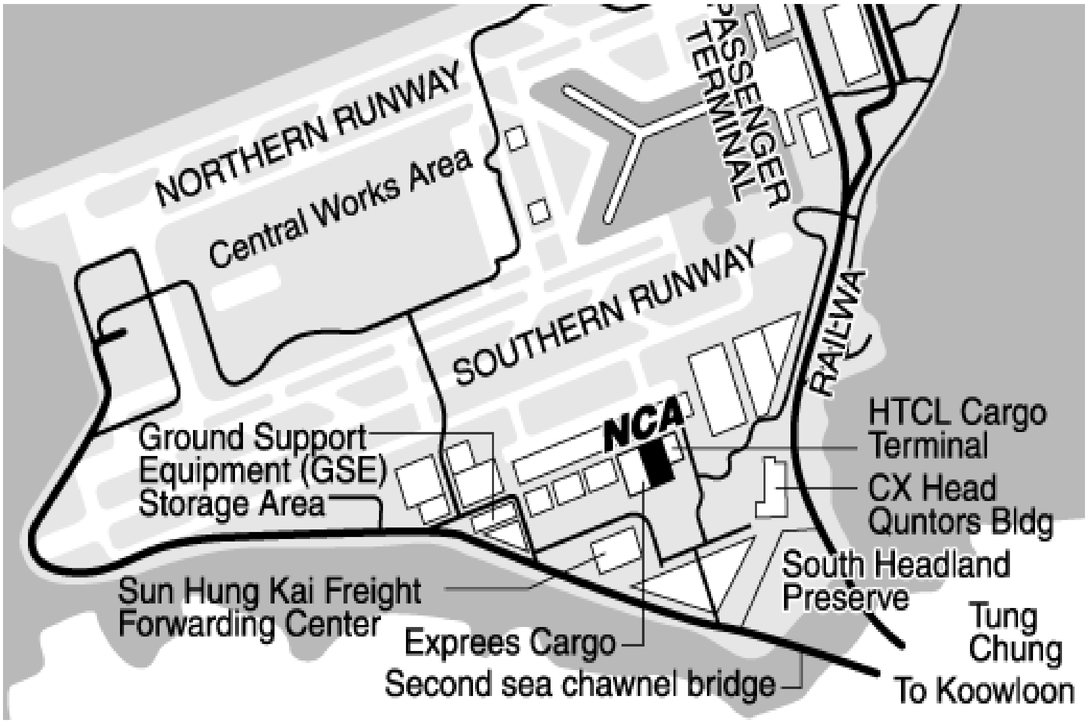
Airport authority

Foster and partner

1,255 hectares.
60,000000
6 July 1998
68.5 million

INTEND OF THE CASE STUDY:

To understand the guiding principles and design criteria on which a airport terminal is based and its supporting services.



PLAN OF HKGIA, HONK KONG

TRANSFER BETWEEN THE TERMINALS:

A free automated people mover train runs between the east and west halls of Terminal 1 and from the new Terminal 2 to the gates. Electric vehicles can also transport passengers around the terminal for a fee.

TERMINALS:

Terminal 1

Terminal 1 of the HKIA, with an area measuring 570,000 square metres (6,100,000 sq ft), is the third largest airport passenger terminal building inthe world, after Dubai International Airport's Terminal 3 and Beijing Capital International Airport's Terminal 3.

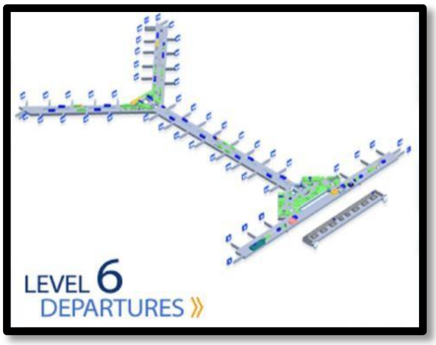
Terminal 2 (140,000 m2 (1,500,000 sq ft)), together with the SkyPlaza, opened on 28 February 2007 along with the opening of the Airport Station's Platform 3. It is only a checking and processing facility for departing passengers with no gates or arrival facilities (passengers are transported underground to gates atTerminal 1).

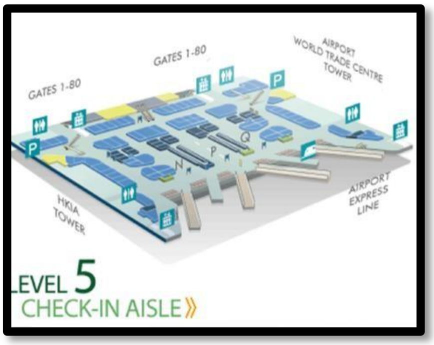
PASSENGER FACILITIES :

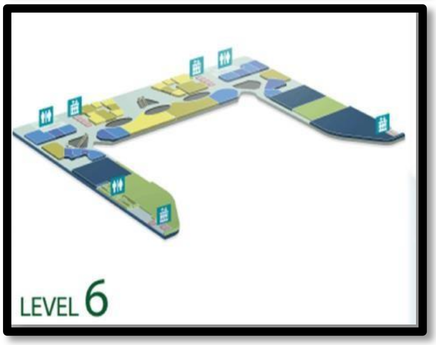
Despite its size, the passenger terminal was designed for convenience. The layout and signage, moving walkways and the automated people mover help passengers move through the building.

The HKIA Automated People Mover a driverless people mover system with 3 stations transports passengers between the check-in area and the gates. The trains travel at 62 kilometers per hour (39 mph). The airport also boasts an IMAX theatre that has the largest screen in Hong Kong. The theatre is located in Terminal 2, level 6 and can seat 350 persons at a time.

PASSENGER CIRCULATION LEVELS TERMINAL1,HKGIA

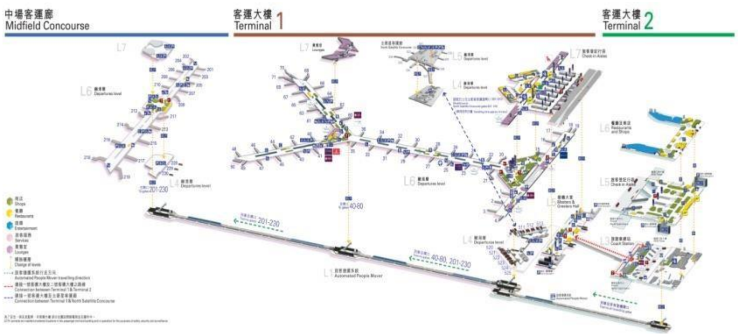






PLANNING

Commissioning of Hong Kong International Airport ("HKIA") in July 1998 marked the completion of the Airport Core Programme –an integrated series of infrastructure projects which included land reclamation, expressways, bridges, a dedicated airport railway system and development of a new town at nearby Tung Chung.

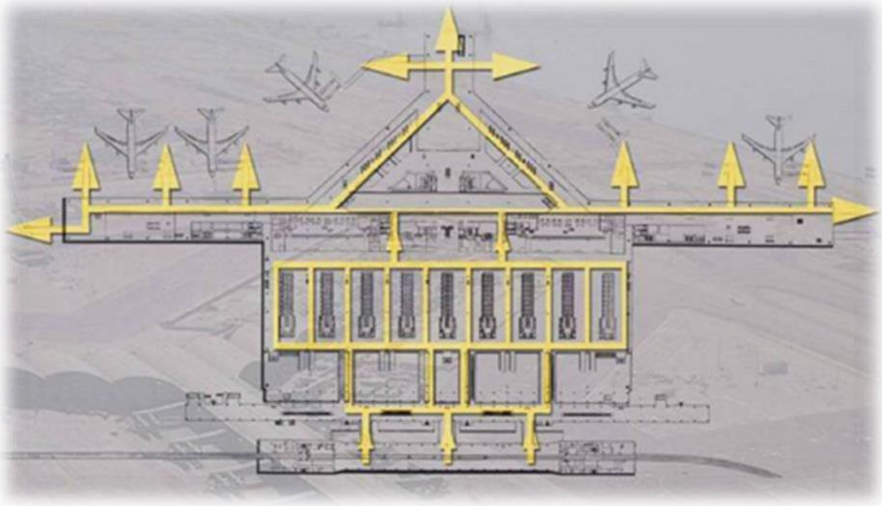


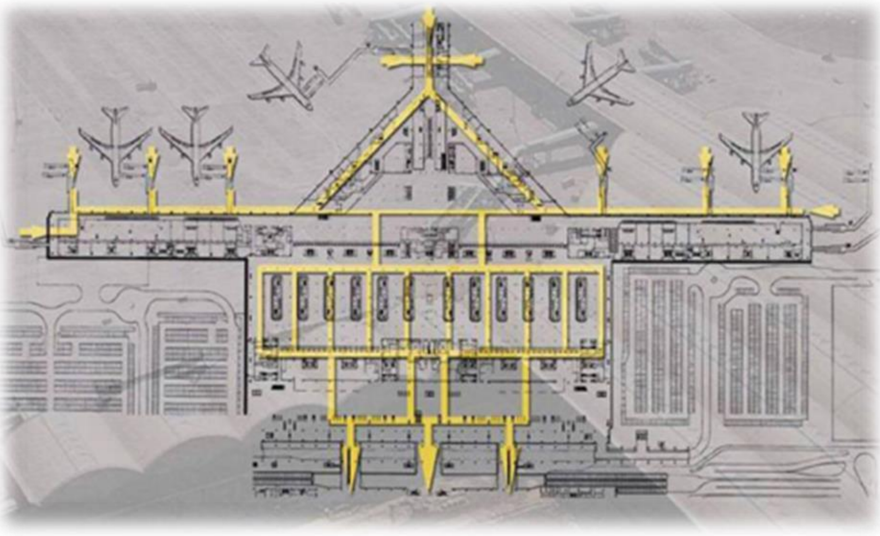
FACILITIES:

CHECK IN COUNTERS:	288
IMMIGRATION DESKS:	200
CUSTOMS:	80

OTHER FACILITIES:

There is a medical Centre on level 6 and a pharmacy. The Plaza Shower and Relaxation Lounge on level 7 of the west hall is open 24 hours and provides shower rooms, semi-private napping rooms and a mini salon. There is also an Oriental *Massage Centre.*





PLANS HKGIA,HONG KONG

CASE STUDIES

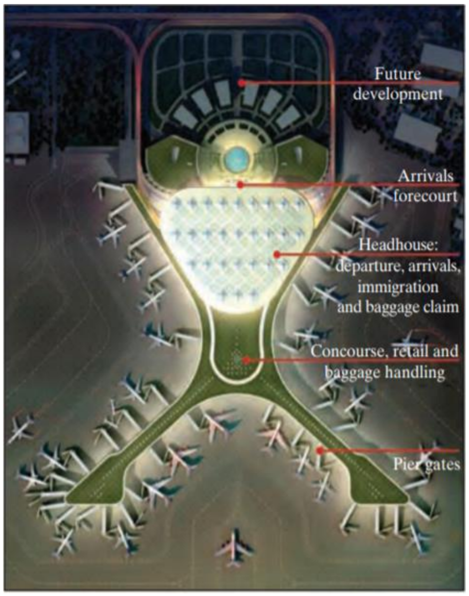
C

CHHATRAPATI SHIVAJI INTERNATIONAL AIRPORT (TERMINAL2)

Mumbai International Airport Limited(MIAL),a consortium of GVK Industries Ltd.(GVK) and Airport Company South Africa(ACSA),was appointed to carry out the modernization of Mumbai Airport in Februray 2006. MIAL unveiled the master plan for CSIA, which has been designed to expand and upgrade the infrastructure to cater for 40 million passengers per yr and one million tonnes of cargo per year by 2013.

TERMINALS

The airport has two main passenger terminal complexes. Terminal 1 at Santacruz was dedicated for domestic passengers and today, it is only for domestic passengers of select low-cost airlines. Terminal 2 at Sahar was the former arc-shaped international terminal, and today, the new X-shaped building is an integrated terminal catering to both international and domestic passengers.

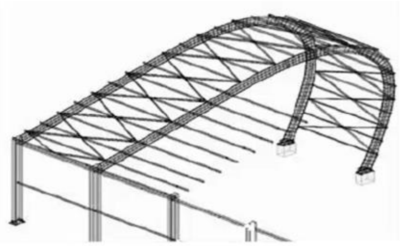


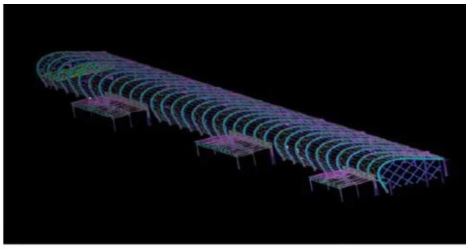
master plan of mumbai airport

TERMINAL-1

Terminal 1, locally known as Santacruz Airport, is used for domestic flights primarily operated by low-cost carriers. It was used by SpiceJet, GoAir and IndiGo, The terminal has 11 passenger boarding bridges.Several airlines operate airconditioned Cerita buses owned by BEST to ferry pass -engers between the terminal and aircraft.It was further divided into Terminals 1A, 1B and 1C after their permanent closure during the course of late 1990s.

CONSTRUCTION OF TERMINAL 1C (DOMESTIC AIRPORT)





LEVELS
Ground Level
1.Arrivals level.
2.Baggage claim area and access to transportation.
First level
1.Departures and check-in level.
2.Access to boarding gates after security check.
3.There are two concourses: Concourse B and Concourse C.

SERVICES
- Restaurants and cafés
- Currency Exchange
- Postal Service
- Smoking Areas
- Baggage Trolleys and Wrapping
- Stores
- ATMs
- Free Wi-Fi
- Information desk
- Baby care facilities

LOUNGES
Travel Club Lounge: Terminal 1.
24 hours open.
Services: Premium food, snacks, drinks, Wi-Fi, newspapers and magazines, TV, Internet terminals

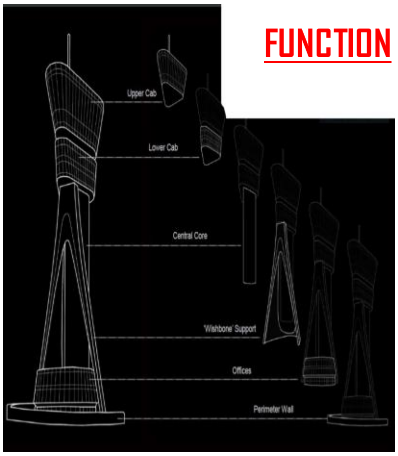
AIR TRAFFIC CONTROL TOWER

Air traffic control tower India's tallest Air Traffic Control (ATC) Tower with a height of 85 m (279 ft) stands in a section of the parking area opposite terminal 1B. The triangular three-dimensional structure with soft vertices that won the Hong Kong Building Information Modeling (BIM) Award for the year 2009, has six storeys commencing from 62.1 m (204ft). The tower was inaugurated on 18 October 2013 and took over operations on 1 January 2014.

FEATURES

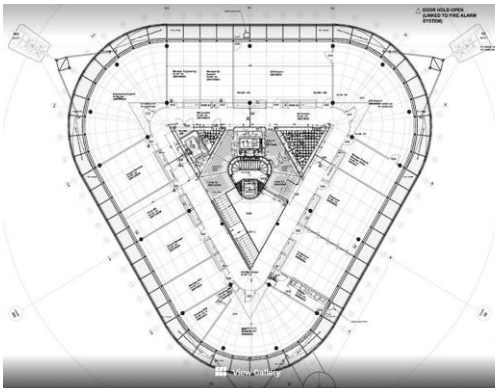
Built in a site area of 1200 sq.m, the tower consists of 3 floors at its base called the technical block for security and Airport Authority of India (AAI) staff for ATC operation.

There are 4 floors at the top called the 'Stalk and CAB' that accommodates the ATC operational area, navigation equipment, etc. The rest of the tower between the technical block and stalk is only a RCC shaft housing lifts and staircases.



FUNCTION

The success of the ATCT lies not simply in its capacity to be seen as the public face of the airport, but also in how clearly it oversees the airport and its multitude of functions.



The semicircular layout of the cab allows multiple viewpoints of the approaches for almost 360° without the need for the controllers to move.Each of the 36consoles for the cab's various control and planning staff is carefully oriented to allow views that, taken together,nearly cover the entire airfield and activity on the ground – impressive given that there are two runway, two terminals, as well asnumerous other potential obstructions.Air traffic controllers are seated on a pedestalbehind but above the other staff manning the cab's control room, and the structure

The ATCT is more than just a beacon for travelers and city dwellers within the central region of Mumbai; it is the critical link between travelers from around the world and their safe arrival to engage business, loved ones and future possibilities on the ground. Priority in the design is always given to the control tower's ability to see and hence regulate the whirl of activity and movements at the airport. while one of the tallest buildings in the area – remains at a low enough elevation to avoid higher stratum fog and haze that would inhibit visibility

Construction Challenges
Safety Overview

- Total Fire extinguishers at a time at site: 50 Nos.
- Total Man hours worked since inception: 2 Million

Total area of 8900 Sqm covered by Safety Nets

SCOPE OF WORK

Terminal Works

1.One-roof new passenger terminal of 4,39,204 sq.m and ancillary facilities.

2.63 contact and 10 remote stands Connector building (T1 C) for two domestic terminals T1 A and T1B.

Airside Works

1.Airfield pavements including runway reconstruction and potential widening of 6.5 km of runways

2.3 new parallel taxiways, associated connectors and rapid exit ways

3.10 million sq.ft. of hard stands for new terminal and for general aviation, airline support and aircraft maintenance

4.Taxiways and aprons for large widebodied 'Code F' aircrafts

5. Associated support buildings, systems and utilities

The elevated corridor leads to a 70 meter wide bay at each of the four levels of the terminal building where visitors are treated to tastefully landscaped areas and adequate signage. One can never feel lost in a 4.39 lakh sq.m expanse equipped to handle 40 million passengers per annum.Resembling an 'X' from a bird's eye view, the T2 has four levels. The uppermost is common for both international and domestic checkin facilities apart from having international security and retail areas.

REQUIREMENTS

1. 10 lakh cu.m concrete
2. 58,000 t reinforcement steel
3 36,000 of structural steel
4 36,000 sq.m of skylight roofing
5. 1.4 lakh sq.m of roofing
6. 28,000 sq.m of façade
7. 11,000 sq.m of cable net wall type façade
8. 46,000 sq.m of ceiling & cladding
9.20.6 km of chilled water piping works
10. 188 check-in counters
11. 5 levels of security screening
12. 2.5 lakh sq.m of ducting
13. 87 elevators
14. 55 escalators
15. 41 travelators
16. 52 passenger boarding bridges
17. 1,98,000 sq.m granite for flooring

VERTICAL & HORIZONTAL TRANSPORTATION

Escalator

With a capacity to handle 9000 persons/ hour, the heavy duty escalators have a rated speed of 0.5 m/s and riserange from 3 to 11.6 m. Among the 55 escalators installed is 'India's tallest airport escalator' which rises to 11.6meters going all the way from the 6th to 10th level of the multi-level car parking(MLCP). Eight escalators are exclusively for the transportation of passengers between MLCP and the terminal building.

Travelators

Travelators a.k.a 'moving walkways' have been thought -fully provided around the terminal to improve passen -ger mobility.MIAL features 41 of such equipment with a handling capacity of 16,200 persons / hour and a rated speed of 0.65m/s. If installed one behind another the travelators would measure a whopping 1.3 km in length. MIAL alsofeatures the first 'Pit-less Travelator'installed in Asia which eliminates the need for a 'travelator pit' and simply rests on the finished floor.

Elevators

There are 87 elevators with stops ranging from 2 to 20 landings with a handling capacity of 544 to 5000 kg and speeds varying from 0.5 to 1 m/s. A high capacity elevator is installed exclusively for moving large show pieces and automobiles into the retail

MULTI-LEVEL CAR PARK

The Multi-level Car Parking (MLCP) at MIAL could easily be India's largest at an airport packed with some of the most passenger-friendly conveniences. The 10 floor MLCP has a 5000 car and 400 two wheeler capacity and can be accessed from both the elevated and at graderoad levels. Built on a 2.32 lakh sq.m area, it connects to every level of the terminal via 8 elevators and 8 escalators for hassle-free movement. The MLCP is also stacked with adequate trolleys for baggage handling and wheelchairs for the differently abled. The HVAC system includes 3324 fans for ventilation and the entire building features a world-class fire detection and protection system apart from CCTV surveillance and public announcement systems for enhanced safety of passengers.

ELECTRICAL WORKS

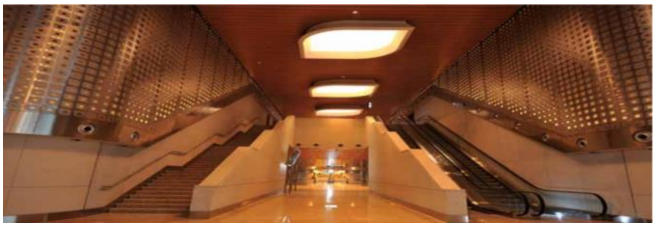
The scope under the electrical system broadly involved power distribution to all utilities, customized chandeliers, decorative feature walls and ceilings and life safety equipment with an IT back bone. The entire work was designed for safety, reliability, operability , maintainability and, at the same time, to ensure a modular design so as to allow the electrical services to grow along with the airport during future expansion phases.

DESIGN CRITERIA

The terminal area was divided into 100% treated fresh air units supplying treated fresh air to tenant spaces such as retail, duty free shops, restaurants,eateries and CIP/VIP lounges within that zone. Life safety systems such as smoke extract systems and lift / stairwell processor pressurization systems are based on the respective NFPA codes. The smoke extract systems for public areas include smoke extract fans designed for high temperatures (300°C) and fire rated ducts.several zones based on various factors,requirements and functions and then accorded weightage based on their functions such as IT, critical services,passenger and retail zones. The termin al building had 13 zones with each one having a mechanical room that housed the Air Handling Units (AHUs) and the heat recovery units for that particular zone. The heat recovery unit consisted of enthalpy wheel and supply / extracts fans with filters. Some mechanical rooms had 100% treated fresh air units supplying treated fresh air to tenant spaces such as retail, duty free shops, restaurants, eateries and CIP/VIP lounges within that zone.

LIGHTING WORKS

CHANDLIERS RESEMBLING LOTUS PETALS

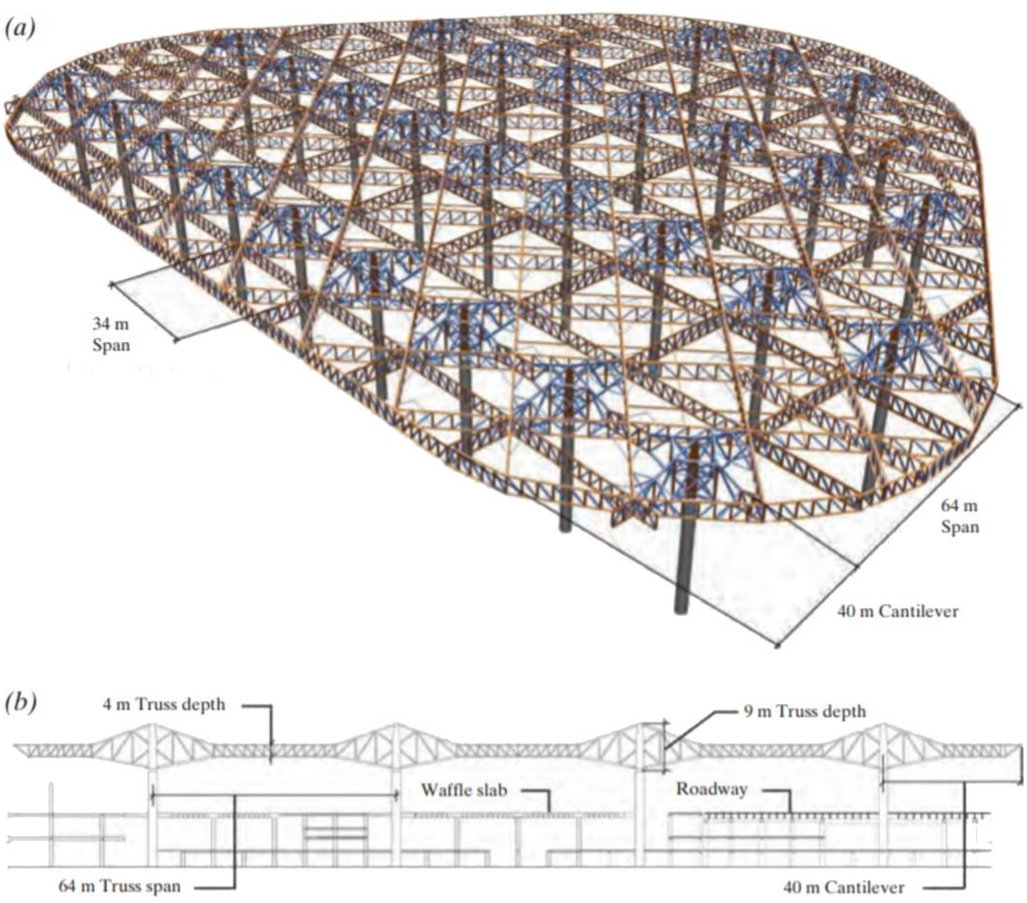


Lighting that integrates skylight and electrical light

STRUCTURES

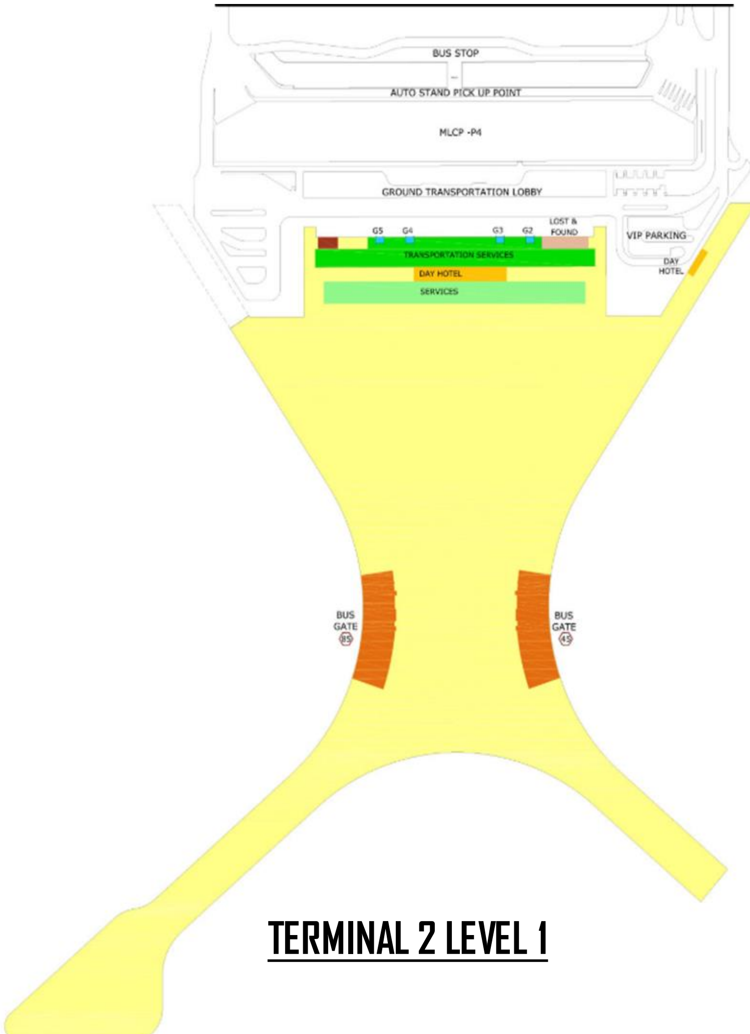
Beyond typical gravity and seismic loads on the roof, special loading considerations were taken for the cable wall which applies a significant wind load to the roof structure and whose cables are pre-stressed against the roof trusses at the nort-hern end of the terminal. The wind loading also presented challenges as a significant portion of the Headhouse Roof is open to the outdoors and beha-ves as a canopy. In order to create one of the largest roofs in the world without an expansion joint, the roof mega-columns and steel roof structure were kept completely independent from the base concrete structures below. Large openings in the concrete base structure allow the mega-columns to pass through as well as create architectural design features. In response to the functional requirement . of the space below the roof, the entire Headhous e Roof is supported on just 30 composite mega-columns.

Fig. 3: Three-dimensional solid finite element analysis model of column pod top node connection: (a) three-dimensional finite element mesh of column pod top node; (b) finite element von Mises stress results of column pod top node (N/m²)

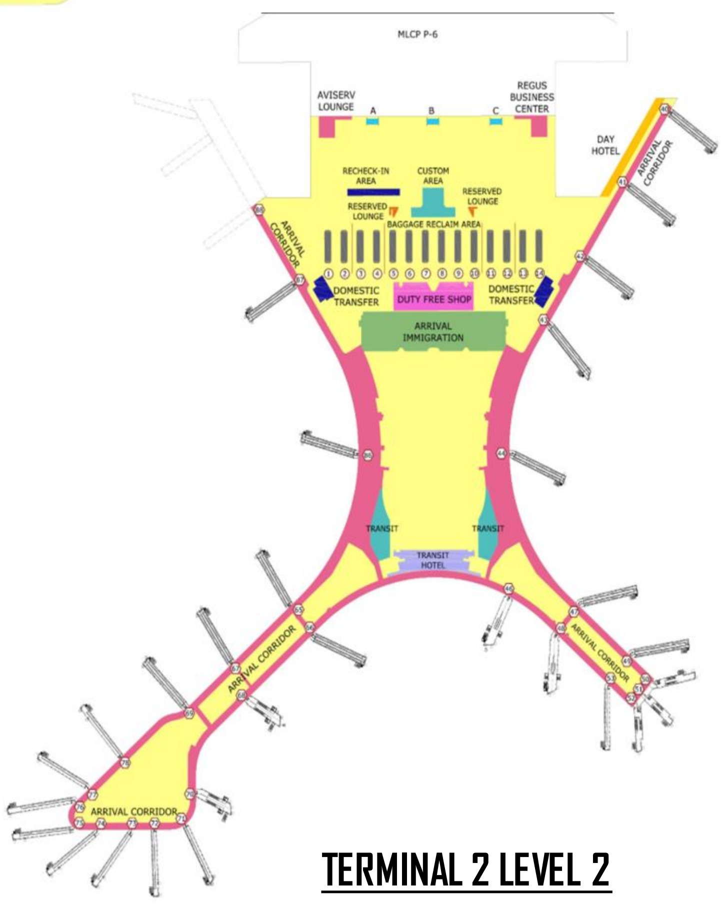


(a) Three-dimensional structural model of Headhouse Roof framing; (b) section through Headhouse Roof

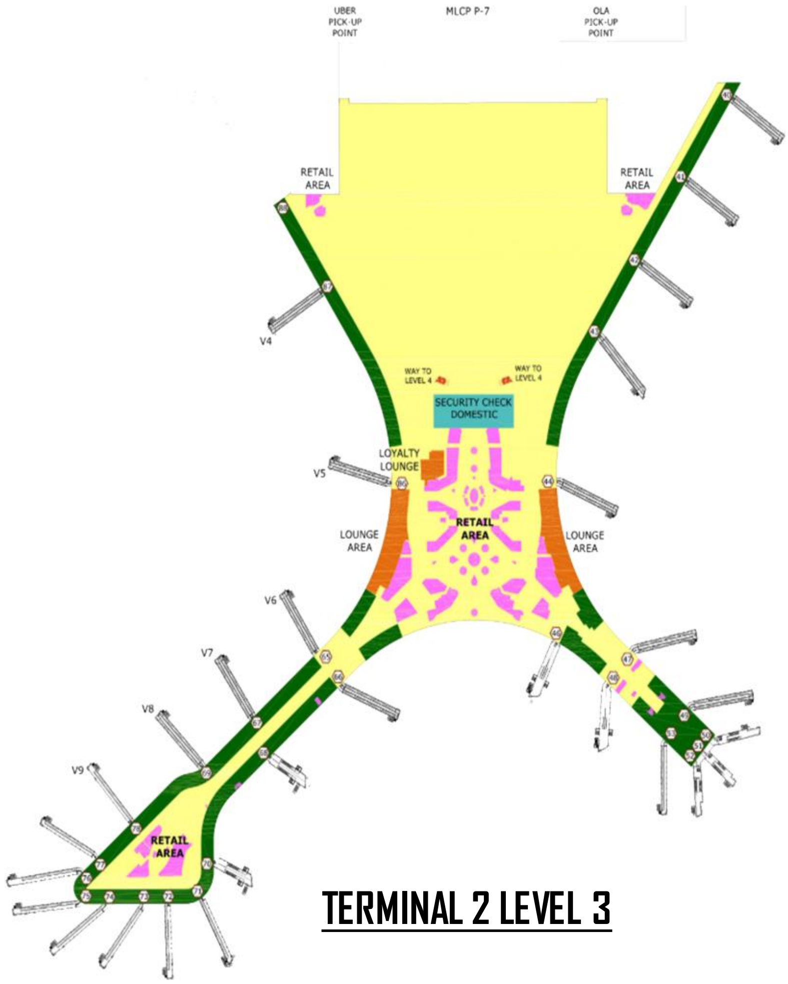
FLOOR PLANS



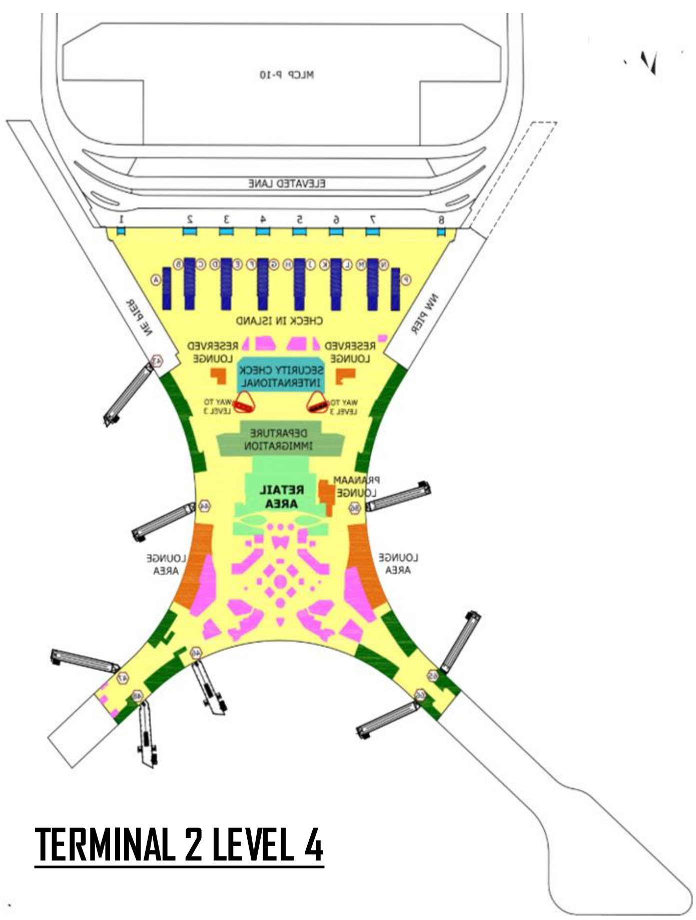
TERMINAL 2 LEVEL 1



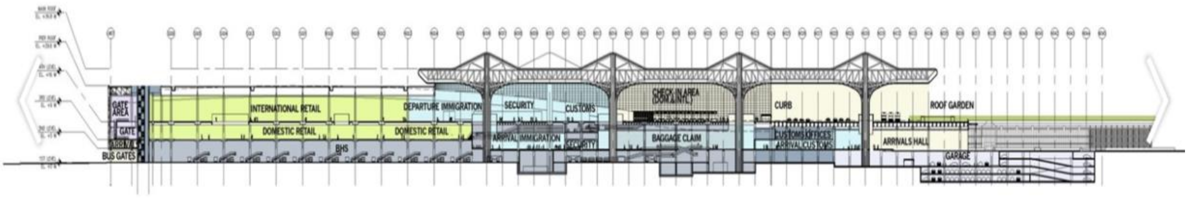
TERMINAL 2 LEVEL 2



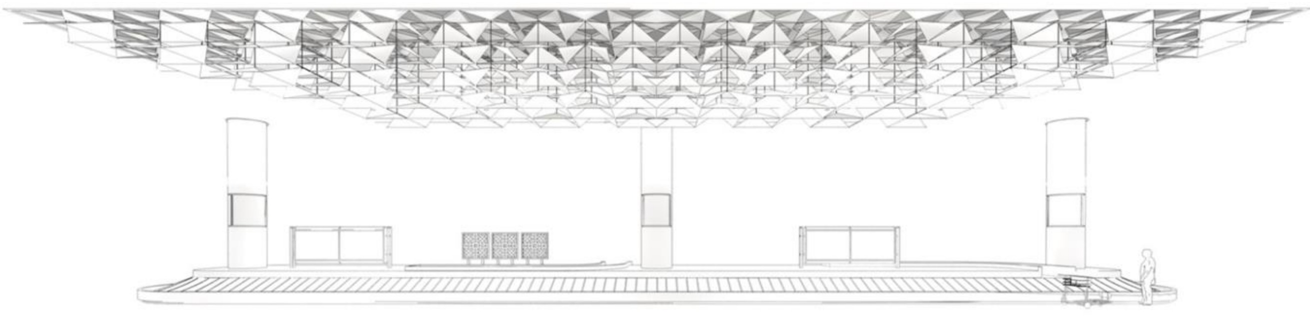
TERMINAL 2 LEVEL 3



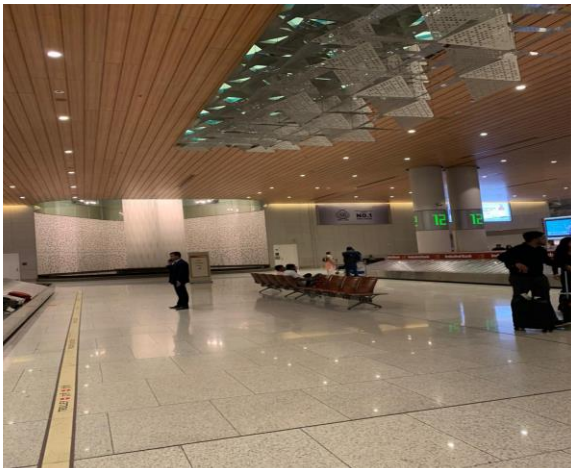
TERMINAL 2 LEVEL 4



SECTION OF CHHATRAPATI SHIVAJI INTERATIONAL AIRPORT



BAGGAGE CLAIM HALL CEILING AREA



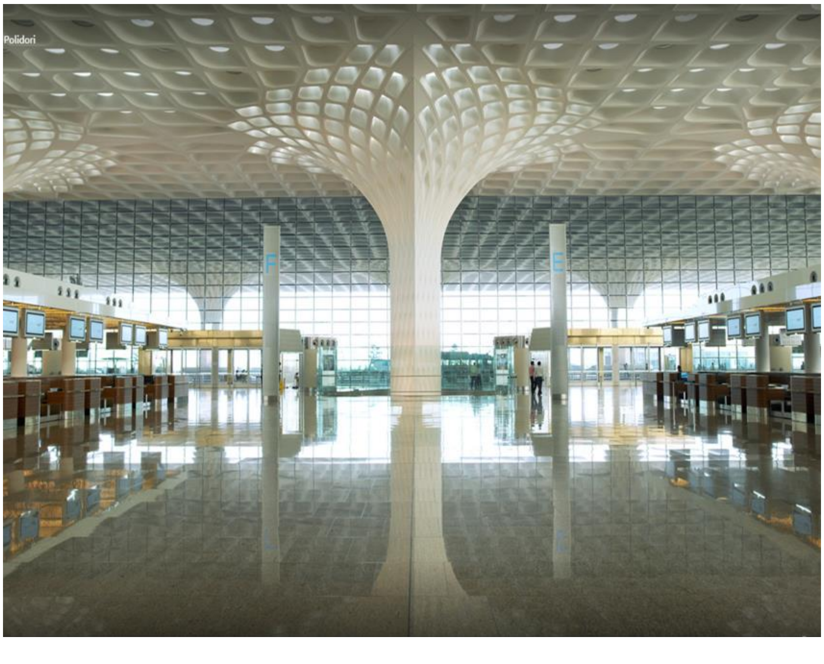
SCOPE AND SCALE

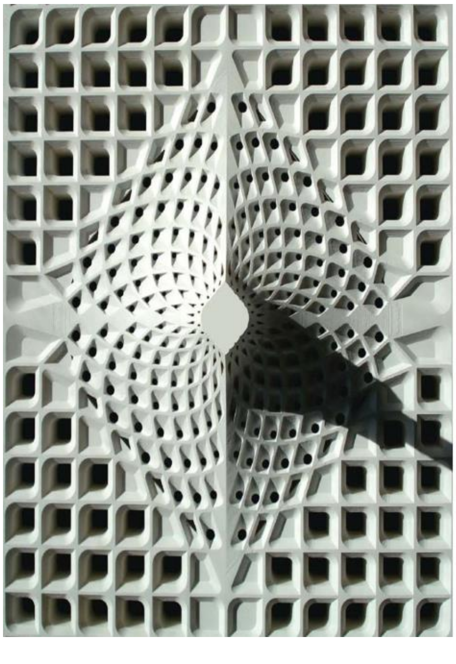
- The size and scale of the project is difficult to appreciate by photography alone. The components manufactured were unusually large and complex.

Standard coffers were 2.8M x 2.7M (9'-2L" x 8'-9W").

• Column shafts were 3M (10'-0")W x 4M (13'-0")L x 8M tall (26'-0") • Column capitals were 7M tall (22'-0") and 34M (111'-0) in diameter, and made up of 320 pieces

• The scope of components supplied included: – Standard coffers – 3,055 – Coffer caps – 1,249 – Capital perimeter parts – 879 – Capital parts – 5,017 – Column shafts – 2,470 – Domes and troughs – 183





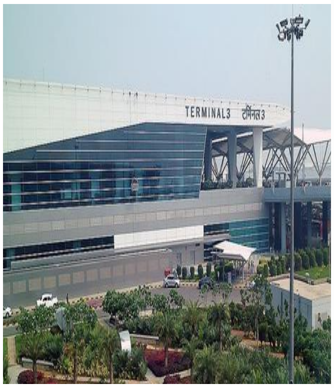
INDIRA GANDHI INTERNATIONAL AIRPORT, DELHI

INTRODUCTION

Due to increasing passenger traffic at Safdarjung airport, civilian operations were moved to Palam Airport (later renamed to IGIA) in 1962.Palam Airport had been built during World War II as RAF Station Palam and after the British left, it served as an Air Force Station for the Indian Air Force. Palam Airport had a peak capacity of around 1,300 passengers per hour. Owing to an increase in air traffic in the 1970s, an additional terminal with nearly four times the area of the old Palam terminal was constructed. With the inauguration of a new international terminal (Terminal 2), on 2 May 1986, the airport was renamed as Indira Gandhi International Airport. New airport terminal T-3 at Indira Gandhi International Airport, has been successfully completed in 3 July 2010. Terminal 3 offers a connecting time of 45 minutes for international to international and 60 minutes for international to domestic services. Delhi currently has direct connections to 58 international destinations and all major domestic destinations.

TERMINALS AT IGIA

. Terminal 1, is used by lowcost carriers such as GoAir, IndiGo and SpiceJet, and is divided in Terminal 1 - C, used for arrivals, and Terminal 1 -D, used for departures. Terminal 3 is a new terminal opened in 2010 and is one of the biggest terminals in the world, being able to handle 34 million passengers per year. Other terminals like T1A, T1B, T2 are unused nowadays.

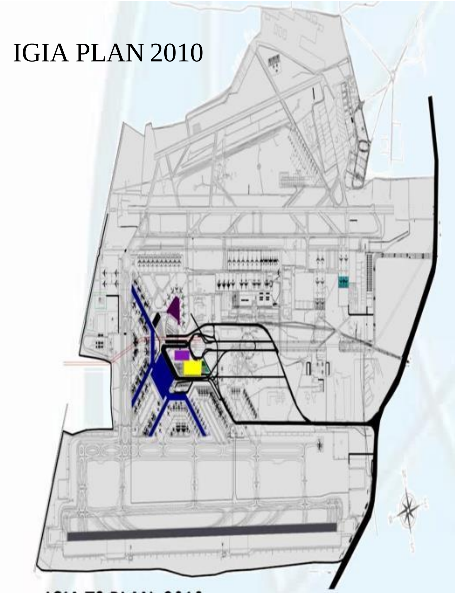


GOOGLE EARTH IMAGE OF AIRPORT

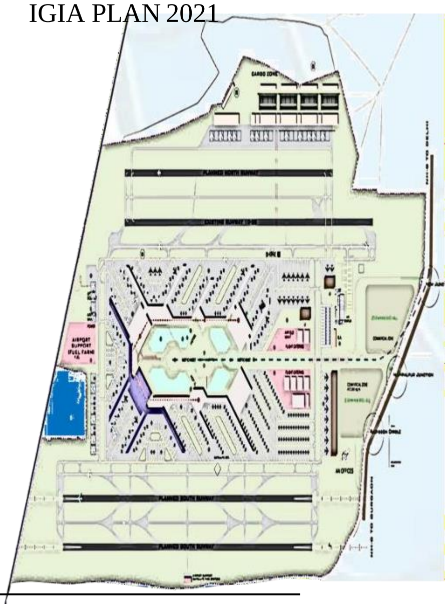
DEVELOPMENT OF IGIA

IGIA PLAN 2008

IGIA PLAN 2010



IGIA PLAN 2021



INTEND OF THE CASE STUDY:

To understand the guiding principles and design criteria on which a airport terminal is based and its supporting services

CLIENT

The airport is operated by Delhi International Airport (DIAL), a public-private consortium led by GMR Group, GMR (54%), Airports Authority of India (26%), Eraman Malaysia (10%) and Fraport (10%

DESIGN TEAM

Mott McDonald group but they again appointed leading global architect HOK international, to design the T3.

AREA

Indira Gandhi International Airport, spread over an area of 5,106 acres

PASSENGER CAPACITY:

It became India's and South Asia's largest aviation hub, with a current capacity of handling more than 62 million passengers. The planned expansion program will increase the airport's capacity to handle 100 million passengers by 2030. In 2013, the airport was the 32th busiest in the world with 36.7 million passengers handled, registering a 7% growth in traffic over the previous year.

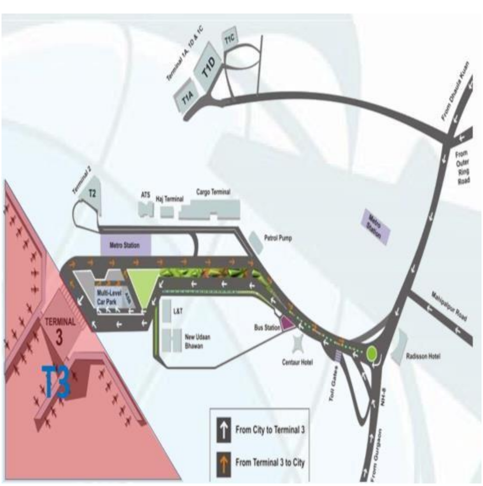
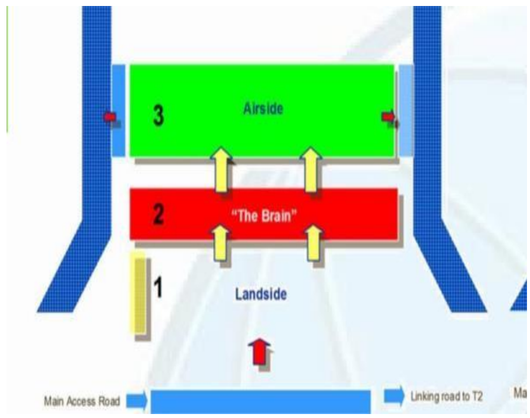


DIAGRAM SHOWING TERMINALS

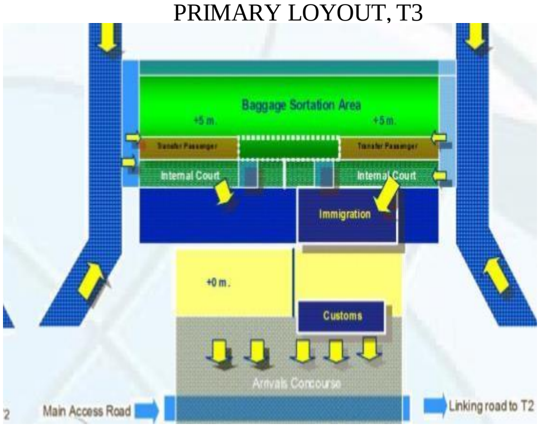
ABOUT TERMINAL 3

T-3 terminal is 2.8 km long from one end to the other. The Passenger Terminal Building (PTB) with its departure complex at the upper level and the arrivals at the lower is flanked by the two pier building structures, each having two tiers measuring 1.2 km in length. The main terminal is designed to be functionally simple and architecturally elegant. Consisting of eight levels, the passenger terminal building is 28m above the ground level with a built-up area of 5.5 lakh sq.m. L&T completed this structure in a record time of 18 months. The apron area spreads out to 6.3 lakh sq.m

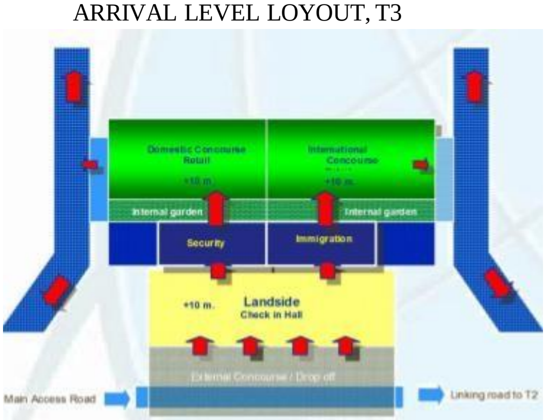
LAYOUT OF T3



PRIMARY LOYOUT, T3

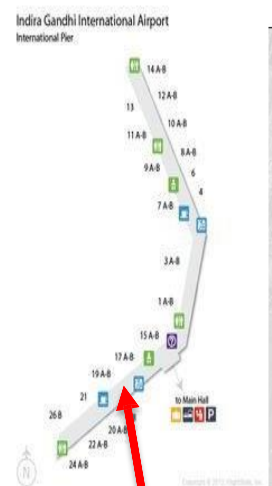


ARRIVAL LEVEL LOYOUT, T3

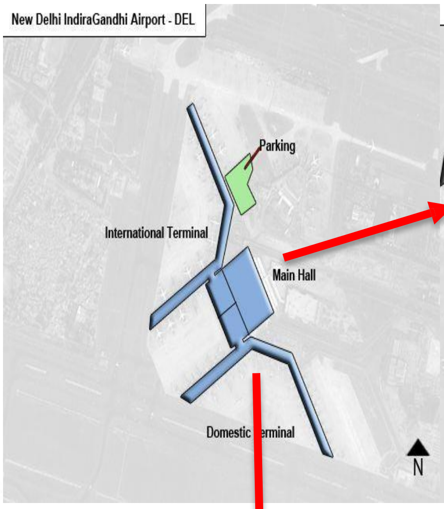


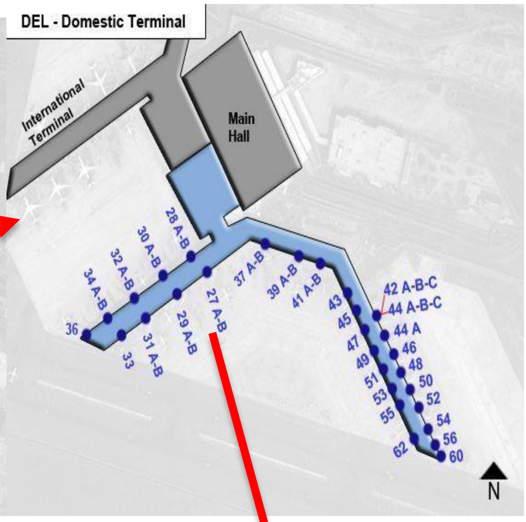
DEPARTURE LEVEL LOYOUT, T3

DIVISION OF VARIOUS SPACES T3

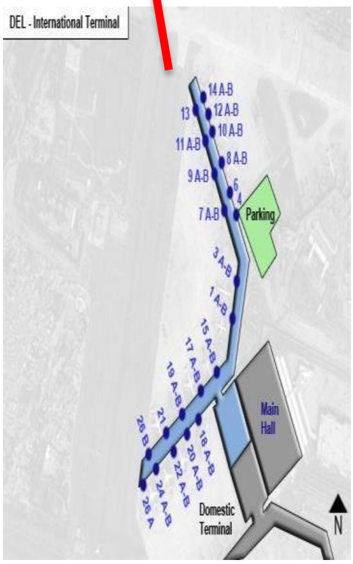


INTERNATIONAL PIER





DOMESTIC TERMIANL



INTERNATIONAL TERMINAL

MAIN HALL

DOMESTIC PIER

T3 FUNCTIONS

The Terminal was opened in 2010 for the Commonwealth Games

Floors

The bottom floor is dedicated to arrivals, the top floor is dedicated to departures.

Flights

The terminal operates all International flights, but also some Domestic Flights.

Airlines

used for all the international Airlines.

Terminal building has the following levels

Sub structure

Sub-basement at -8.05m

Basement at -5.5m

Super-structure

Arrival level at +0.0m

Mezzanine level at +5.0m

Departure level at +10.0m

CIP level at +16.0m

Stakeholder offices at +20.0m

Hotel level at +24.0m

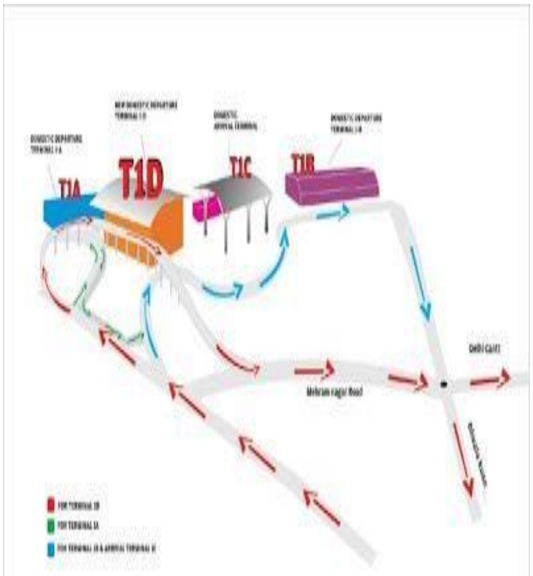
Piers

Apron level at +0.0m

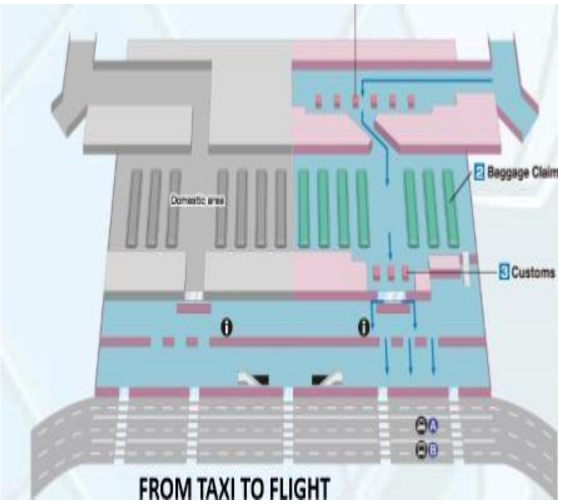
Arrival level at +6.0m

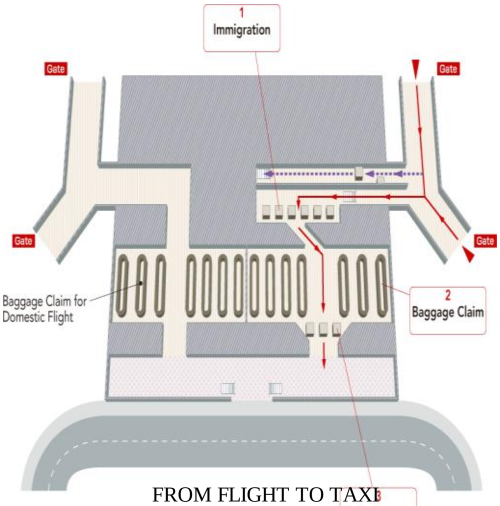
Departure level at +10.0

TERMINALS T1A, T1B, T1C, T1D, APPROACH



TERMINALS T1A, T1B, T2 are unused nowadays. Low cost Carriers (GoAir, IndiGo and SpiceJet) are operated from Terminal 1.





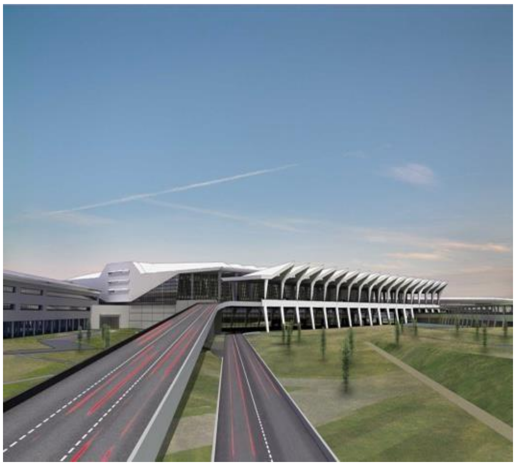
FROM FLIGHT TO TAXI

CARGO TERMINAL

The Cargo Terminal is managed by Delhi Cargo Terminal Management India. Pvt. Ltd. and handles all cargo operations It is located at a distance of about 1 km from the main terminal T3. Integrated Cargo Terminal – 70,000sqm and Greenfield cargo terminal – 20,000sqm built-up area

The new terminal also joins the league of airports that operate Airbus A-380, the world‟s largest passenger aircraft0

One of the MARS F stands that is capable of serving A 380 aircrafts



FACILITIES IGIA, NEW DELHI

Some of the innovative elements of the new Terminal 3 include: Common Use Passenger Processing System (CUPPS); 168 check-in counters; 100 rooms transit; baggage handling capacity of 12,800 bags per hour; fivelevel inline baggage screening with automated sorting; drop off area at departure has eight lanes and pickup area at arrival has 10 lanes; water treatment plant and sewage treatment plant; 7 MLD (million litres per day) water treatment plant and 10 MLD sewage treatment plant; 88 automatic walkways, 63 elevators,

31 escalators; 48 boarding gates and 78 aerobridges with nine remote stands for aircraft; Visual Docking and Guidance System; 3400 CCTV cameras for surveillance and 8,500 speakers for the Public Address System. The Phase 1 capacity of Terminal 3 is 27 million passengers per year, which can be upgraded to 34 million. construction of the world‟s seventh largest terminal – 5.02 million square metres – in a record time span of 37 Months. DIAL is aspiring for connectivity to more than 200 international destinations in the next five to 10 years by using existing and new bilateral agreements. "In the process

48 boarding gates and 78 aerobridges with nine remote stands for aircraft

Interior of airobrigde

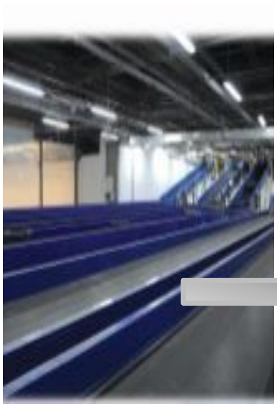
168 check-in counters with check post at departure level.

88 automatic travelltors, Asia‟s longest travellator of 118 m length helps in comfortable.

APRON

6.4 lakh sq.m. of apron area with 106 aircraft parking bays on domestic and international sides.

SECURITY AND BAGGAGING



CONVEYOR BELT FROM G.L

CONVEYOR BELT AT ARRVAL LEVEL

- There are 12 belts at the arrival carousels out of which 5 are used for international arrivals and 5 for domestic. 2 belts will be used varyingly as per peak hour requirement. For instance if there is additional requirement at the international arrival then the 2 belts will be used additionally

RUNWAYS

There are three runways in which the new runway is asia‟s largest runway which is 4.43km. Other two are 3.81km and 2.813km. The aircraft pavements at IGIA have been designed to cater to the biggest of aircrafts including the Code F A-380 Superjumbo flights. The runway is primarily made of asphalt construction with concrete end portions. With taxiways

The access control system installed at Delhi Indira Gandhi International Airport has different levels of security, including a proximity card, proximity card with pin, and fingerprint and iris recognition.

Terminal 3 has a 30,000sqm retail area under one roof and the largest duty free area in India at 3,778sqm. Categories featured include: fashion, liquor, tobacco, confectionery, perfumes, cosmetics, toys, books and gifts

- There are 300 closed circuit television sets and 2500 access control entries in the airport. Distinct features of the T-3 terminal include an in-line baggage handling system which has four sorter machines with a capacity to cater to 12,800 bags per hour and 6.5 kilometers of conveyor system with 12km of belts and 3500 sensors system for automatic bag tag reading which captures the information on each individual bag. This is stored in the „Sort Allocation Computer‟ thus ensuring that baggage data is available at any given point of time. There are 41 X-ray machines to ensure fool-proof baggage screening and passenger safety.

SERVICES, IGIA

ELECTRICAL

Intake power tapping at 66kV from 220/66kV GIS Substation. Serve as a 11kV main power distribution centre

DG Control Room 14 DG SETS

FIRE FIGHTING SYSTEM

Following are installed in T3

1. Fire hydrant system (internal & external)
2. Automatic sprinkler system
3. Medium velocity spray system
4. Intelligent addressable fire alarm system
5. Clean agent gas suppression system
6. Water curtain system
7. Fire extinguisher
8. Very early smoke detector apparatus (VESDA)

HVAC

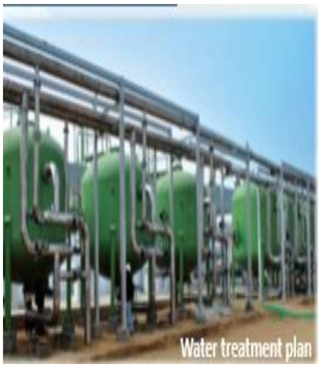
The design process basically started with conceptualizing the HVAC requirement for an airport of international standard considering peak passenger flow of 34 million per annum

Chiller system

WTP AND STP

The external utilities package comprised of design, construction and development of water source, water treatment plants, water supply system to various facilities, sewage collection and conveyance system and sewage treatment plant

Feed pumps for the RO plant



Water treatment plan

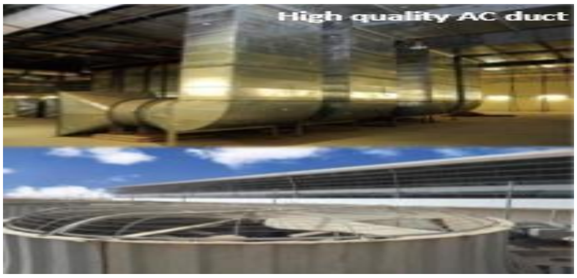
PTB & Pier roof rain water drainage is through syphonic drainage system. This system works on the principle of restricting air flow into the pipes by installing an anti-vortex plate. The total pipeline installed is in excess of 11 km and the jointing has been done by using electro-fusion welding and butt welding.

IT SYSTEM

The IT network implemented at the IGI T-3 is based on Nortel Communication Equipment. Three Primary Communication Centers (PCCR) are provided with Core and Distribution switches, which comprise the highspeed switching backbone and Service Aggregation systems, including Load Balancers and Firewalls for connectivity to the various IT system servers

FUEL HYDRANT SYSTEM

All aircraft stands at Terminal 3 will have aviation fuel delivered via underground hydrant system. The system consists of 13km of 600mm diameter pipe configured in two main loops with smaller 150mm diameter branches feeding to hydrant points at the surface



High quality AC duct

COMPARITIVE CHART

COMPARITIVE ANALYSIS

DESCRIPTION	HONG KONG INTERNATIONAL AIRPORT	BEIJING CAPITAL INTERNATIONAL AIRPORT	CHHATRAPATI SHIVAJI INTERNATIONAL, AIRPORT	NDRA GANDHI INTERNATIONAL AIRPOF
	(LITERATURE 1)	(LITERATURE 2)	(CASE 1)	(CASE 2)
LOCATION	chekLap Kok, Hong Kong,	Location Chaoyang & Shunyi Districts, Beijing	mumbai,maharastra	palam,delhi,india
Climate	warm and humid spring	Average weather, temperature, rainfall,	tropical, wet and dry climate	
Architect	Foster + Partners	Foster + Partners	Skidmore, Owings & Merrill	HOK Architects
Footfall	60,000000 per annum	50 million passengers per annum	49.8 million passangers in a yr	100 million passangers in a yr
Material	mammoth pre-cast concrete steel structure	steel space frame with triangular roof lights	concrete,steel	
Circulation	mezamine floor	mezamine floor	mezamine floor	mezamine floor
Orientation	drive along the west kowloon expressway	north-east	north of mumbai	south of the city center
Area	1,255 hectares	1,300,000m²	750 hectare	5600 acres
Form and Plan	Polygon form with symmetry on all sides, scattered planning.	Every block is linked with each other	Every block is linked with each other	
Concept	Based on MVA,The storyline around temple like traditional temples	chinese sense	Modern Architecture	
Main Parts	medical Centre Temple Library Restaurant Musical fountain Prikarma Path Exhibition hall	arrival hall departure hall lounge runway taxiway apron PARKING terminal	arrival hall departure hall lounge runway taxiway parking terminal apron	arival hall departure hall lounge runway taxiway apron PARKING terminal
Construction Technique		roof trussed		
Architectural features		parallel lines,glass walls,skylights		
Services	DG sets, Water tank, Parking, AHU, water supply	DC,Chiller plant,AHU,pump room	DG sets, Water tank, Parking, AHU, water supply	DG sets, Water tank, Parking, AHU, water supply,fire fighting
Parking				7 levels parking and 4800 vechical parking

NORMS AND STANDARDS

TERMINAL AREA CALCULATION

The terminal area is determined by calculating peak hour passenger which is calculated from annual passenger traffic.
According to the Airport Authority of India the passenger traffic will be 4.15 million per annum which is 4150000 persons per year.

By the given data of annual passengers we can bring out the average day passengers

Average day passengers (AD) = 4150000/365
= 11369.863 passengers

To calculate the peak day traffic and peak hour traffic we need to study a ratio table-

Table 1: Traffic Ratios at International & Domestic Airports in India

Sl. No	Traffic (in million passengers per annum)	Ratios for International Terminal		Ratios for Domestic Terminal	
		PD/AD	PH/PD	PD/AD	PH/PD
1	10.0 and above	1.15	0.15	1.10	0.10
2	5.0-10.0	1.20	0.20	1.15	0.15
3	1.0 -5.0	1.30	0.30	1.25	0.25
4	0.50 - 1.0	1.35	0.35	1.35	0.35
5	Less than 0.5	1.45	0.45	1.45	0.45

SOURCE: IMG NORMS

From the above table we came to know the ratio of PD/AD and PH/PD
PD/AD = 1.30 and PH/PD = 0.30

Peak day passengers (PD) = 1.30 x AD
= 1.30 x 11369.863
= 14780.818

PD = peak day
AD = average day
PH = peak hour

Peak hour passengers (PH) = 0.30 x PD
= 0.30 x 14780.818
= 4435 passengers

So, from the above calculations we came to know the peak hour traffic of a peak day which is 4434 passengers
The terminal building is designed on the basis of peak hour passenger traffic

UNIT AREA NORMS

Sl.No	Nature of Terminal	Area Norm – Sqm/ php
1	Domestic Terminals	
	a) Traffic up to 100 php	12
	b) Traffic between 100 – 150 php	15
	c) Traffic between 150 – 1000 php	18
	d) Traffic above 1000 php	20
2	Integrated terminal for handling both domestic and international	25
3	International Terminals	27.5

SOURCE: IMG NORMS

So, for integrated terminal building per unit area is 25 sq meter/person

Area of terminal building = peak hour passengers x 25

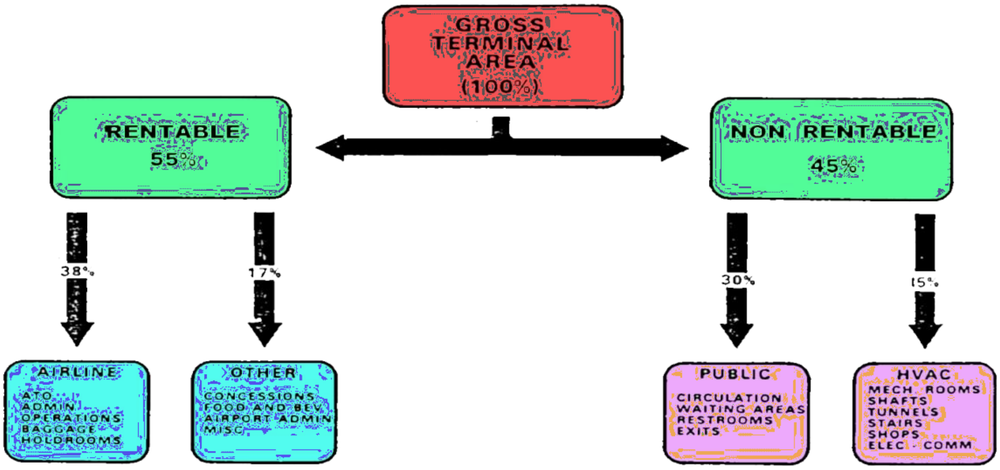
Area = 4435 x 25
110875 sq meter.

So, the area of terminal building will be 110875 sq meter
6.5 % of the total land is occupied by the building.

PARKING STANDARD

Car parking standard is 1ECS/100 sqm.
So total numbers of cars are -1108.75 cars

AREA DIVISION DIAGRAM



SOURCE: ADVISORY CIRCULAR OF FAA

According to the FEDERAL AVIATION ADMINISTRATION (FAA) the area has been divided as shown in the above diagram-

TOTAO AREA = 1,10,875 sq.m.

RENTABLE AREA (55%) = 60,981.25 sq.m.

- AIRLINE (38%) = 42,132.5 sq.m.
- OTHER (17%) = 18,848.75 sq.m.

NON RENTABLE (45%) = 49893.75 sq.m.

- PUBLIC (30%) = 33,262.5 sq.m.
- HVAC (15%) = 16,631.25 sq.m.

CHECK-IN DESKS (CENTRALISED, COMMON CHECK-IN)

Data Required:

a = Peak hour number of ORIGINATING passengers

b = Number of TRANFERED passengers NOT processed airside

t_1 = Average processing time per passenger (minute)

Data Required:

$N = \frac{(a+b)t_1}{60}\, desks\ (+10\%)$

<u>NOTE 1:</u> By providing 40counters as in this example, one ensure that the 1200 passengers are checked-in within 60 minutes (provided no counter is ideate any time). However possible services standards are not met.

QUEUEING AREA -- CHECK-IN

Data required:

a = Peak hour number of originating passengers

b = Number of TRANSFER passengers NOT processed airside

s = Space required per passengers (square meters)

Assumptions:

s = 1.5 square meters [separation between checked-in counters and thus queues (av. 1.9 meters) multiplied by lateral space requirement per passenger (0.8 meters) = 1.5 square meters].

<u>NOTE:</u> 50% of peak hour number of passengers arrive within the first 20 minutes

Area required:

$A = s \times \frac{20}{60} \times \left(\frac{a+b}{2}\right)(a+b) = 0.25(a+b)$ square meters (+10%)

PASSPORT CONTROL – DEPARTURE

Data required:

a = Peak hour number of ORIGINATING passengers

b = Number of TRANSFER passengers NOT processed airside

t_2 = Average processing time per passenger (minutes)

Control position required: $N = \frac{(a+b)t_2}{60}$ positions (+10%)

DEPARTURE LOUNGE

Data required:

c = Peak hour member of departing passengers

s = Space required per passenger (square meters)

u = Average occupancy time per long-haul passenger (m)

v = Average occupancy time per short-haul passenger (m)

l = Proportion of long-haul passengers

k = Proportion of short-haul passengers

Assumptions: $A = s\left(\frac{cul}{60} + \frac{cvk}{60}\right) = c\left(\frac{ul+vk}{30}\right)$ square meters (+10%)

PASSPORT CONTROL – ARRIVAL

Data Required:

d = Peak hour number of TERMINATING passengers

b = Number of TRANSFER passengers NOT processed airside

t3 == Average processing time per passenger (minutes)

Control Positions Required: N = (d+b) t3 positions/60 (+10%)

NUMBER OF BAGGAGE CLAIM DEVICES

Data Required:

e = Peak hour number of TERMINATING passengers, including INTERNATIONAL/DOMESTIC TRANSFER passengers, where applicable

q = proportion of passengers arriving by wide-body aircraft

r = proportion of passengers arriving by narrow body aircraft

y = Average claim device occupancy time per wide-body aircraft (minutes)

z = Average claim device occupancy time per narrow-body aircraft (minutes)

n = Number of passengers per wide-body aircraft at 80% load factor

m = Number of passengers per narrow-body aircraft at 80% load factor

Claim devices required:

Wide-body aircraft

N = eqy/60n = eq/425

Narrow-body aircraft

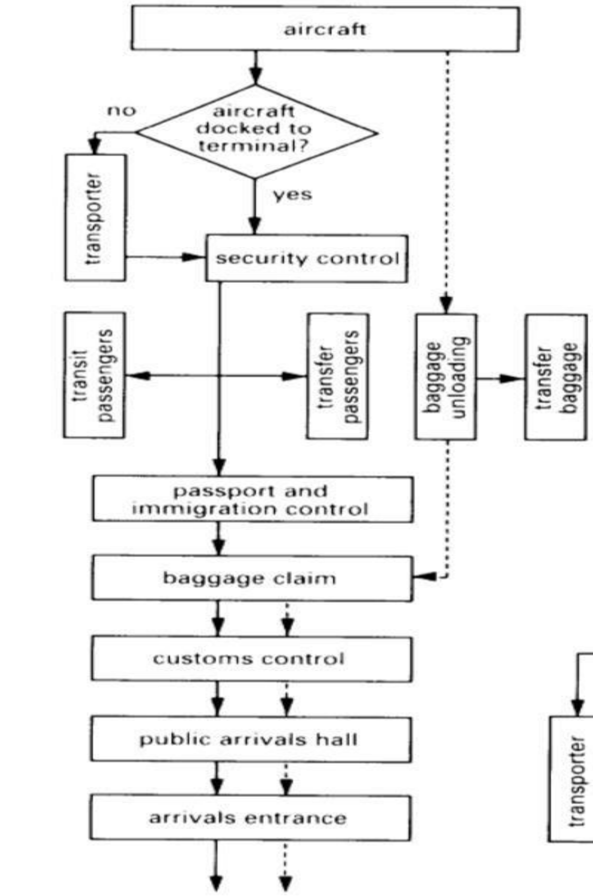
N = erz/60m = er/300

CALCULATING FROM THESE FORMULAS WE GET-

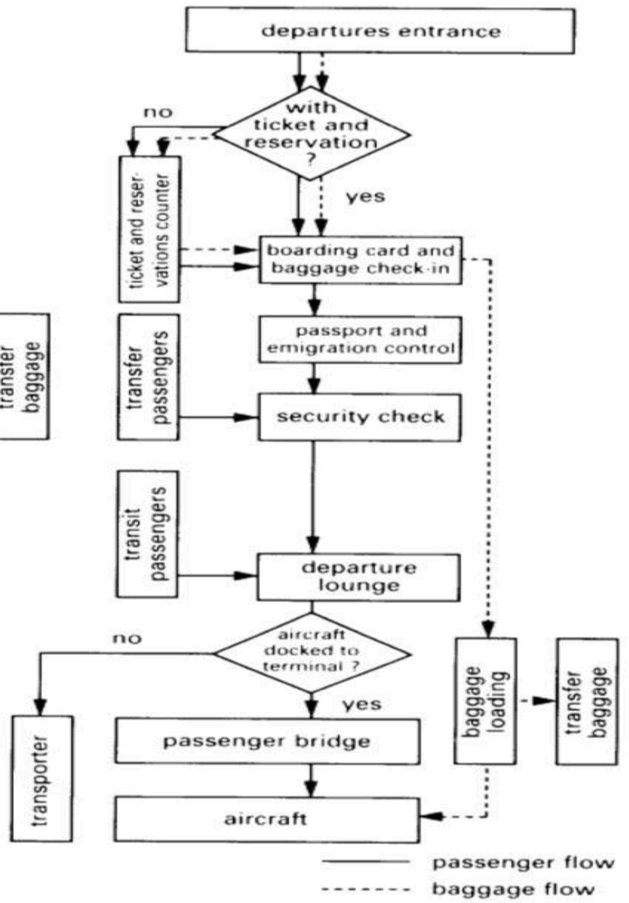
1. Check-in desks -85 desks.
2. Queveing area check-in – 620 sq.m.
3. Passport control- Departure – 4 positions.
4. Departure lounge – 4000 sq.m.
5. Passport control- Arrival – 7 positions
6. No. of baggage claim devices – 2 wide body & 5 narrow body

PASSENGER FLOW DIAGRAM

Passenger flow is a very important aspect in airport terminal. The flow should be smallest and easy which should be understood easily by the passengers.



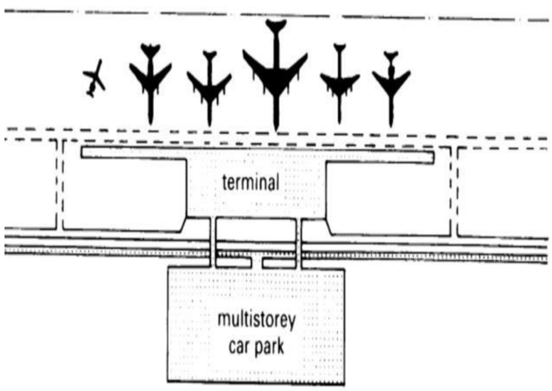
(1) **Passenger arrival flow diagram**



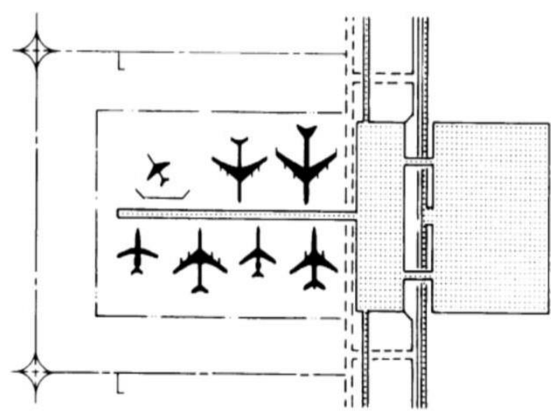
(2) **Passenger check-in/ departure flow diagram**

DESIGNS OFAPRON

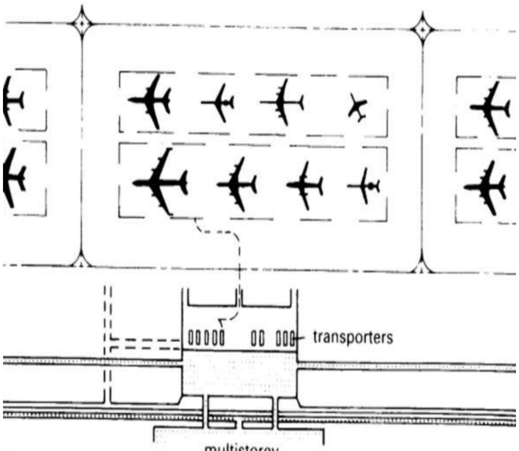
Aprons are an important part of an airport. Aprons are designed so that they can accommodate large number of airplanes at a time. They have jet bridges connected to them which opens at the plane entrance gates. Various concepts of designing aprons have been evolved for effective use



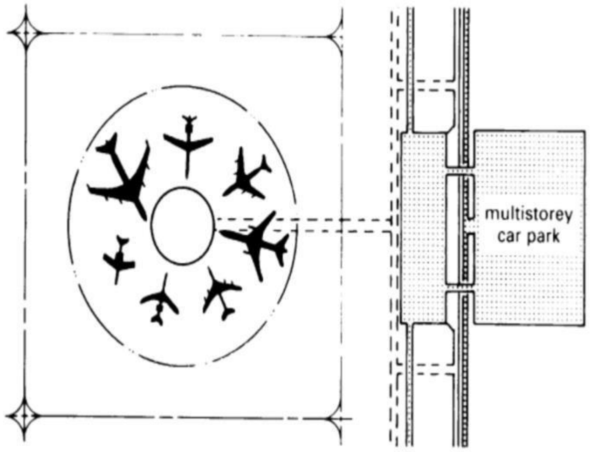
Linear concept



Pier concept

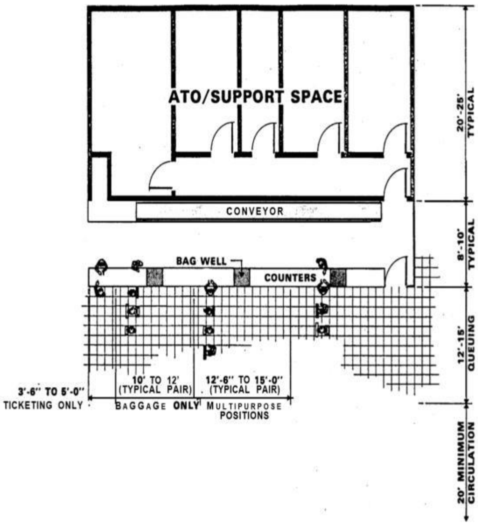


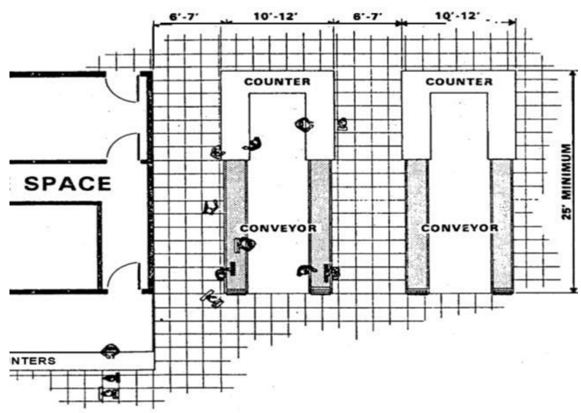
Transporter concept



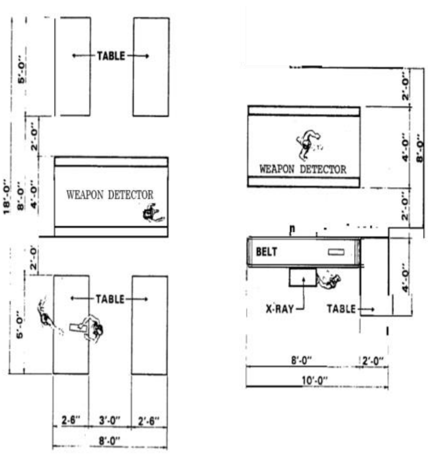
Satellite concept

CHECK IN DESK TYPES



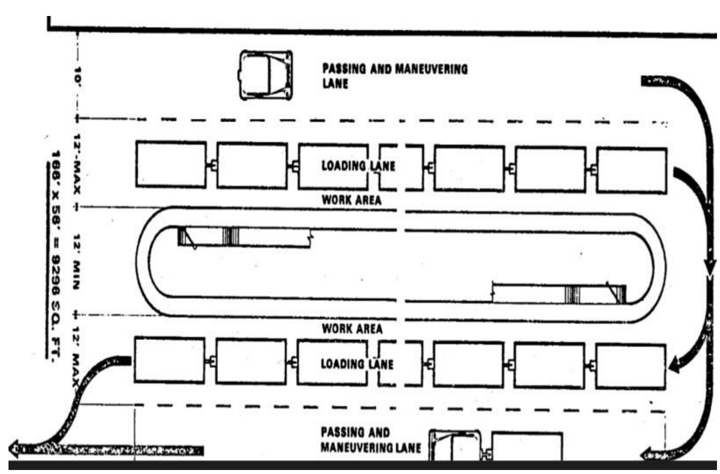


SCREENING AREA



MANUAL SEARCH (144 SQ FT) X-RAY SEARCH (120 SQ FT)

BAGGAGE MAKE-UP & BREAK DOWN AREA



SPACE NAME	SPACE REQUIREMENTS	STANDARD(SQ.M) DOMESTIC AND INTERNATIONAL	AREA(SQ.M) DOMESTIC AND INTERNATIONAL	DISCRIPTION
DEPARTURE AREA				
TICKETING AREA	STAFFED CHECK IN COUNTER	dwell time=21 min service time = 60 sec queue length/pax =1m no.of peak hrs. pax= 1600, At a given time, no.of pax cleaned per counter =60x60/60=60pax No.of counter =1600/60=27 nos. No.of pax in a queue =21x60/60=21 pax queue length per counter = 21mt area required =(5+21+3)x2.7x21=90m	1644 sqm	CONFIRMATION OF TICKETS AND BAGGAGE BOOKING
	VISITOR AND PASSENGER CONCOURSE	RATIO OF PAX TO VISITOR =1:1 NO.OF PAX = 1600 NO.OF VISITOR = 1600 DWELL TIME PAX=10MIN PASSENGER = 20MIN AREA/PAX = 2 SQM AREA PASSENGER=1.5SQM AT GIVEN TIME NO.OF VISITOR=(1600/60)x20=533 AT GIVENTIME NO.OF PAX=(1600/60)x10=267	1334SQM	
	PRE-CHECKIN AREA	Dwell time=10 min service time for x-ray machine =15 min Area/Machine=35 sqm Area/pax=2sqm One machine clear in one hr=(60/25x60)=144pax No.of machine Required=1600/144=11 machine No of pax cleaned at given time=10x(60/25)x11=264pax=264x2=528sqm area for 11 machines=11x35=385sqm,	923sqm	X-Ray machine for checking of bags
	DEPARTURE AREA	10% OF PAX SITTING HERE AREA/PERSON=25SQM THUS	320SQM	AFTER CHECK IN PAX WATING FOR FINAL CHECK
	RESTROOMS	15 SQM EACH	225SQM	15 ROOMS
AIRPORT MANAGEMENT	SECURITY CHECK AREA	DWELL TIME=8MIN SERVICE TIME=12SEC QUEUE LENGTH PER PAX=1M NO. OF PAX CLEARED PER GATE IN ONE HOURS=60x60/12=300 PAX. NO. OF PAX IN A QUEUE=8x60/12=40 PAX QUEUE LENGTH AGAINGED EACH GATE=40/2x1=20M AREA REQUIRED=2x7.5x31.54=472.5 SQM	473 SQM	FINAL CHECKING OF BAGS PASSENGERS PASS THROUGH METAL DETECTION
	STAFF TOILET	1.2SQM/PER PERSON		
	SECURITY HOLD AREA	DWELL TIME=40MIN AREA/PERSON SITTING=2SQM AREA/PERSON STANDING=1.5SQM AT A GLANCE TIME NO.OF PAX=(1600/60)x40=1067 PAX 30% STANDING = 480 PAX 70% OF STANDING = 1120 PAX AREA = (1120x2)+(480x1.5)=2960SQM	2960 SQM	PAX WAIT TILL THE ARRIVAL OF FLIGHT
	BAGGAGE CART & OTHER STORAGE		15 SQM	
	FACILITY MAINTAINANCE		15 SQM	
	GROUND HANDLING STAFF		15 SQM	
	PORTER SERVICES		10 SQM	
	STAFF LOCKERS		10 SQM	
GENERAL ENQUIRY	PASSENGER WITH LUGGAGE	FOR 2 PERSON	20 SQM	PASSENGER WITH LUGGAGE
	CONCESSIONARE	10% OF THE AREA OF ITEM 1 TO 10	768 SQM	SHOPS,RESTURANTS,SNACKS,BARS,TELEPHONES
	TICKETING,INFORMATION & AIRLINE BA	GIVEN BY AAI	200 SQM	
	OFFICES	FOR 4 EMPLOYES	35 SQM	
	POST & TELEGRAPHIC OFFICE	AREA PER PASSENGER = 25 SQM	180 SQM	
	RERERVED OR VIP LOUNGE	10% OF THE AREA OF ITEM 1 TO 10	886 SQM	FOR PASSENGERS & VISITORS
	TOILETS	15% OF AREA OF 1 TO 12	1462 SQM	CORRIDORS & CONNECTING SPACE
	INDIAN IMMIGRATION SUPPORT STAFF		500 SQM	EIGHT COUNTERS
	CIRCULATION	NET DEPARTMENT AREA		

ARRIVAL AREA				
	ARRIVAL HALL	DWELL TIME = 10 MINS AREA PER PAX = 25 SQM NO. OF PEAK HOURS PAX= 1600SQM AT A GIVEN TIME,NO.OF PAX=1600/60x10 = 267 PAX AREA REQUIRED 267x2=534SQM	1600SQM	
	BAGGAGE CLAIM AREA	DWELL TIME = 30MINS AVERAGE NO. OF CONVEYOR BELT AT A GIVEN TIME=(1600/60)x(30x/150)=5 FOR 5 BELT AREA REQUIRED=(9+16+16+16+16+9)x(22+8)= 2460SQM	2460 SQM	AREA PROVIDED FOR CLAIMING OG CHECKED BAGGAGE FROM AIRLINES BY PASSENGERS ON ARRIVING
	WAITING AREA	5% OF PH PAX		
	PUBLIC CONCOURSE	NO. OF PEAK HOUR VISITOR = 1600 NO.OF PEAK HOUR PAX = 1600 DWELL TIME PAX= 5 MIN VISITOR = 30 MIN AREA/VISITOR=1.5 SQM AREA/PAX = 2 SQM AT A GIVEN TIME, NO OF PAX= (1600/60)x5=133SQM AT A GIVE NO. OF VISITOR=(1600/ 60)x 30=800SQM	1466 SQM	VISITORS & PASSENGERS
	VIP LOUNGE	AREA PER PERSON 25 SQM	180SQM	FOR 90 PERSON
	CONCESSION AREA	MAX. 10% OF AREA 1 TO 4	464 SQM	SHOPS,SNACKS BAR,BOOTHS,TOURIST INFORMATION,TAXI,CAR HIKE ETC.
	CLOCK ROOM		120 SQM	
	REST ROOM & RETIRING ROOM	15 SQM EACH	270 SQM	18 ROOMS
	TOILETS	10% OF AREA 1 TO 8	549 SQM	
	CIRCULATION	15 % OF AREA 1 TO 8	906 SQM	
	IMMIGRATION		600 SQM	10 NOS OF COUNTER
INDIAN IMMIGRATION SERVICE	OFFICES	SUBJECT TO USER DEPTT	120 SQM	IMMIGRATION AND HEALTH
	GENERAL OFFICE SPACE	SUBJECT TO USER DEPTT	120 SQM	BANK AND CUSTOMS
	CONFERENCE/TRAINING AREA		20 SQM	
	BREAK/LUNCH ROOM		20SQM	
	SECONDARY INSPECTION AREA		25SQM	
	INTERVIEW ROOMS		10SQM	
	SUPERVISOR'S OFFICES		15SQM	
	PORT DIRECTOR'S OFFICE		20SQM	
	CLERK/RECEPTION AREA		15SQM	
	EMPLOYEE LOCKER & TOILETS		25SQM	
	STORAGE/ARCHIVES		10SQM	
	HOLD ROOM		20SQM	
	COMPUTER ROOM		10SQM	
INDIAN PUBLIC HEALTH SERVICE	SUPERVISOR'S OFFICES		20SQM	
	CLERK/RECEPTION AREA		15SQM	
	GENERAL OFFICE SPACE		35SQM	
	ISOLATION AREA		20SQM	
INDIAN CUSTOM SERVICES	NO. OF BOOTHS			
	CUSTOMS SUPERVISORS		25SQM	
	CUSTOM OFFICE		70SQM	
	IN-BOND ROOM		20SQM	
	CASHIERS AREA		10SQM	
	LOCKABLE TECS ROOM		15SQM	
	SEARCH ROOMS		8SQM	
	PUBLIC SPACE/COUNTER AREA		15SQM	
	STORAGE/ARCHIVES		15SQM	
	AIRPORT DIRECTOR & SECRETORY		30SQM	
	CONFERENCE/TRAINING AREA		35SQM	
	CUSTOMS PATROL		25SQM	
	EMPLOYEE LOCKER & TOILETS		25SQM	
DEPARTURE LOUNGE				
TERMINAL 1	PLAZA PREMIUM PLAZA			
	AMBASSADOR TRANSIT LOUNGE			
	CIP LOUNGES			
TERMINAL 2	TRANSIT HOTEL WITH SWIMMING POOL			
	AMBASSADOR TRANSIT LOUNGE			
	THE HEAVEN BY JETQUAY			
	SATS & PLAZA PREMIUM LOUNGE			

GROUND SERVICES				
	BAGGAGE BREAK-DOWN AREA	15SQM PER ARRIVING PASSENGER(FOR TOTAL NO.OF PEAK HOUR PAX)	800SQM	AREA WHERE CHECKED BAGGAGE FROM ARRIVING FLIGHT IS UNLOADED FROM THE BAGGAGE CART
	BUS LOUNGE	35 SQM FOR EACH	315SQM	FOR 9 BUSES
	SERVICE EQUIPMENT & SUPPORTING D	SUBJECTED TO AIRPORT OPERATIONAL DEPARTMENT	2000SQM	FOR SERVICE VEHICLE TO AIRCRAFT
	TOILETS AND REST ROOM FOR LOADERS		200SQM	
	CIRCULATION	15% OF THE AREA 1 TO 5	737SQM	
SERVICES				
	ELECTRICAL SUB	ADOPTED AS GIVEN BY AAI	325SQM	
	ASSISTANT OFFICE	6SQM EACH	60 SQM	
	METROLOGICAL & BRIEF ROOM		40 SQM	
	ELECTRONIC EQUIPMENT ROOM		30SQM	
	AERONAUTICAL COMM.ROOM		40SQMT	
	ATC ROOM	PROVIDED BY AAI	30SQMT	
	GROUND CONTROL ENGG.DEPARTMENT	PROVIDED BY AAI	30SQM	
	FOUR ASST. ENGINEERS	15 SQM EACH	60SQM	2 ELECT.& 2 CIVIL
	EIGHT JUNIOR ENGINEERS	10SQM.EACH	80SQM	4 ELECT.& 4 CIVIL
	STAFF CANTEEN AND KITCHEN		80SQM	
	CIRCULATION	15% OF AREA	240SQM	
	TOILETS	10% OF AREA	140SQM	
	POLICE AND SECURITY		100SQM	
TOTAL				
HVAC STRUCTURE CIRCULATION				
	HVAC	15% OF TOTAL AREA		
PARKING				
GENERAL PARKING	PUBLIC PARKING	NO. OF VEHICLES @25SQM 400 @25SQM(25% OF PHP)	10000 SQM	FOR PRIVATE VEHICLE NOT INCLUDING HIRED MODE
	HIRED MODE PARKING	NO.OF VEHICLES@25SQM 160@25SQM (8% TO 10% OF PHP)	4000SQM	FOR TAXI AND RENTED CAR
	BUSES & AIRLINE VEHICLES	AREA @35SQM. EACH	700SQM	20 NO OF BUSES
	STAFF PARKING	FOR CAR,TWO-WHEELERS&CYCLES	2500SQM	PARKING SPACE FOR EMPLOYEE
TWO PARALLEL RUNWAYS				
	RUNWAY			
	RUNWAY TURNING RADIUS			
APRON PARKING				
	PARKING FOR SEVEN AIRCRAFT	500SQM EACH	3500SQM	NOISE IN PARKING PATTERN IN ONE WAYS
	SIX REMOTE PARKING WAYS	1500SQM.EACH WAYS	9000SQM	

NOTE - 1. AREA NOT INCLUDED ARE HVAC PLANT ROOM AND SUB STATION, WHICH IS SEPRATED AND COMPUTED FOR WHOLE PASSENGERS TERMINAL COMPLEX.

2. ALL BASIC STANDARDS AND DATA PROVIDED BY THE AIRPORT AUTHORITY OF INDIA - MUMBAI

CONCEPT

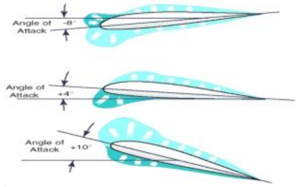
CONCEPT :
PORTAL OF THE WIND

The mystery of this project was how to fuse into a coherent design vision the geography of a region with aspiration for technological advancement. The contextual pressures of the site and nature were used as an inspirational source, as opposed to the immediate built surroundings, which included an unwelcoming sea of parking against the relentless flatness of the topography.Having the wind as the form-giver for the scheme determined a curvilinear geometry.

PARAMETRIC WIND DESIGN

Although gradual, the changes in the weather patterns are also noticeable and impactful to architectural design. If the local microclimate is taken into account early in the conceptual stage of design, the longevity of the ultimate structure can be greatly enhanced, despite challenging environmental factors. Parametric designing enables to discover the optimal architectural shape based on specific weather data.

WIND-DESIGNED 'FLOWBRANE'

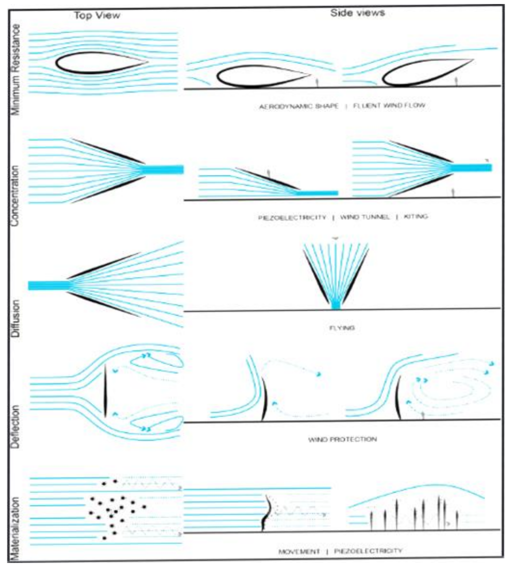


The case study site in Stockholm is selected to demonstrate the described design approach. Three of the concrete silos are selected, and instead of storing oil, the silos are filled with purified rainwater . They serve as circular swimming pools The height of the silos for swimming is reduced, so the pools can be approached from the ground, using stairs or ramps. By reducing the height of silos and designing the new architecture, the wind flow is altered.

PARAMETRICALLY-CONTROLLED DESIGN

An optimal shape is sought to interact with the wind with minimum resistance to the flow, providing a pleasant outdoor climate around the entrance to the airport terminal, as well as the outdoor wind shelters, while not influencing airplanes' take-offs and landings on the runways in the proximity of the terminal.

Warnings about the changing climate, global warming, and the resulting extremes have sent a clear signal for architects, engineers, and planners to start thinking differently about design. It is probable that if we keep building the way we are building now, with architecture as a static element placed in a dynamic environment, we will be unable to fit into and influence the ever-changing surroundings.



'FlowBrane' (wind flow membrane) is a term invented to name tensile membranes that are developed based on the wind flow movement between the concrete silos in Loudden Docks. One such membrane is designed to alter the wind direction around the circular swimming pools/ice rinks and to serve as a protection against the wind.

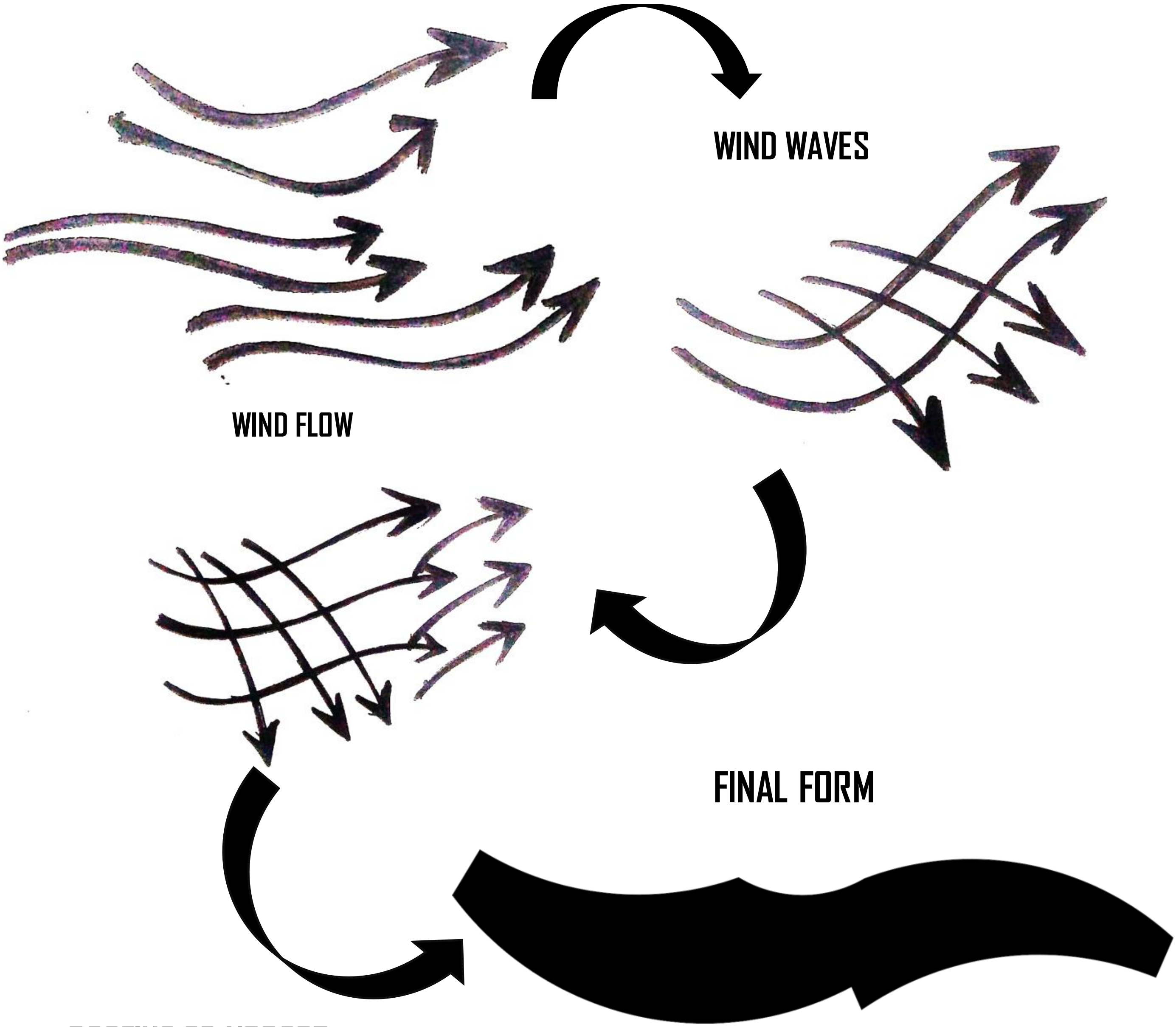
DESIGN APPROACH

The interaction between an architectural shape and wind flow is tested in a study called 'FlowBrane'.

(1) Designing a parametrically changeable geometry,
(2) Testing its behavior in the wind,
(3) Evaluating the results allows looping back to the initial geometric design, continuing to improve the design and ultimately the performance of the architecture in the specific wind conditions of the chosen site

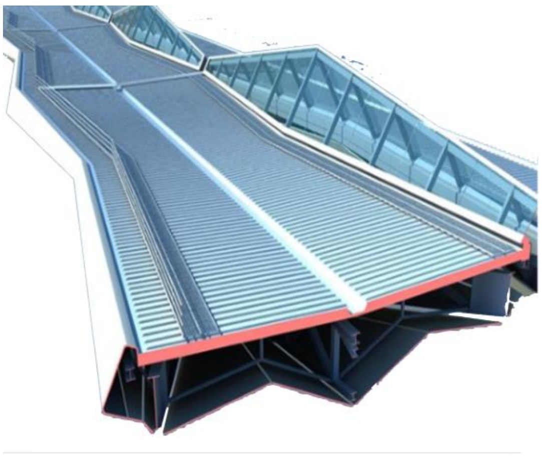
FORM EVOLUTION APPROACH

These core elements are variable and are designed and set at the beginning of the wind-influenced form-finding process, based on the knowledge of the sites wind situation.



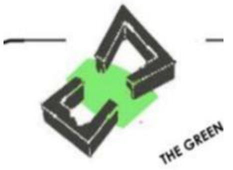
ROOFING OF AIRPORT

steel is a responsible choice In a world concerned with changing climate, increased population, and a renewed commitment to environmental responsibility, steel stands tall (sometimes literally). Steel provides an environmentally responsible construction material that is long lasting, highly recyclable, and flexibly reusable. The steel industry continues to find innovative methods of reducing emissions during production and recycling. Using steel provides jobs, tax revenue, and important infrastructure for protecting humans.



DESIGN CONSIDERATION

1.BREAK THE MONOTONY



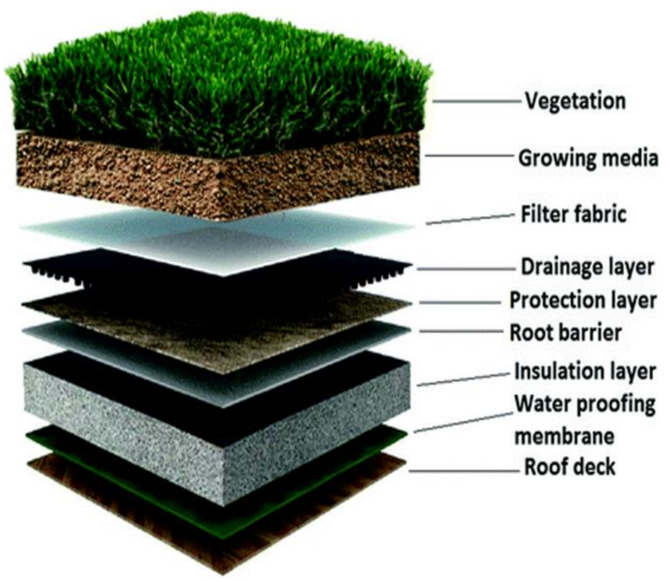
Regenrating the modulated airport space as anature emphimerality which generally looks less material and more of green.

As North India is rich with culture and airport being a gateway to the city,lot of inspirations and grandeur to the tradition is added.

Passenger flow is the most important factor foe a succesful airport design, the passenger walking radius work as a primary element of internal planning.

Bigger projects can reduce the impact on Enviornment by providing sustainable and other energy centric architecture.

CONSTRUCTION CONCEPT



GREENWALL

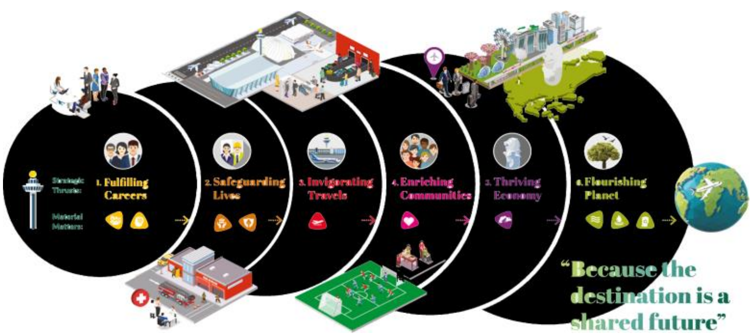
The plants are grown on stainless steel cables and each cable is removable in case there is a need to replace plants individually.

- "Strategically located in the mid-belly of the terminal, the wall separates two main functions, providing a clear demarcation of an international border;

The green tapestry gives it a form that is friendly, organic, and alive.

- The length is separated only by four water features.
- The Greenwall also helps to regulate the internal temperature of the terminal with the occasional misting.

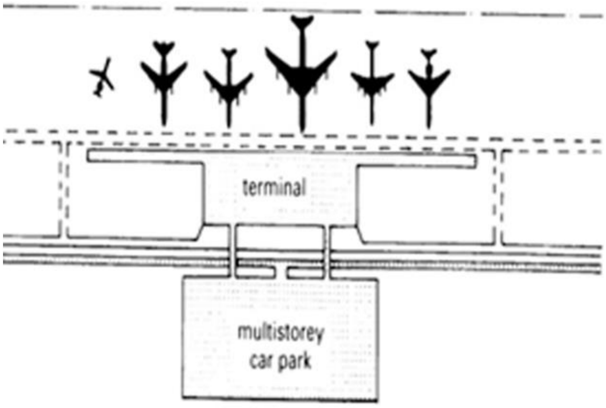
SUSTAINABLILITY



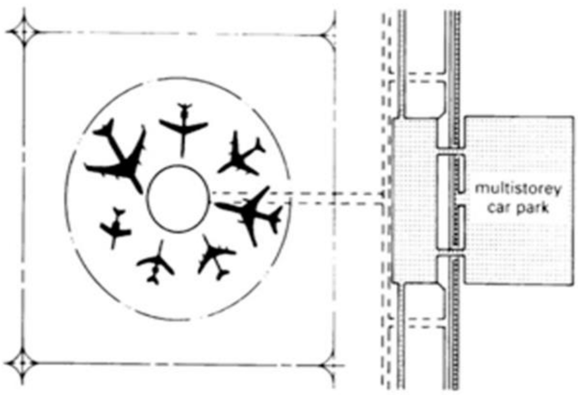
AIRPORT WILL BE CARBON EFFICIENT

As of today, this ambition is being prepared to contribute to the fight against climate change around two main directions for new construction

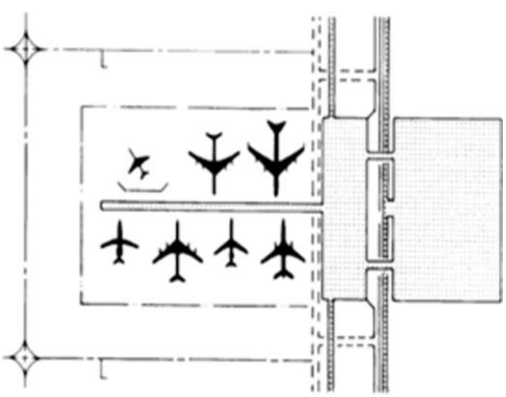
DESIGNING THE APRON



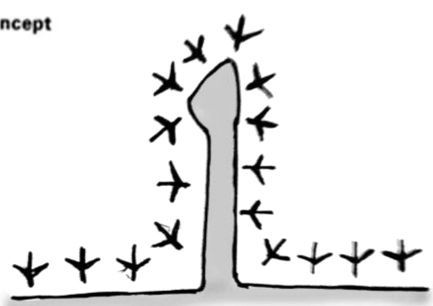
Linear concept



Satellite concept

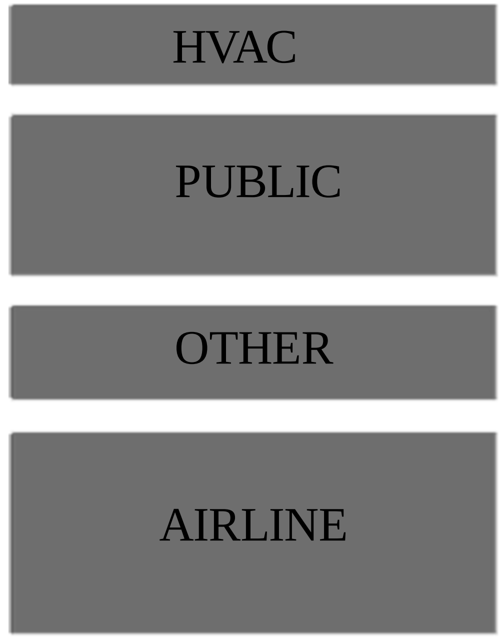


Pier concept

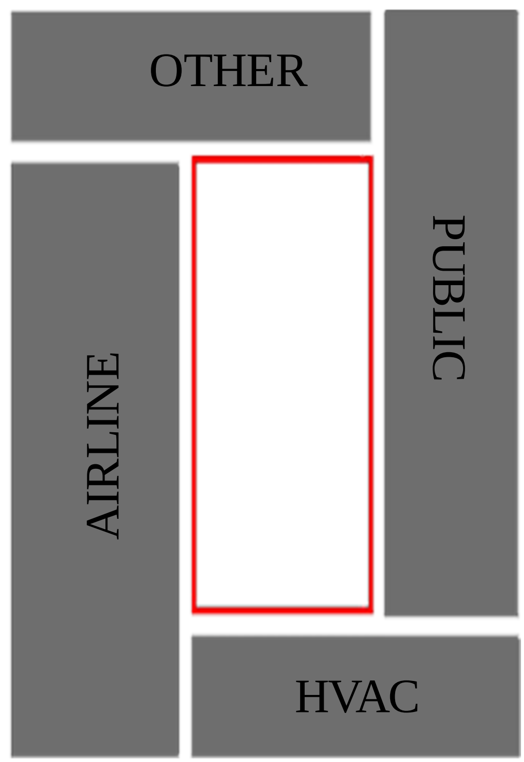


INCORPORATING ALL THE CONCEPTFOR

PLANNING APPROACH

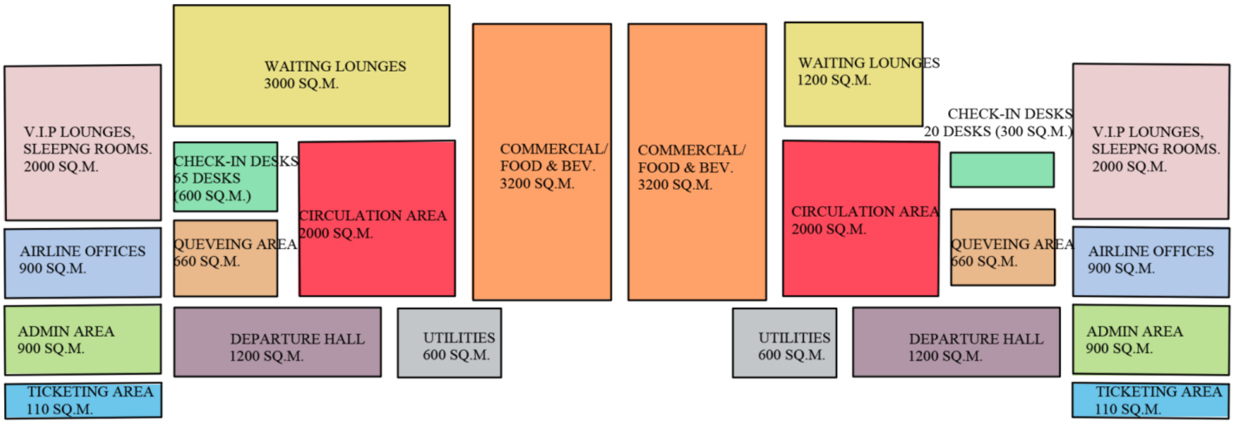


AREA IS DIVIDED INTO 4 MAJOR PARTS

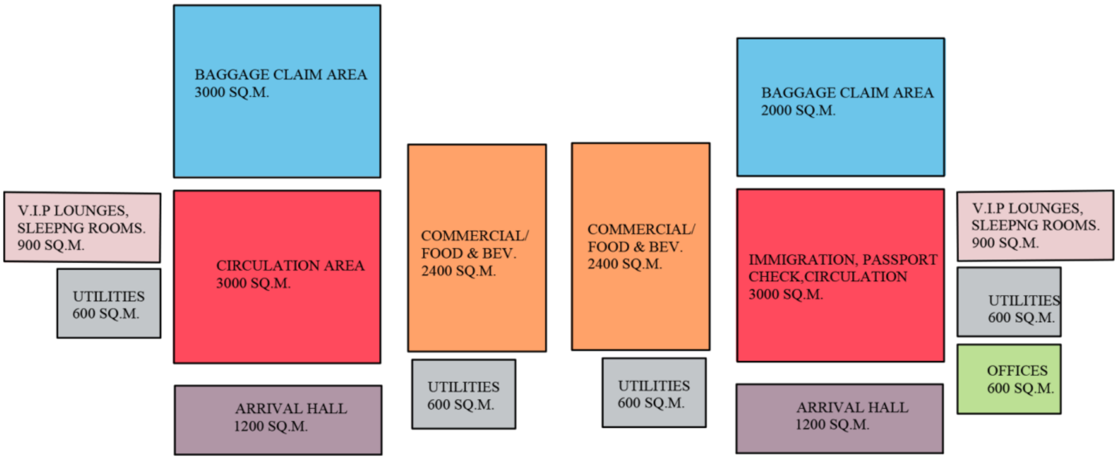


ARRANGING THE MAIN AREAS

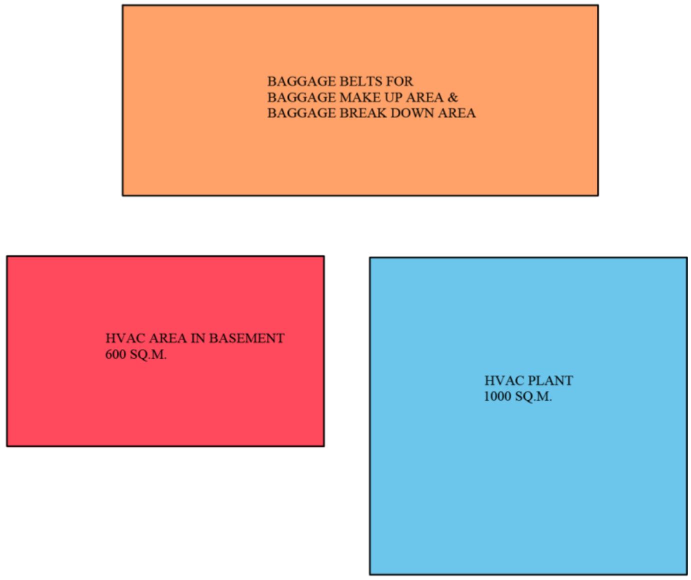
ZONING DIAGRAMS



ZONING DIAGRAMS OF DEPARTURE AREA

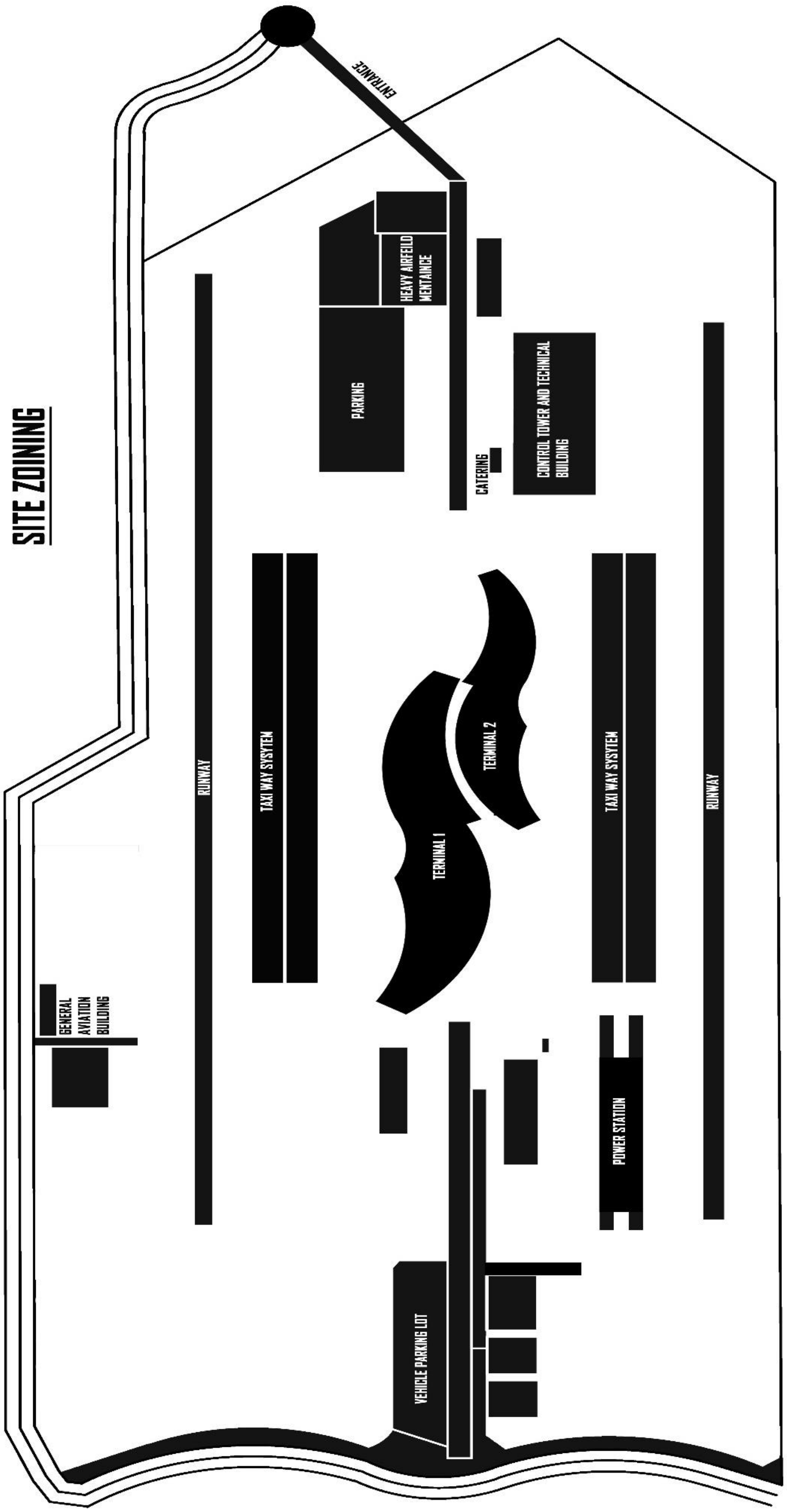


ZONING DIAGRAM S OF ARRIVALAREA

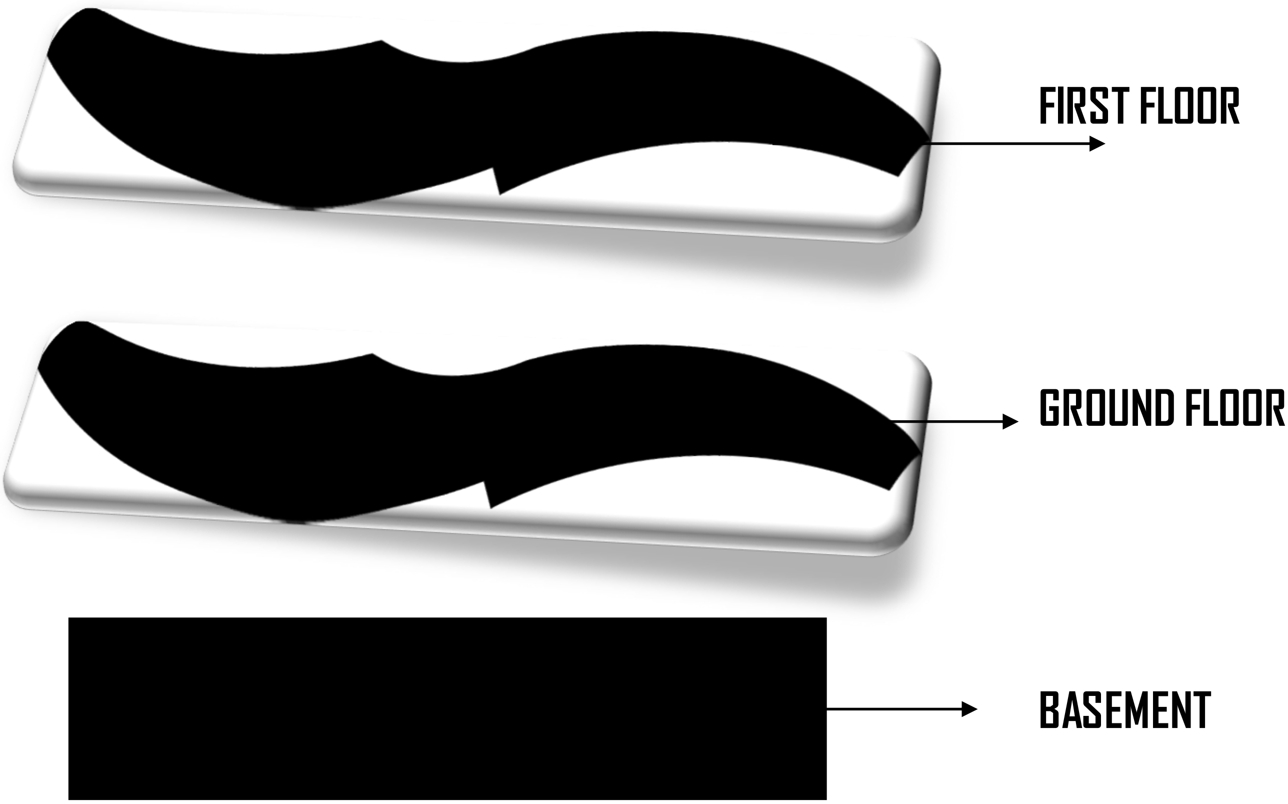


ZONING DIAGRAM S OF BASEMENT

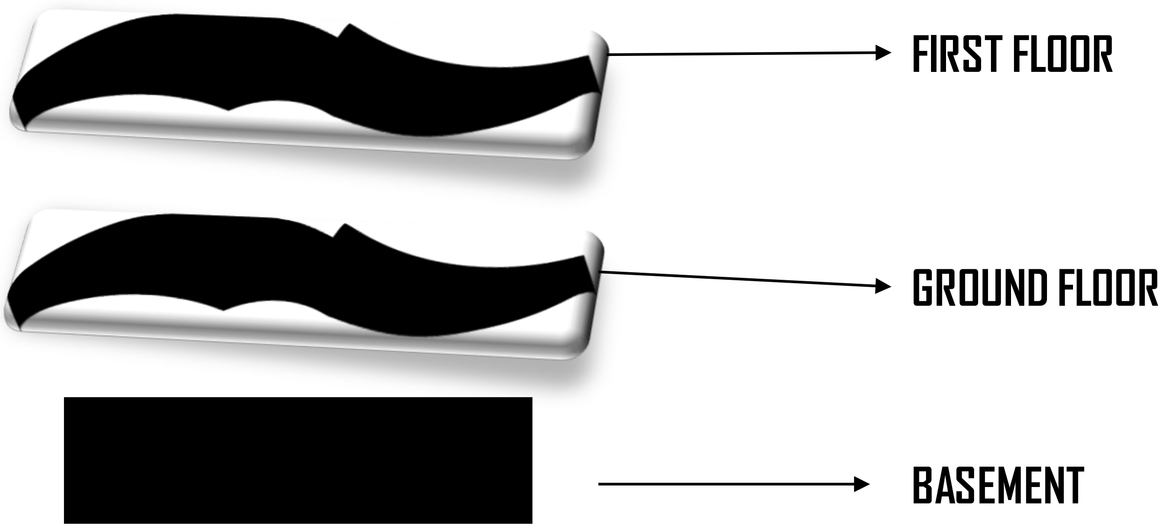
SITE ZOINING



VERTICAL STACKING

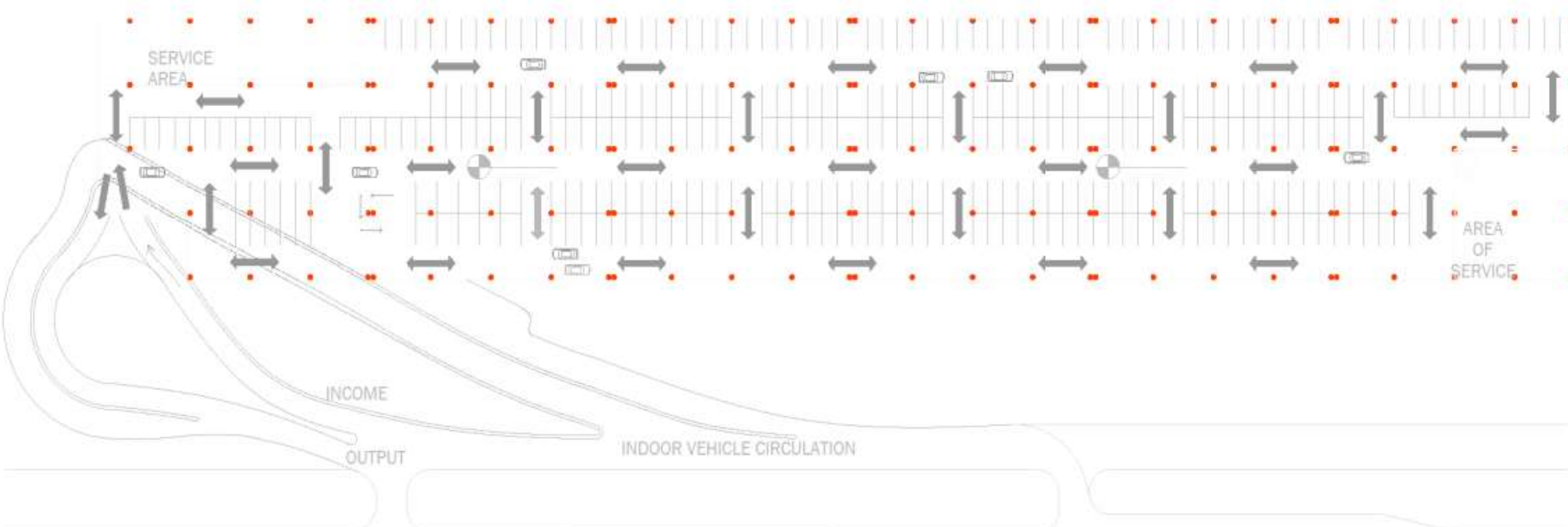


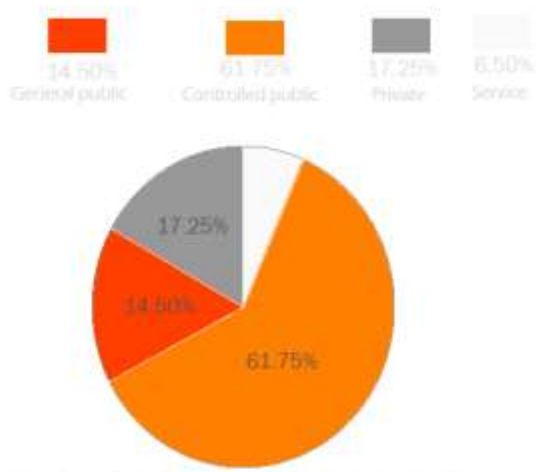
TERMINAL 1



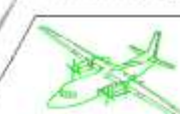
TERMINAL 2

BASEMENT FLOOR PLAN





NAVI MUMBAI INTERNATIONAL AIRPORT



STUDENT: PRIYA SUKHWANI, AR 5-2,5TH YR

COLLAGE: BABU BANARSI DAS UNIVERSITY LKO.

TOPIC: DOMESTIC TERMINAL

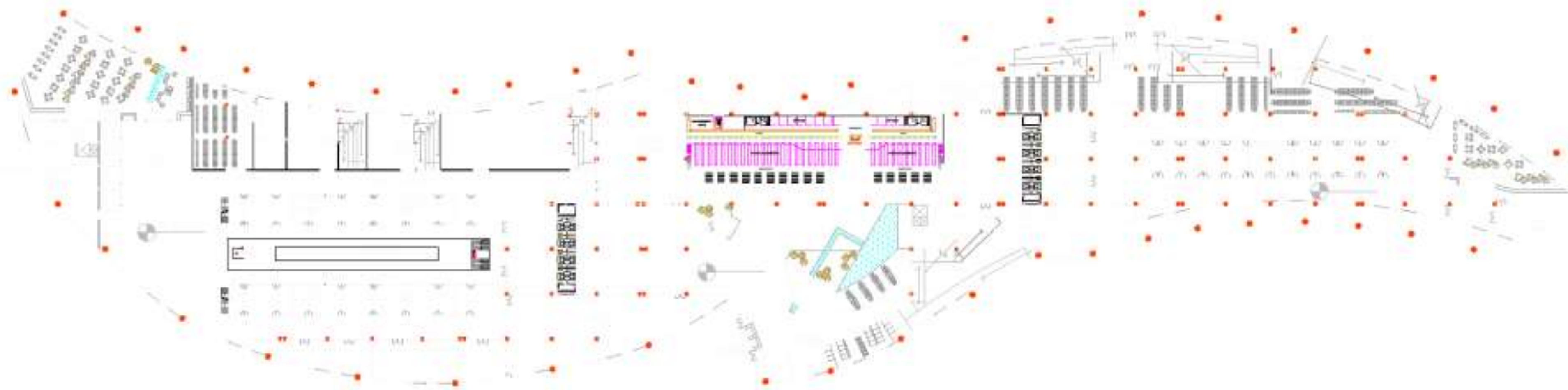
PROJECT: INTERNATIONAL AIRPORT

A1

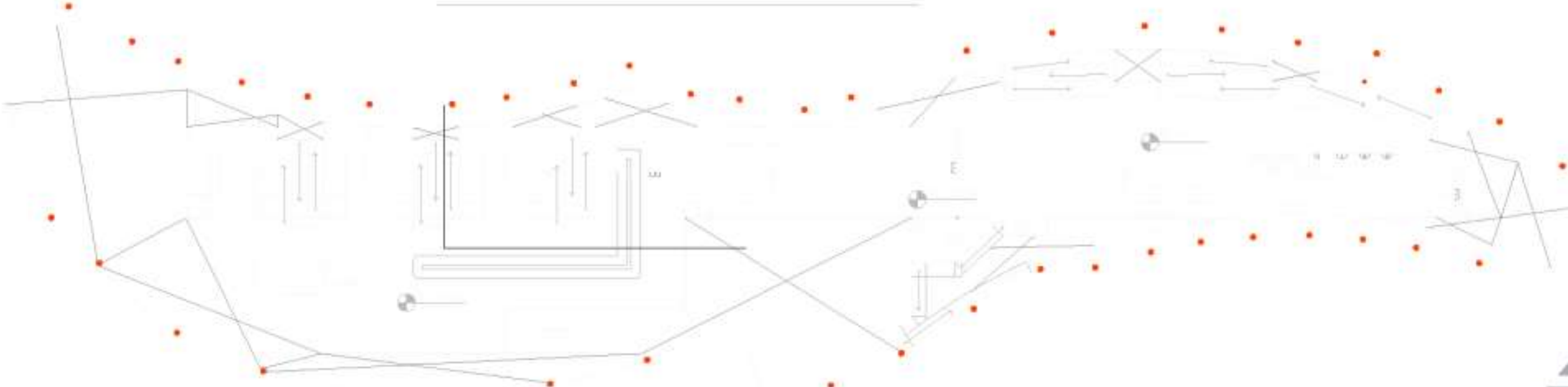
TIME: 10:00 AM

SCALE:

UNIT: METERS



GROUND FLOOR PLAN



FIRST FLOOR PLAN

NAVI MUMBAI INTERNATIONAL AIRPORT

STUDENT:
PRIYA SUKHWANI, AR 5-2,5TH YR

COLLAGE:
BABU BANARSI DAS UNIVERSITY LKO.

TOPIC:
DOMESTIC TERMINAL

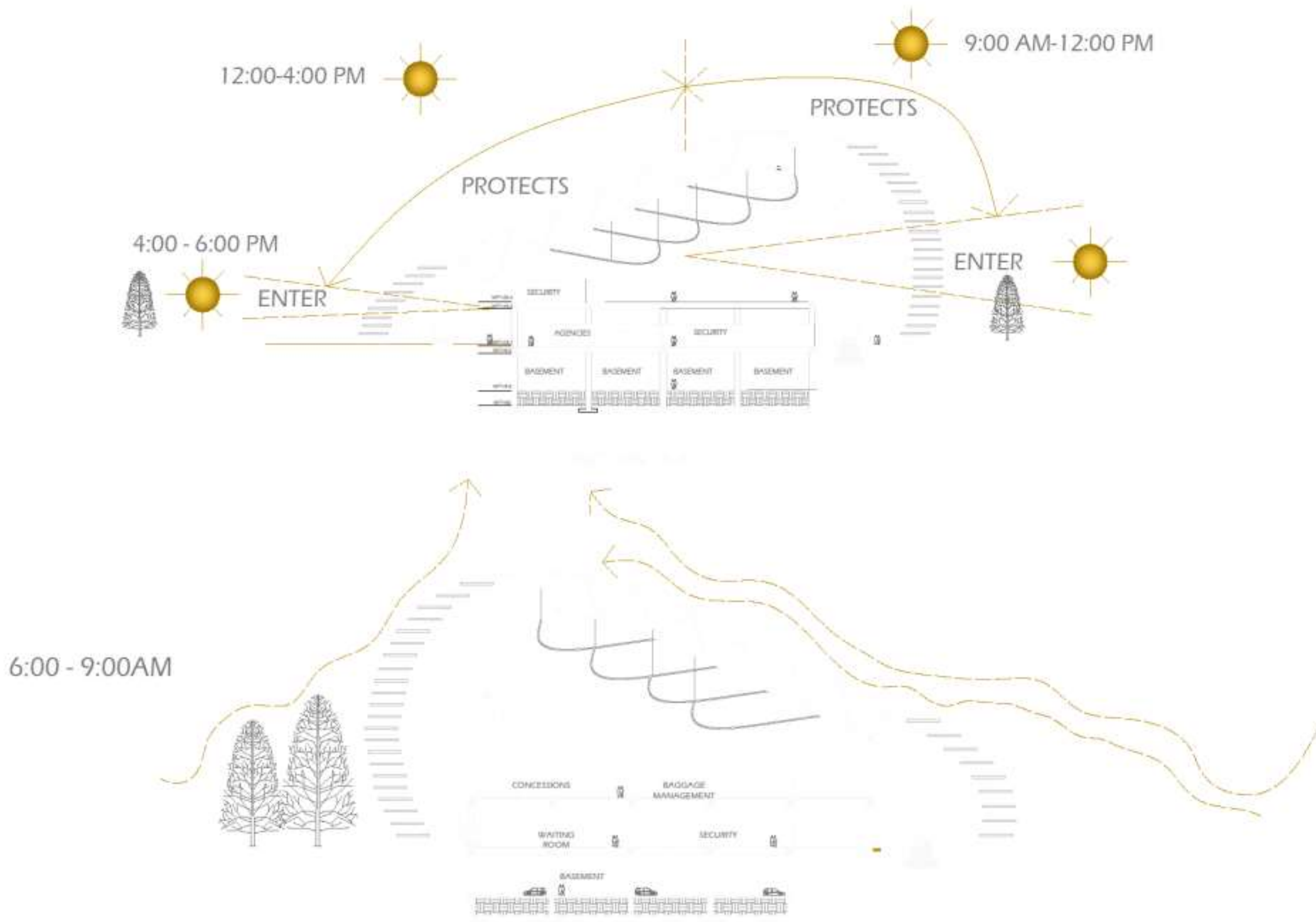
PROJECT:
INTERNATIONAL AIRPORT

A1

TIME:
10:00 AM

SCALE:

UNIT:
METERS



NAVI MUMBAI INTERNATIONAL AIRPORT

STUDENT: PRIYA SUKHWANI, AR 5-2,5TH YR

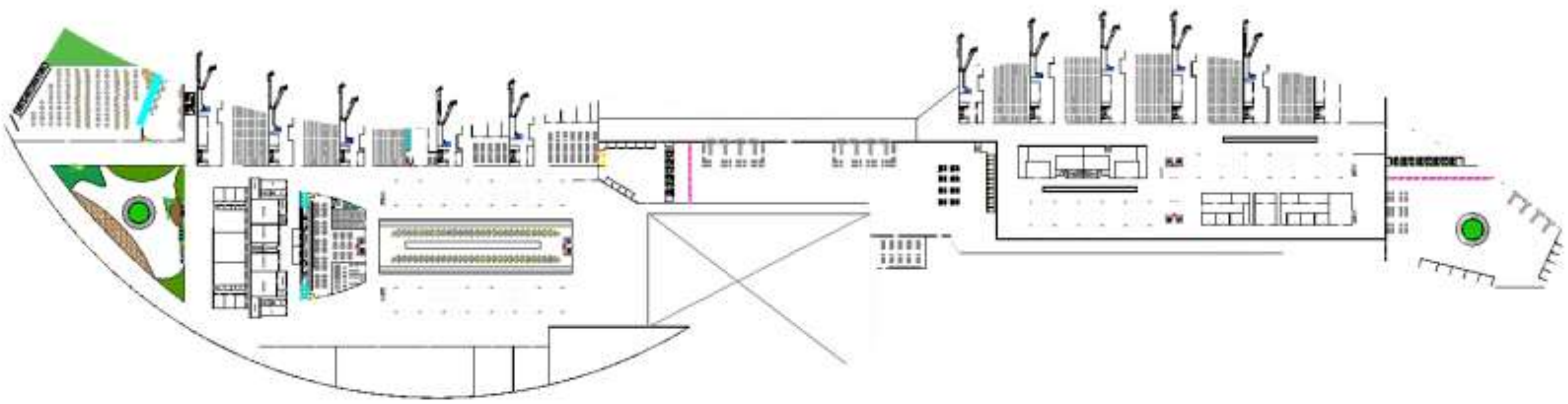
COLLAGE: BABU BANARSI DAS UNIVERSITY LKO.

TOPIC: DOMESTIC TERMINAL

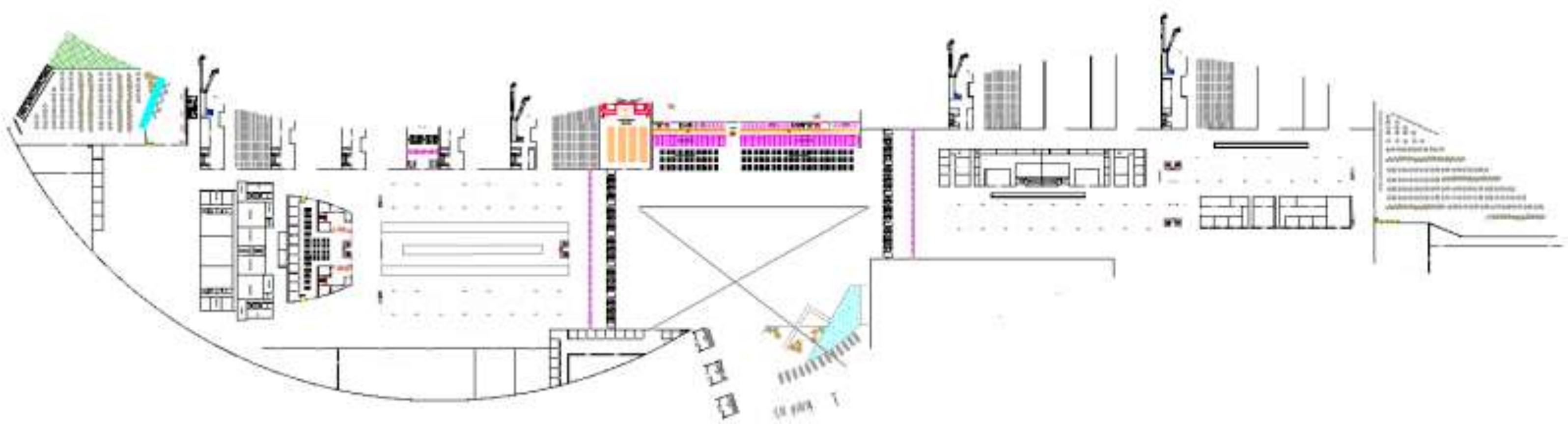
PROJECT: INTERNATIONAL AIRPORT

A1

TIME: 10:00 AM | SCALE: | UNIT: METERS

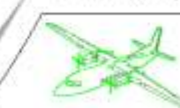


FIRST FLOOR PLAN



GROUND FLOOR PLAN

NAVI MUMBAI INTERNATIONAL AIRPORT



STUDENT:
PRIYA SUKHWANI, AR 5-2,5TH YR

COLLAGE:
BABU BANARSI DAS UNIVERSITY LKO.

TOPIC:
INTERNATIONAL TERMINAL

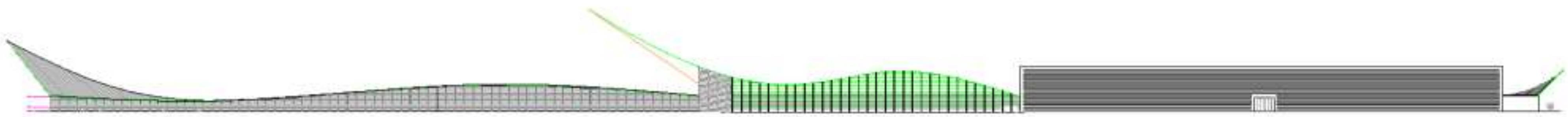
PROJECT:
INTERNATIONAL AIRPORT

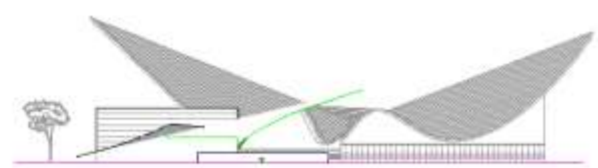
A1

TIME:
10:00 AM

SCALE:

UNIT:
METERS





NAVI MUMBAI INTERNATIONAL AIRPORT

STUDENT:
PRIYA SUKHWANI, AR 5-2,5TH YR

COLLAGE:
BABU BANARSI DAS UNIVERSITY LKO.

TOPIC:
INTERNATIONAL TERMINAL

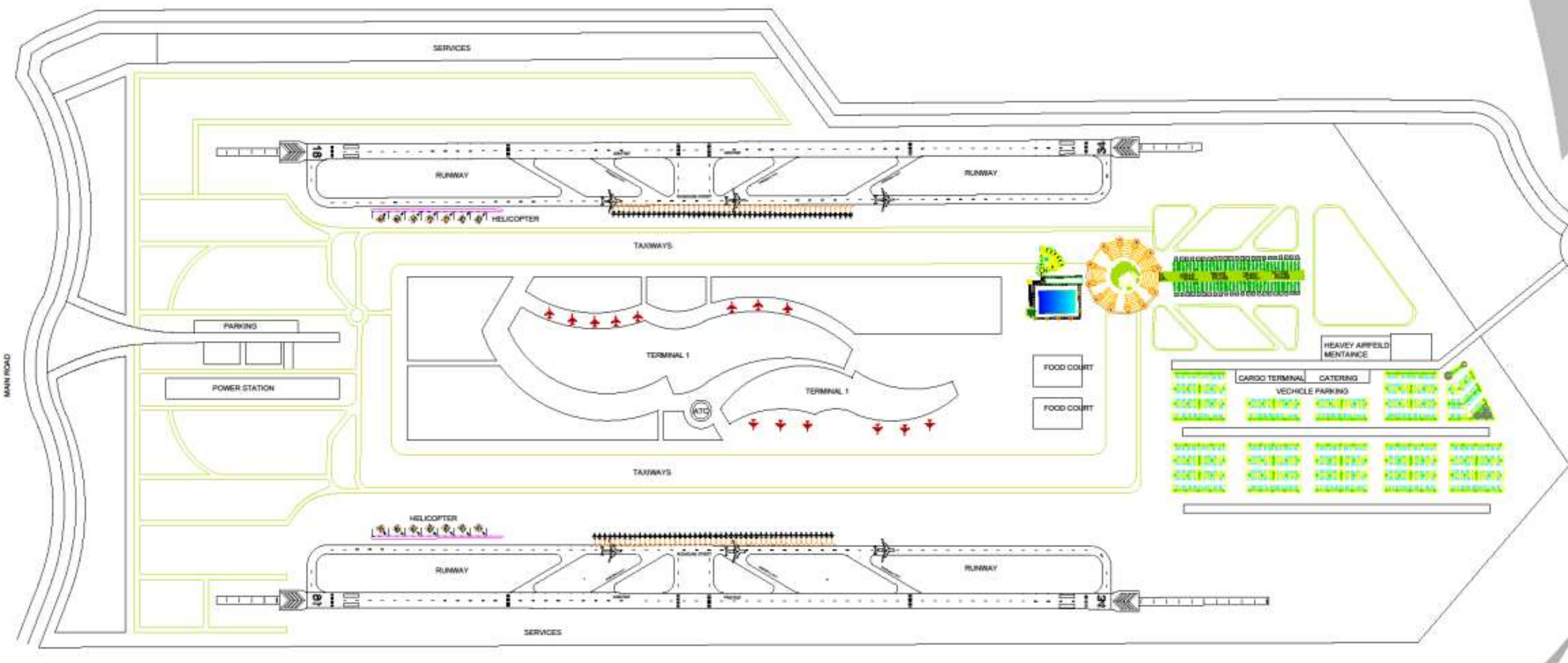
PROJECT:
INTERNATIONAL AIRPORT

A1

TIME:
10:00 AM

SCALE:

UNIT:
METERS



NAVI MUMBAI INTERNATIONAL AIRPORT

STUDENT: **PRIYA SUKHWANI, AR 5-2,5TH YR**

COLLAGE: **BABU BANARSI DAS UNIVERSITY LKO.**

TOPIC: **SITE PLAN**

PROJECT: **INTERNATIONAL AIRPORT**

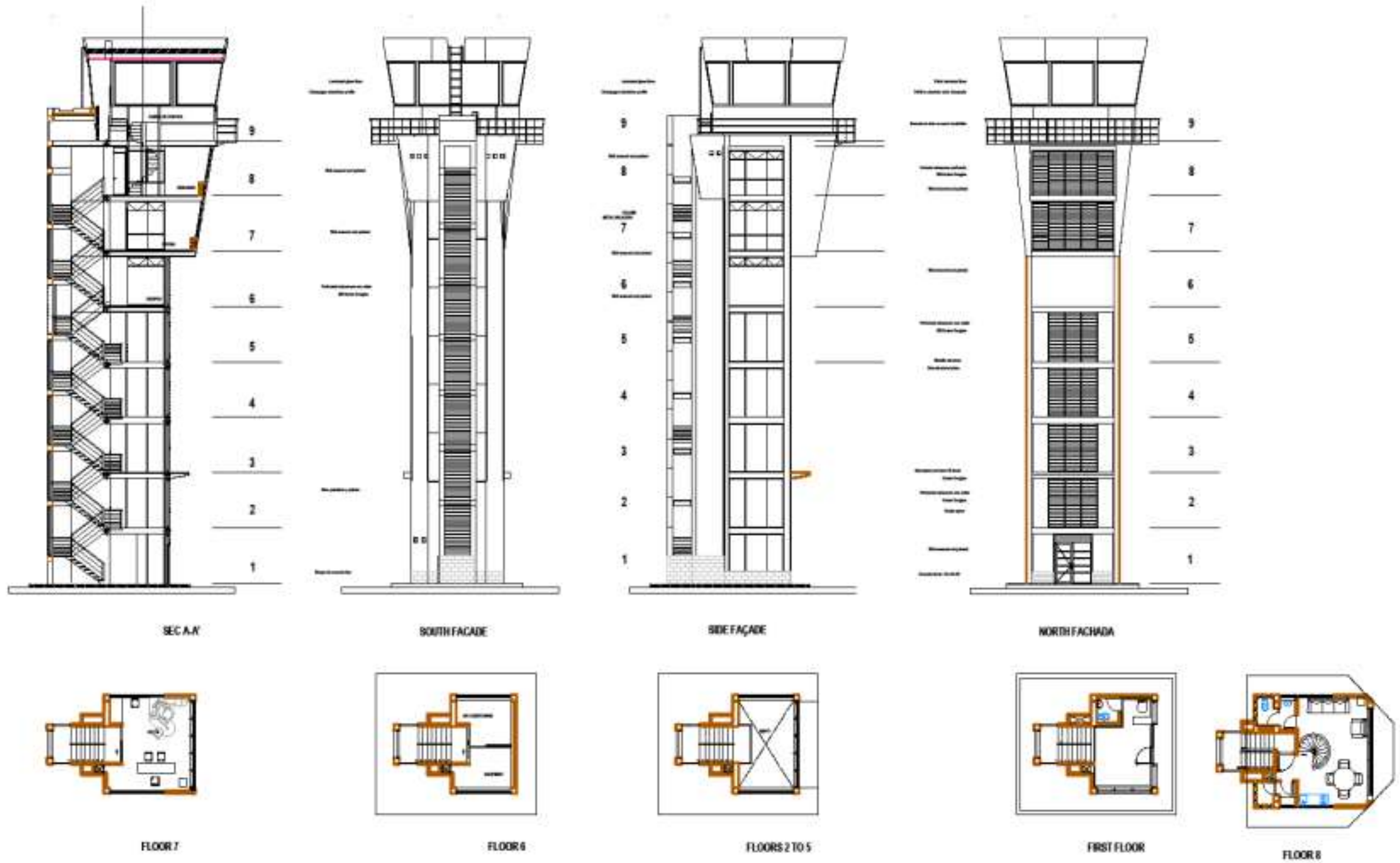
A1

TIME: **10:00 AM**

SCALE:

UNIT: **METERS**

CONTROL TOWER



NAVI MUMBAI INTERNATIONAL AIRPORT

STUDENT: PRIYA SUKHWANI, AR 5-2,5TH YR

COLLAGE: BABU BANARSI DAS UNIVERSITY LKO.

TOPIC: ATC

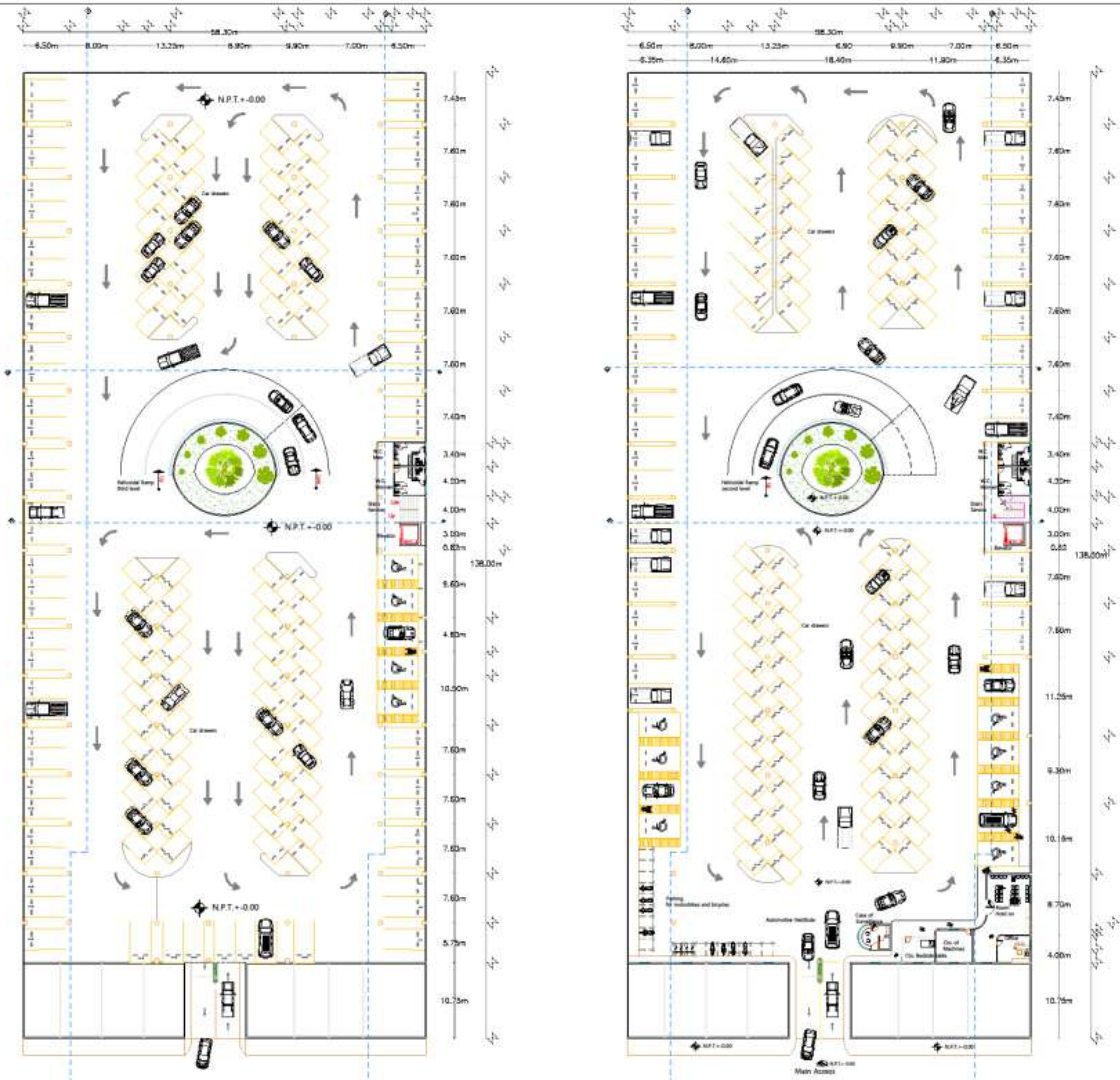
PROJECT: INTERNATIONAL AIRPORT

TIME: 10:00 AM

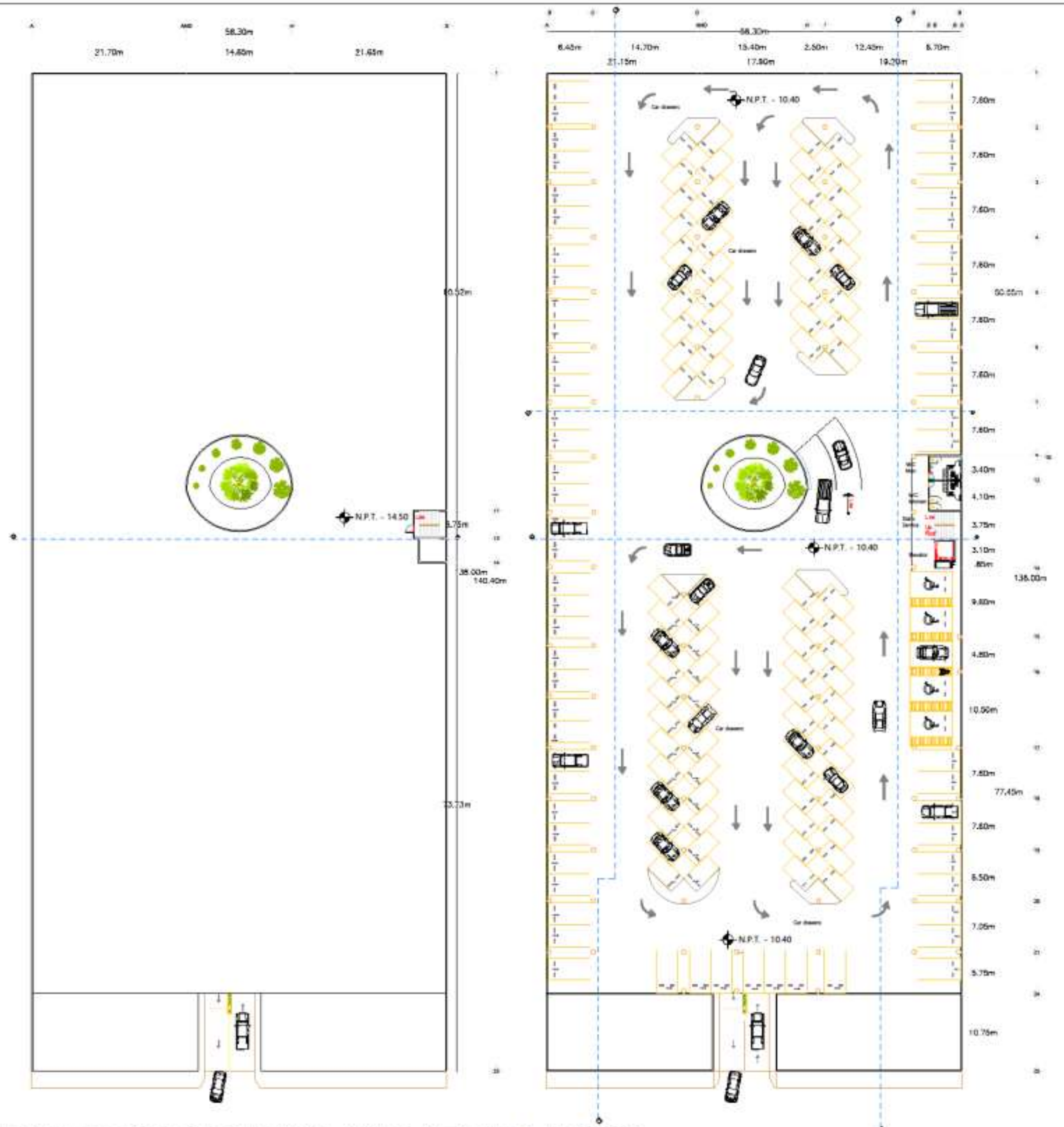
SCALE:

UNIT: METERS

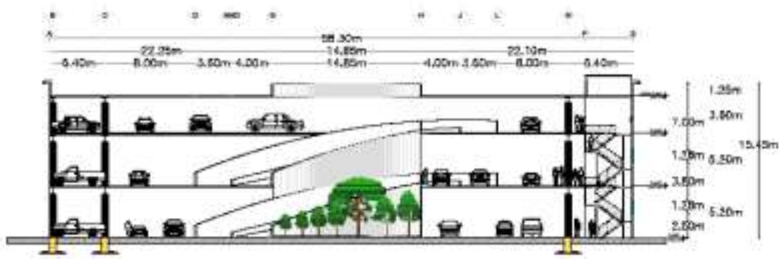
A1



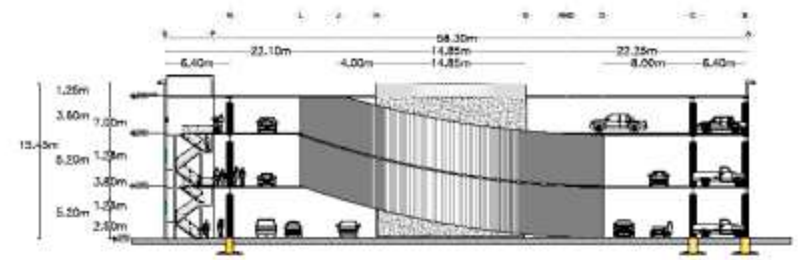
ARCHITECTURAL FLOOR 1ST LEVEL AND 2RD LEVEL



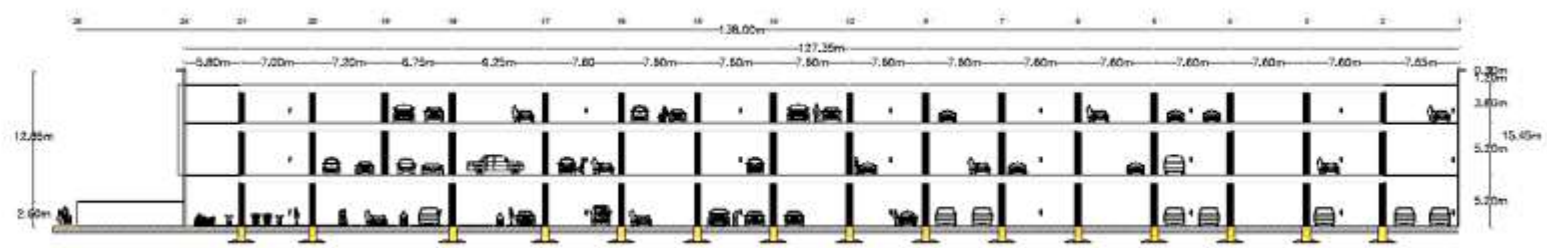
ARCHITECTURAL FLOOR 3RD LEVEL AND AZOTEA FLOOR



X-X CROSS-CUTTING'



X-X CROSS-CUTTING'



LONGITUDINAL CUT AND-Y'

LONGITUDINAL CUT AND-Y'

FACADES AND COURTS