AIRPORT ENGINEERING

AIR TRANSPORTATION

- Improves accessibility to otherwise inaccessible areas
- Provides continuous connectivity over land and water (No change of equipment)
- Brings in relief during emergency conditions
- Saves productive time spent in journey
- Increases the demand of specialized technical skill workforce

AIR TRANSPORTATION

- Adds to foreign reserve, through tourism etc.,
- Heavy funds are required, not only initially but also during operations
- Operations are highly dependent up on weather conditions
- Requires highly sophisticated machinery
- Adds to outward flow of foreign exchange

AIR TRANSPORTATION

- Safety provisions are adequate
- Specific demarcation of flight paths and territories is essential

AIR TRANSPORTATION

AIR TRANSPORT AGENCIES

- International Civil Aviation Organisation
- Federal Aviation Administration
- Airports Authority of India
- Air India International Corporation
- Indian Airlines Corporation
- Private Air Transport Agencies

AIR TRANSPORT AGENCIES

- Airport Authority of India
  - Airports Authority of India (AAI) was constituted by an Act of Parliament and came into being on 1st April, 1995 by merging erstwhile National Airport Authority and International Airports Authority of India
  - AAI manages 125 airports, (11 International Airport, 89 Domestic Airports and 27 Civil Enclaves at Defence airfields)
  - International airports are at Ahmedabad, Amritsar, Bangalore, Goa, Guwahati, Hyderabad, CIAL (Pvt.), Mumbai, Delhi, Calcutta, Chennai and Thiruvananthapuram.

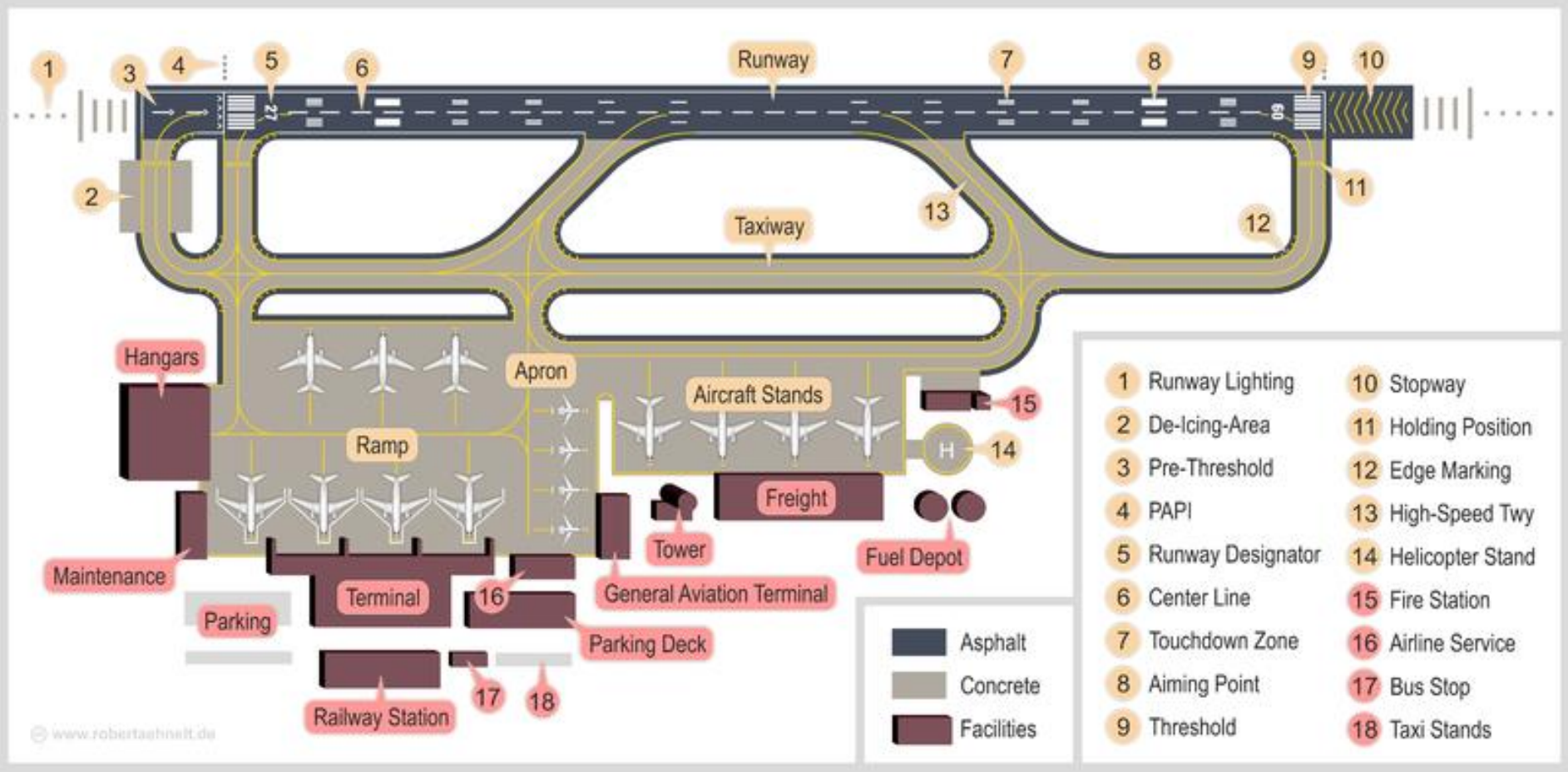
FUNCTIONS OF AAI

- Control and management of the Indian airspace extending beyond the territorial limits of the country as accepted by ICAO
- Design, Development, Operation and Maintenance of International and Domestic Airports and Civil Enclaves
- Construction, Modification and Management of Passenger Terminals
- Development and Management of Cargo Terminals at International and Domestic Airports

FUNCTIONS OF AAI

- Provision of Passenger Facilities and Information Systems at the Passenger Terminals at airports
- Expansion and strengthening of operation area viz., Runways, Aprons, Taxiway etc.,
- Provision of visual aids
- Provision of Communication and Navigational aids viz., Radar etc.,

AIRPORT LAYOUT



AIRPORT LAYOUT

- Main components of an Airport layout are
  - Airfield
    - Landing strip
    - Taxiways
    - Apron
  - Terminal Area
    - Gates
    - Terminal building
    - Aircraft service facilities
  - Flight support area

AIRPORT LAYOUT

- Landing strip
  - Runway – Strip provided specifically for landing and take off.
  - Shoulders – Shoulders are provided on either side of the runway to serve as safety zones.
  - Stopways – Provided at the end of the runway to accommodate an aircraft that overshoots or undershoots a runway during landing.
  - Taxiways – It is a strip connecting runways with one another and with the aircraft parking apron.

AIRPORT LAYOUT

- Landing strip
  - Apron – Hard standing area where aircraft are parked. Passengers emplane/deplane here and cargo is loaded/unloaded here. Fuelling and other servicing is also carried out here.
  - Gate – It is the opening in the terminal building through which passengers enter/ leave the building.
  - Hangars – A **hangar** is a closed structure to hold aircraft or spacecraft in protective storage.
    - Used for – Protection from weather, protection from direct sunlight, maintenance, repair, manufacture, assembly and storage of aircraft on airfields.

AIRPORT LAYOUT

Aerial View of Chennai International Airport

Stockholm Arlanda Airport, Sweden

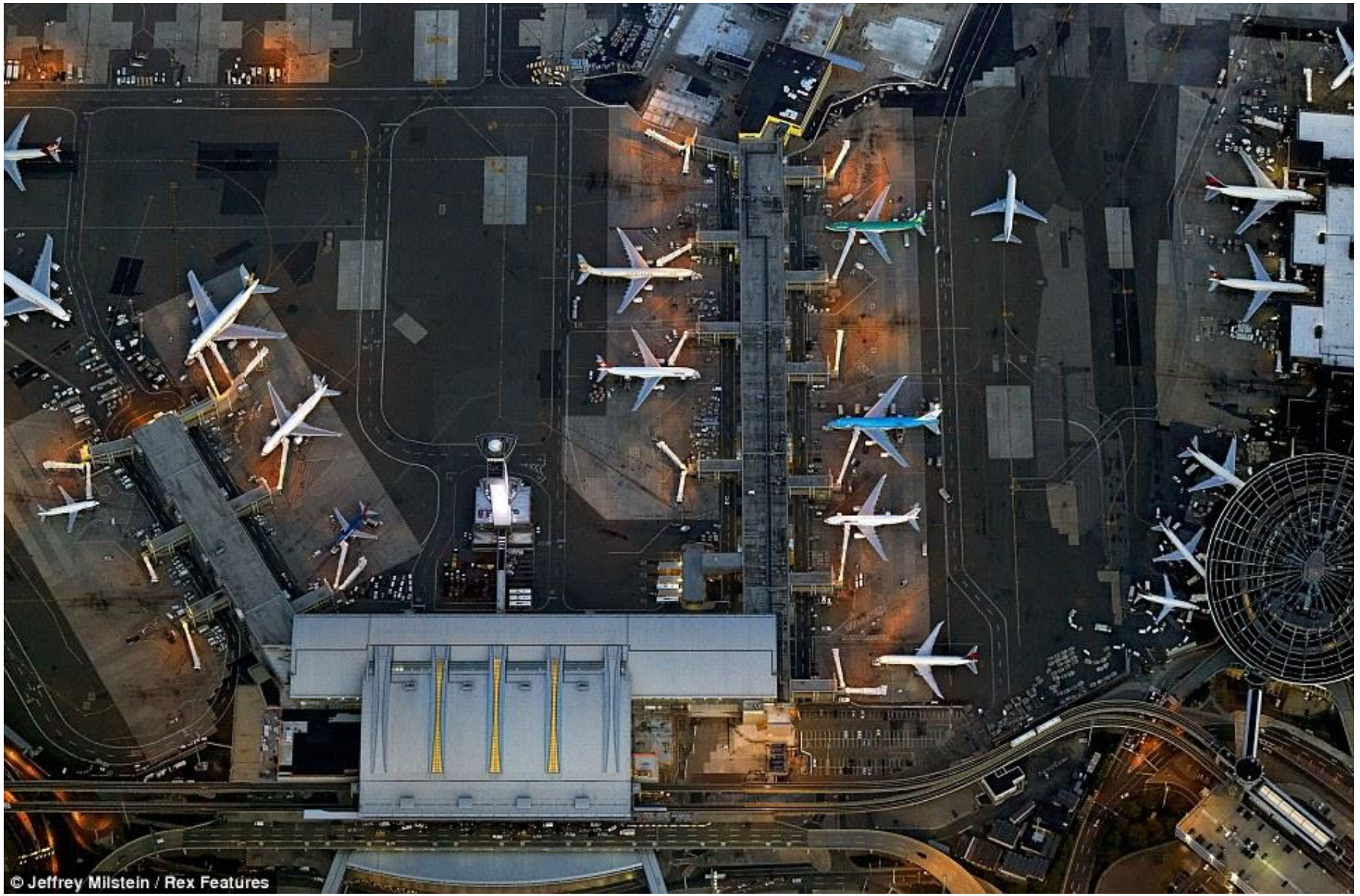
Stockholm Arlanda Airport, Sweden

Boston Logan International Airport, U. S. A.

LaGuardia Airport in New York

John F. Kennedy International Airport, U. S. A.

John F. Kennedy International Airport, U. S. A.



John F. Kennedy International Airport, U. S. A.

APRON

APRON

APRON

HANGER

AIRCRAFT CHARACTERISTICS

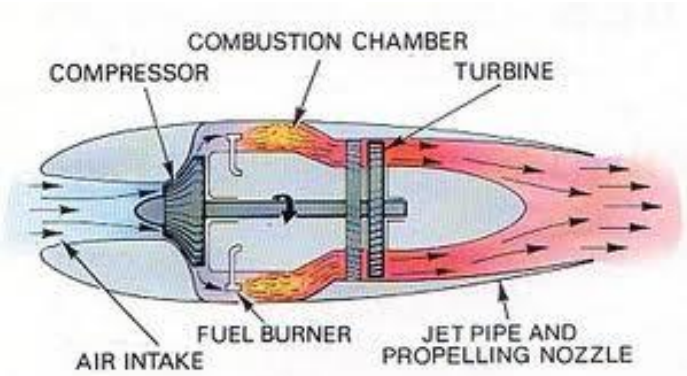
AIRCRAFT CHARACTERISTICS

- Engine Type and Propulsion
- Size of aircraft
- Aircraft weight and wheel configuration
- Minimum turning radius
- Minimum circling radius
- Speed
- Capacity
- Noise
- Vortices at tail ends
- Jet Blast
- Fuel Spillage

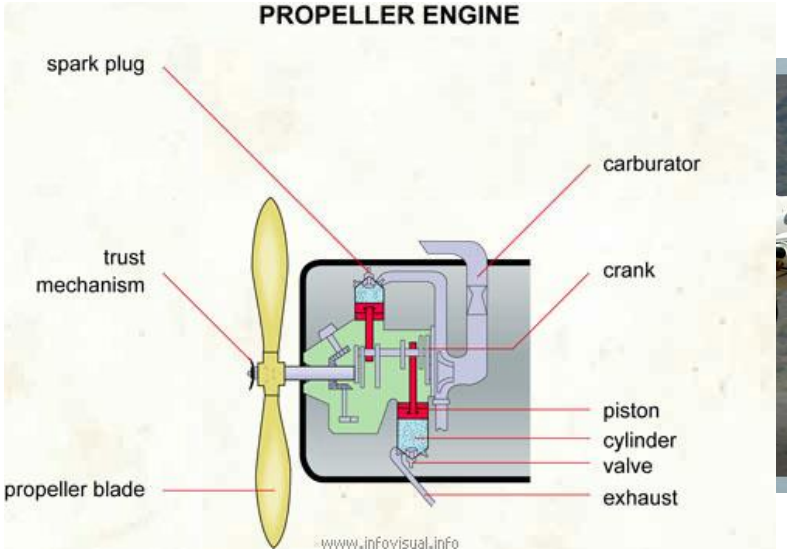
AIRCRAFT CHARACTERISTICS

ENGINE TYPE AND PROPULSION

- Propulsion may be through any type of engine –
  - Piston engine, Jet engine (Turbo jet, Turbo propulsion or Ram jet) or Rocket engine



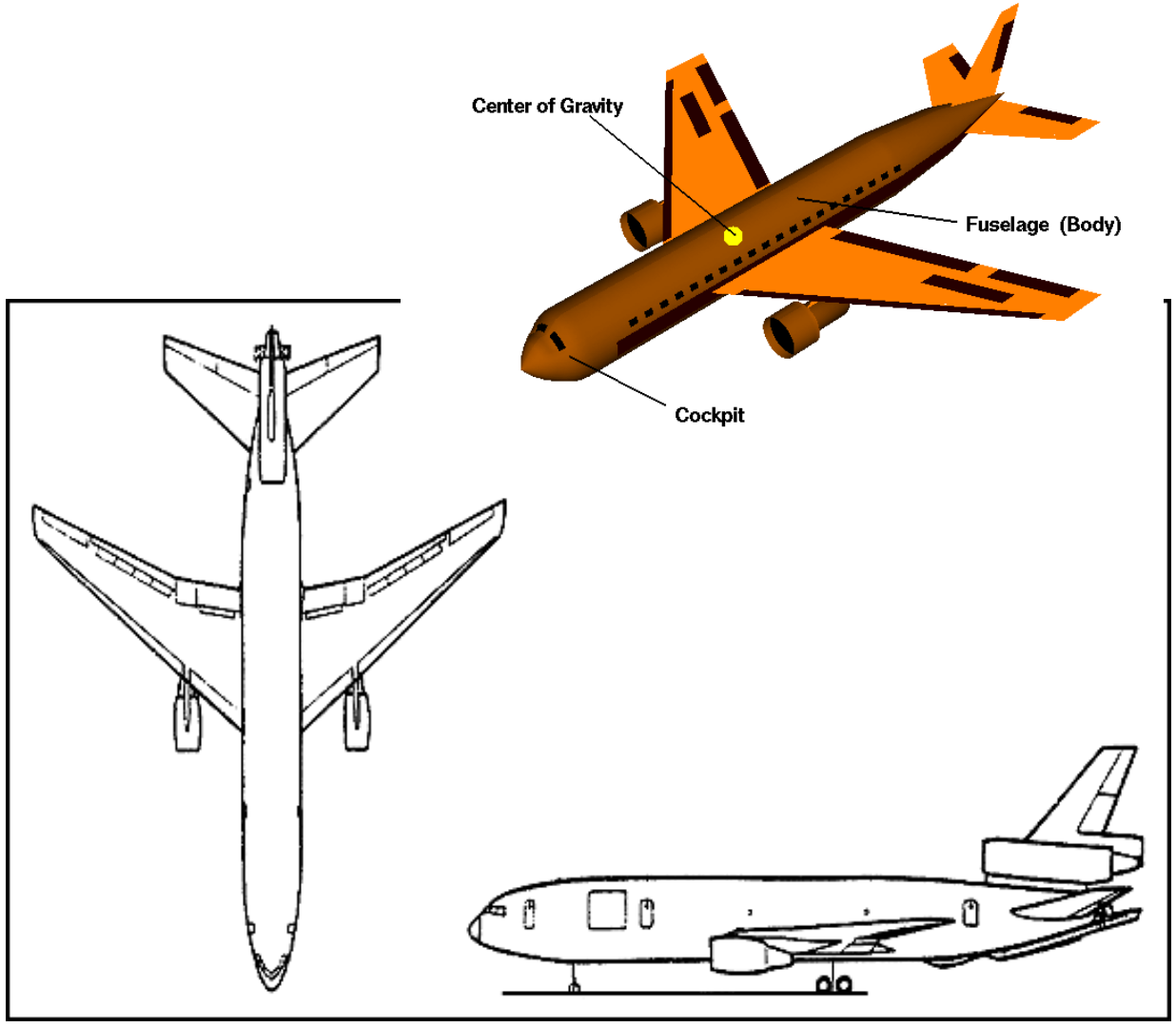
  - These may provide speed as high as 500 km/hr, 800 km/hr, 1280 – 2400 km/hr, 4600 km/hr respectively.
  - The aircraft may operate at low, low to high, middle altitudes.



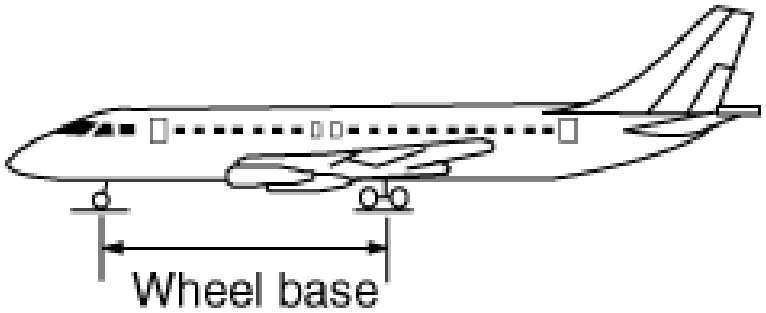
AIRCRAFT CHARACTERISTICS

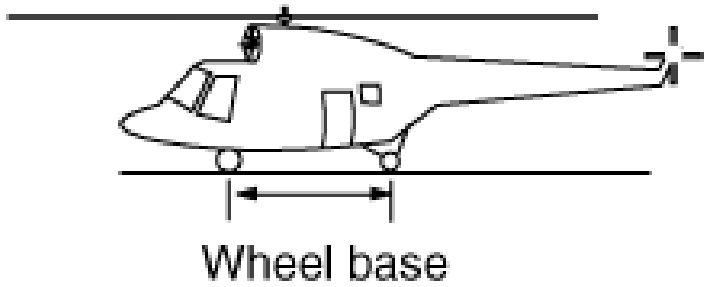
SIZE OF THE AIRCRAFT

- This is defined using basic parameters like
  - Fuselage length (from nose to tail)
  - Gear tread (distance between main gears)
  - Height (at tail)
  - Tail width
  - Wheel base (distance between nose gear and main gear)
  - Wing span (near main gear)



AIRCRAFT CHARACTERISTICS





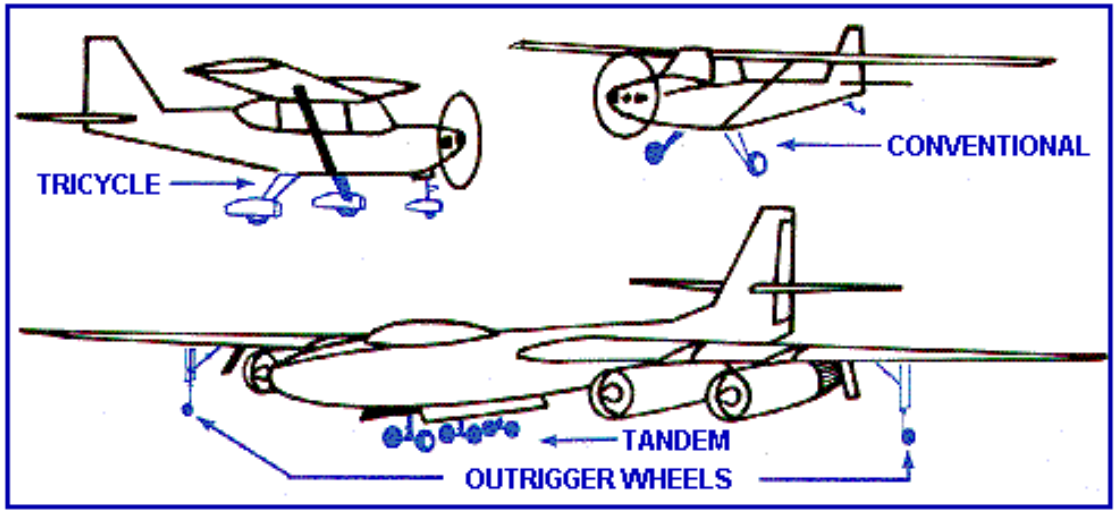
AIRCRAFT CHARACTERISTICS

AIRCRAFT CHARACTERISTICS

- **AIRCRAFT WEIGHT**
  - Maximum Gross take-off weight
  - Maximum Structural landing weight
  - Operating Empty weight
  - Pay-load
  - Zero-Fuel weight

AIRCRAFT CHARACTERISTICS

- **WHEEL CONFIGURATION**
  - Different types of wheel configuration depends upon size of aircraft.
  - Single wheel assembly
  - Dual wheel assembly
  - Twin Tandem or Multiple wheel assembly

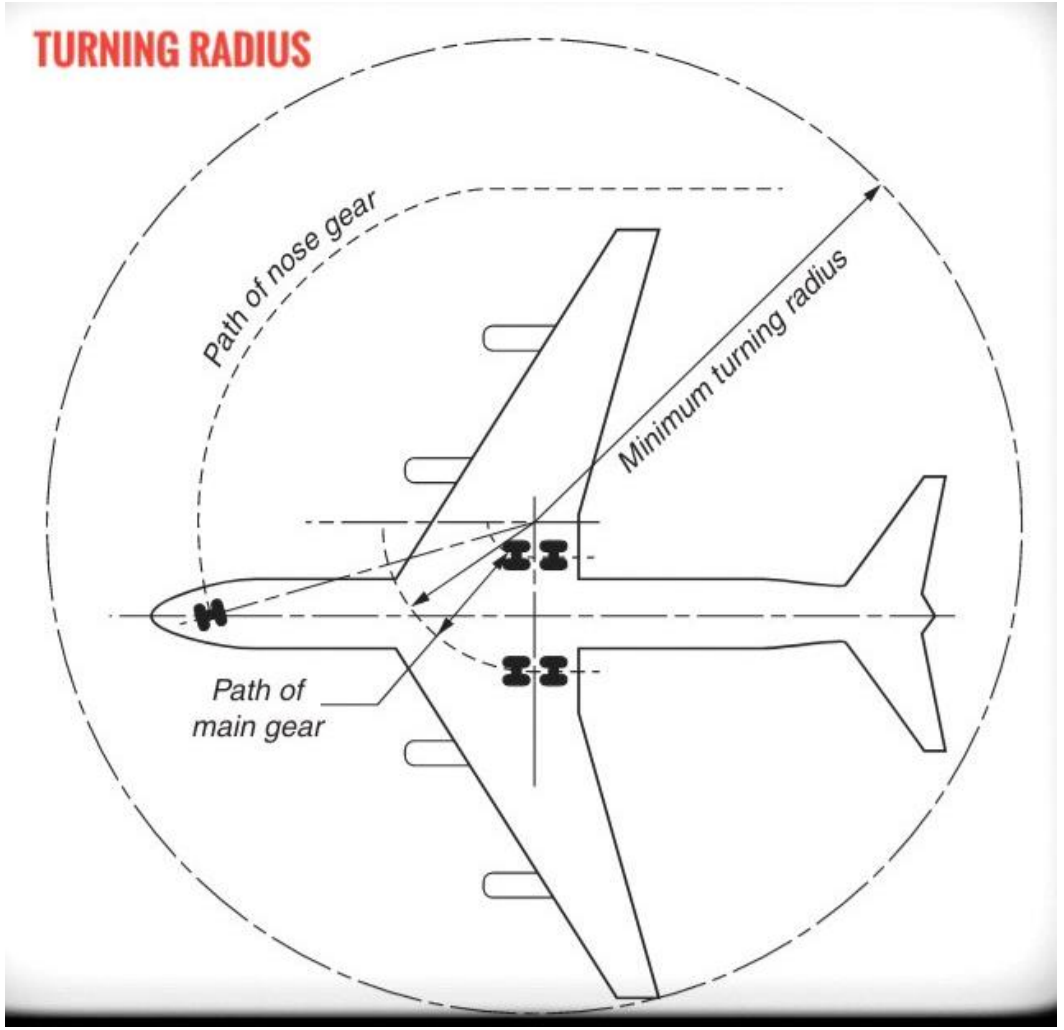


http://aeromates.blogspot.com/2016/08/landing-gear.html

AIRCRAFT CHARACTERISTICS

MINIMUM TURNING RADIUS

- While taking a turn, the nose gear is steered and therefore, makes an angle with the axis of main gear, called **angle of rotation.** The point of intersection of axis of main gear and line through axis of steered nose gear is called **point of rotation.**
- The maximum angle of rotation is around 50 - 60º
- The line joining the centre of rotation and the tip of farthest wing of the aircraft is known as the **minimum radius.**



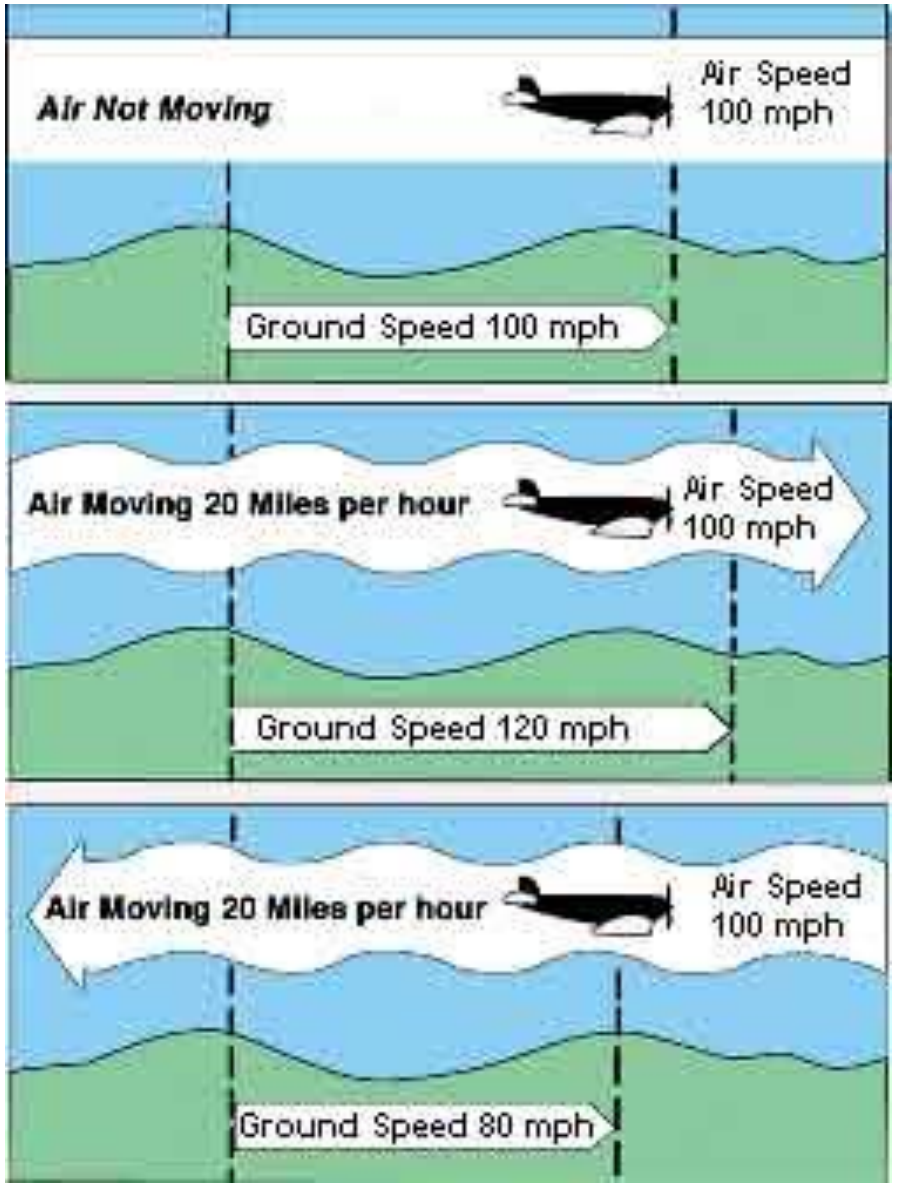
https://medium.com/@penerbanganilmu/aircraft-turning-radius-d6931833f2cf

AIRCRAFT CHARACTERISTICS

- **MINIMUM CIRCLING RADIUS**
  - This is the radius in space required for the aircraft to take a smooth turn.
    - Type of aircraft
    - Air traffic volume
    - Weather condition

AIRCRAFT CHARACTERISTICS

- **SPEED**
  - **Air Speed**
    - Speed of aircraft in air relative to the medium (i.e air)
    - Indicated speed – indicated by the instrument on board
      - This is around 2 percent lower than the true speed
  - **Ground Speed**
    - Speed of aircraft relative to the ground
    - Air speed = Ground speed (+/-) wind velocity



AIRCRAFT CHARACTERISTICS

- **CAPACITY**
  - Defined as the number of passengers and amount of cargo it can handle
  - Dependent up on
    - Size of aircraft
    - Propulsive power of aircraft
    - Speed of aircraft

AIRCRAFT CHARACTERISTICS

- **NOISE**
  - Big problem in areas where airports are quite near to the developed areas
  - Major sources of noise are
    - Engine
    - Machinery (prominent during landing)
    - Primary jet (prominent during take-off)
  - Disturbances are more sever during take-off than during landing
  - Since the inception of the jet engines, the noise has reduced due to technological advancement

AIRCRAFT CHARACTERISTICS

- **VORTICES AT TAIL ENDS**
  - Vortices are made up of two counter rotating cylindrical masses extending along the flight path
  - These are formed near the tail ends of the wings or tail end of the aircraft
  - The velocity of wind in these vortices may be very high

AIRCRAFT CHARACTERISTICS

- **JET BLAST**
  - This is the blast that comes out of the jet engine at the rear of the aircraft to provide the force for movement
  - Its severity depends up on
    - Height of the tail pipe from the ground
    - Angle of the tail pipe
  - Blast fences need to be erected to control pavement damage
- **FUEL SPILLAGE**
  - Spilling of fuel occurs when the engine is shut down or is loosing speed

AIRCRAFT CHARACTERISTICS

AIRPORT CLASSIFICATION

AIRPORT CLASSIFICATION

- Based on Take-off and Landing
  - Conventional Take off and Landing Airport

    Runway length more than 1500m

  - Reduced Take off and Landing Airport

    Runway length between 1000 – 1500m

  - Short Take off and Landing Airport

    Runway length between 500 – 1000m
  - Vertical Take off and Landing Airport

    Operational area 25 – 50 sqm (Helicopter)

AIRPORT CLASSIFICATION

- Based on Geometric Design

  Employs aerodrome reference code. It consists of

  - Length of runway available
  - Aircraft wing span and outer main gear wheel span

  Based on Length of Runway

Code No	Basic Runway, Length (m)
1	<800m
2	800 – 1200m
3	1200 – 1800m
4	>1800m

AIRPORT CLASSIFICATION

Based on Aircraft wing span and outer main gear wheel span

Code	Wing Span(m)	Outer main gear(m)
A	15	0.5
B	15 – 24	0.5 – 0.6
C	24 – 36	6 – 9
D	36 – 52	9 – 14
E	52 – 65	9 – 14

AIRPORT SITE SELECTION

AIRPORT SITE SELECTION

- Specific Aspects
  - Air Traffic Potential
  - Adequate Access
  - Sufficient Airspace
  - Sufficient Land

FACTORS AFFECTING - AIRPORT SITE SELECTION

- Atmospheric and Meteorological conditions
- Availability of Land for expansion
- Availability of utilities
- Development of the surrounding area
- Economy of construction
- Ground accessibility
- Presence of other airports
- Soil Characteristics
- Surrounding obstructions
- Use of airport

FACTORS AFFECTING - AIRPORT SITE SELECTION

- **ATMOSPHERIC AND METEOROLOGICAL CONDITIONS**
  - **Visibility**
    - Fog, smoke, haze
      - Affected by wind velocity
      - Development of area (industrial)
    - Causes reduction in frequency and hence in capacity handling

FACTORS AFFECTING - AIRPORT SITE SELECTION

- **ATMOSPHERIC AND METEOROLOGICAL CONDITIONS**
  - **Wind**
    - Direction and intensity
    - Associated topographical features, like hill, valley
    - Windward / Leeward side
    - Locating development with respect to site of airport

FACTORS AFFECTING - AIRPORT SITE SELECTION

- **AVAILABILITY OF LAND FOR EXPANSION**
  - Future prediction of air traffic
    - Land for parking of vehicles, terminal facilities, apron, runway length etc.,
  - Land cost at later stage
  - Availability of land at later stage

FACTORS AFFECTING - AIRPORT SITE SELECTION

- **AVAILABILITY OF UTILITIES**
  - Water, Power, etc.,
  - Sewerage
  - Communication
  - Generator Plants

FACTORS AFFECTING - AIRPORT SITE SELECTION

- **DEVELOPMENT OF SURROUNDING AREA**
  - Residential or Sensitive area
  - Industrial development
    - Height of development
    - Zoning laws
  - Noise Pollution
  - Movement of Air pollution
  - Bird movements and hits

FACTORS AFFECTING - AIRPORT SITE SELECTION

- **ECONOMY OF CONSTRUCTION**
  - Alternate sites to be examined
  - Availability of local construction material
  - Uneven terrain, grading or flattening
  - Problematic areas
    - Water logging areas
    - Reclaimed areas

FACTORS AFFECTING - AIRPORT SITE SELECTION

- **GROUND ACCESSIBILITY**
  - Travel time in air v/s travel time on land
  - Easily approachable using all types of modes
  - Proximity to areas of air trip generation
  - Facilities for private vehicle users
  - Efficient transport system

FACTORS AFFECTING - AIRPORT SITE SELECTION

- **PRESENCE OF OTHER AIRPORTS**
  - Traffic Volume
  - En-circling radius of aircraft
  - Type of aircraft
  - Type of operating facilities
    - Instrumental Flight Rules (IFR)
    - Visual Flight Rules (VFR)
  - Separation of distance between radii
    - May cause –
      - Serious air traffic congestion
      - Reduction in airport capacity

FACTORS AFFECTING - AIRPORT SITE SELECTION

- **SOIL CHARACTERISTICS**
  - Strength of soil sub grade
  - Bearing on the cost of construction
  - Drainage of soil – self draining
  - Level of water table
    - Sub-soil drainage
  - Valley side may have flooding
  - Soil with reasonable amount of pervious material like gravel or sand along with suitable natural binder is good

FACTORS AFFECTING - AIRPORT SITE SELECTION

- **SURROUNDING OBSTRUCTIONS**
  - Clear air space for landing and take-off
  - High-rise structures (man-made)
  - Natural obstructions like trees etc.,
  - Height restrictions and laws

FACTORS AFFECTING - AIRPORT SITE SELECTION

- **USE OF AIRPORT**
  - Civil or military
  - Adaptability for other uses during emergencies

AIRPORT SITE SELECTION

- **DEFINED BY SPACE REQUIRED FOR**
  - Operations
  - Controlling Systems
  - Management staff and
  - Ground Movements

- **IT IS CONTROLLED BY:**
  - Peak Aircraft Traffic
  - Aircraft characteristics etc.,

FACTORS CONTROLLING - AIRPORT SITE SELECTION

- Elevation of Airport Site above MSL
  - Affects runway requirements
  - Aircraft performance varies with altitude, air density, temperature etc.,
  - Affects lift, drag, length of runway, etc.,

FACTORS CONTROLLING - AIRPORT SITE SELECTION

- Meteorological conditions
  - Wind
    - Intensity
    - Direction
    - Duration
- Temperature
- Affects runway orientation and number of runways required
- Length of runway changes (increases)
  - Due to change in air density and subsequent lift etc.,

FACTORS CONTROLLING - AIRPORT SITE SELECTION

- Traffic Volume
  - Peak hour volume
  - Nature of air traffic
  - Size of aircraft
  - Number of Air Transporters
  - Runways, Taxiways, Aprons
  - Hangers, terminals
  - Forecasted traffic

AIRPORT SITE SELECTION

DON MUEANG INTERNATIONAL AIRPORT, THAILAND

MADEIRA INTERNATIONAL AIRPORT, PORTUGAL

AIRPORT SITE SELECTION

GIBRALTAR AIRPORT

KANSAI INTERNATIONAL AIRPORT, JAPAN

AIRPORT SITE SELECTION

COURCHEVEL INTERNATIONAL AIRPORT, FRANCE

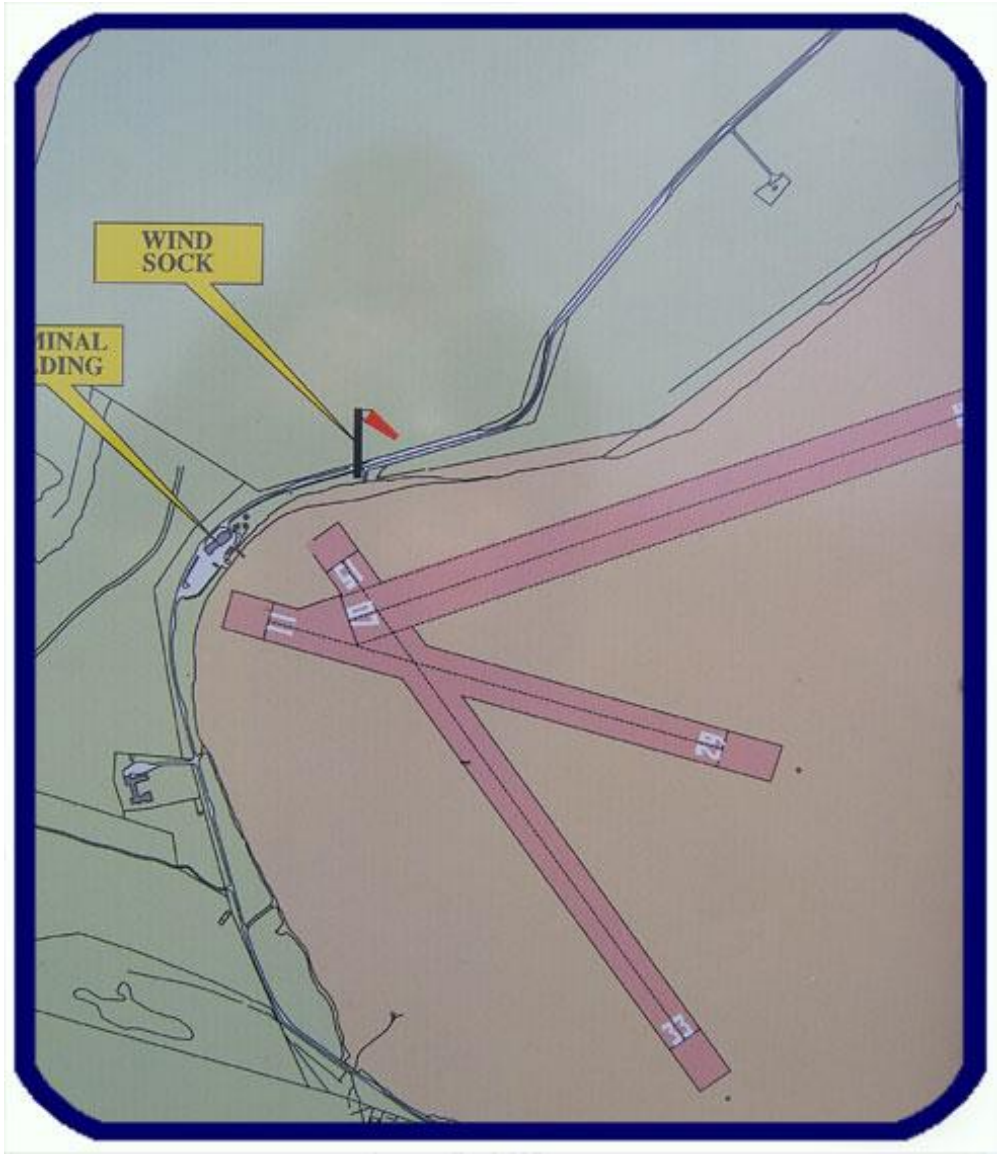
CONGONHAS AIRPORT, BRAZIL

AIRPORT SITE SELECTION

PRINCESS JULIANA INTERNATIONAL AIRPORT, SAINT MAARTEN

SVALBARD AIRPORT, NORWAY

BARRA INTERNATIONAL AIRPORT, SCOTLAND



TENZING-HILLARY AIRPORT, NEPAL

JUANCHO E. YRAUSQUIN AIRPORT, NETHERLANDS ANTILLES

ICE RUNWAY, ANTARCTICA

ICE RUNWAY, ANTARCTICA

REGIONAL PLANNING

REGIONAL PLANNING

- Planning of an airport should be done considering the air traffic needs of the nation as a whole rather than an individual locality.

- Regional plan usually provides the following information:
  - Approximate locations of the airports in national map
  - Classification of airports
  - Location of air strips
  - Routes of air travel

REGIONAL PLANNING

- Following data is collected for a scientific and sound planning on regional basis:-
  - Population
  - Topographical and geographical features
  - Existing airports in the vicinity
  - Air traffic characteristics