Lecture 9

University of Anbar
Civil Engineering Department
MSc- Highway Engineering
Railway and Airport Engineering

Characteristics of Aircraft as they Affect Airports

- Aircraft Characteristic
- The Airport Master Plan
- The Airport System

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Aircraft Characteristic

- **Aircraft Characteristics Related to Airport Design:**

1- Characteristics of Principal Transport Aircraft.
2- Gear Configuration.
3- Static weight on main gears and nose gear.
4- Turning Radii.

1- Characteristics of Principal Transport Aircraft

Principle of aircraft characteristic (Size, Weight, Capacity, Necessary runway length)

- **Size**: - (The wing span, face large length, wheel tread, wheel base, Max. length, …..) Aircraft size has an effect on:

  1) Size of parking aprons which in turn influence the configuration of terminal building.

  2) Size also dictates width of runways and taxiways as well as distance between these traffic way.

  3) Hangers.

- **Weight:** Weight of aircraft is important for determining the thickness of runway, taxiway and apron pavements.

Aircraft Characteristic

- **Capacity:** - The passenger capacity has an important bearing on facilitates within and adjacent to the terminal building, aircraft used in airline operations have passenger capacity ranging from 20 to nearly 500.
- **Runway Length:** - Influence a large part of the land area required at an airport.

Aircraft	Wingspan	Length	Wheel base	Wheel track	Max. Structural takeoff weight, lb	Max. loading weight ,lb	Operating empty weight , lb	Zero fuel weight, lb	Number and type of engines	Max. payload passenger	Runway length , ft	Manufacture
DC-9-32	93 ' 04 "	119' 04"	53' 02"	16' 05"	108000	99000	56855	87000	2TF	115-127	7500	McDonnel - Douglas
DC-9-50	93' 04"	132' 00"	60' 11"	16' 05"	120000	110000	63328	98000	2TF	130	7100	
B-737-200	93' 00"	100' 00"	37' 04"	17' 02"	100500	98000	59958	85000	2TF	86-125	5600	Boeing
B-727-200	108' 00"	153' 02"	63' 03"	18' 09"	169000	150000	97400	138000	3TF	134-163	8600	Boeing
B-747B	195' 09"	229' 02"	84' 00"	36' 01"	234300	175000	115000	156000	4TF	131-149	6100	Boeing
Concorde	83' 10"	202' 03"	59' 08"	25' 04"	389000	240000	175000	200000	4TJ	108-128	11300	British Aircraft

Runway length at standard conditions (at sea level) [No wind, standard day and level runway)

Note: It is important to note that it is not valid to assume that the larger weight of aircraft required larger runway length.

Aircraft Characteristic

- Types of Aircrafts according to Type of Propulsion and Thrust- Generating Medium:

  1-Piston Engine Aircraft= applies to all propeller driver aircraft powered by gasoline reciprocating engine.

  2- Turbo Propeller Aircraft = refers to propeller driven aircraft powered by a turbo in engine.

  3- Turbojet Aircraft = refers to those aircrafts which are not dependent on propellers for thrust, but which obtain the thrust directly from the turbine engine.

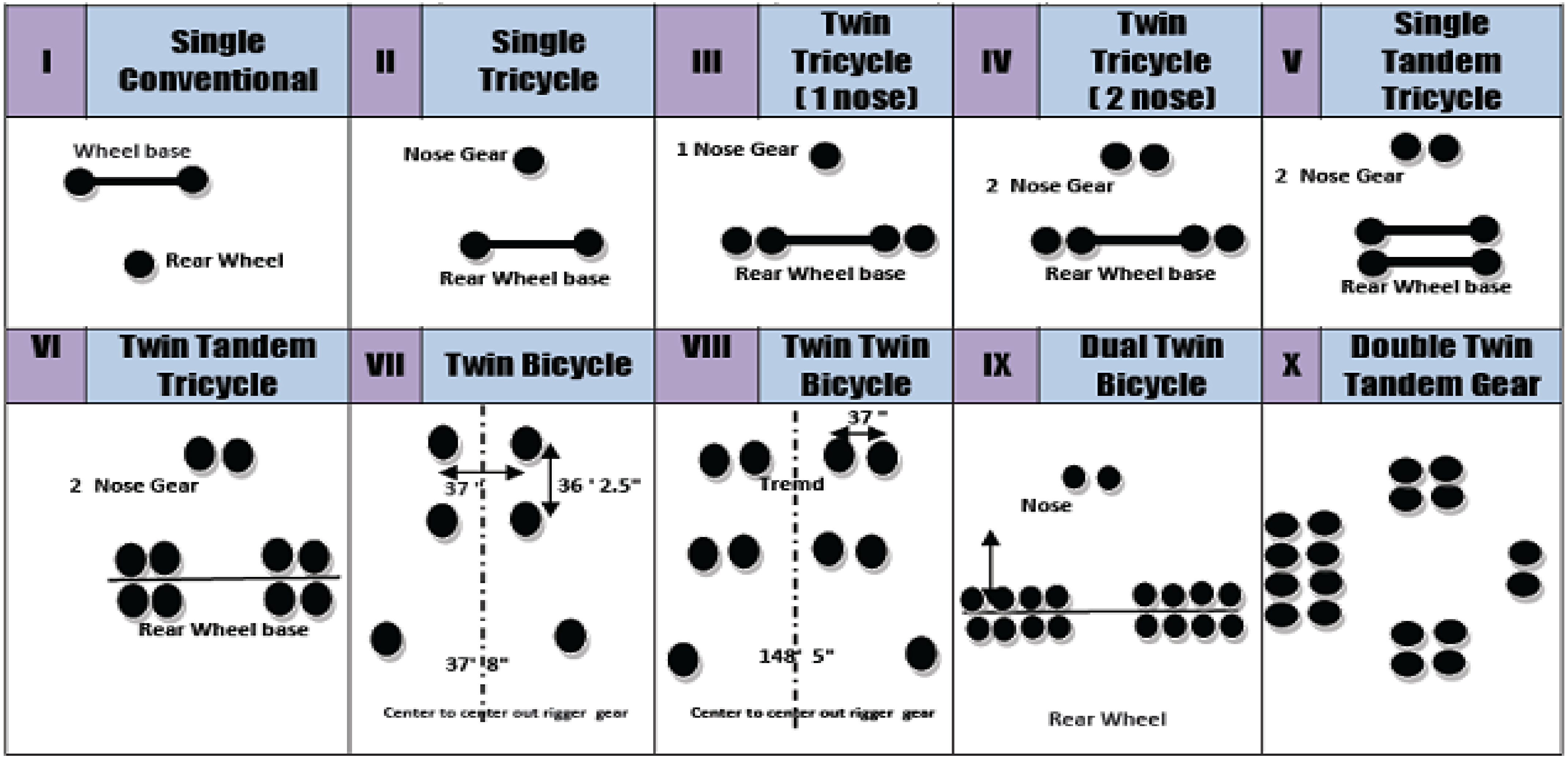
  4- Turbofan Aircraft = Turbojet engine with a fan added in the front or rear of it most fans are installed in front of the main engine.

  Note: - nearly all airline transport aircrafts are non-powered by turbofan as they are more economical than turbojet.

Aircraft	Fuel Consumption
B-727-200	7000 Ib/hr
B-747-A	21000 Ib/hr

Aircraft Characteristic

2- Loading Gear Configurations



Aircraft Characteristic

3-Static Weight Main Gears and Nose Gear:-

The distribution of the load between the main gears and the nose gear depends on the type of aircraft and the location of the center of gravity of the aircraft for design of pavement it's normally assumed that

1- 5% of the weight supported on the nose gear and 95 % on the main gears for the tricycle configuration.

2- 50% of the weight supported on the nose gear as well as for the main gear for the bicycle configurations.

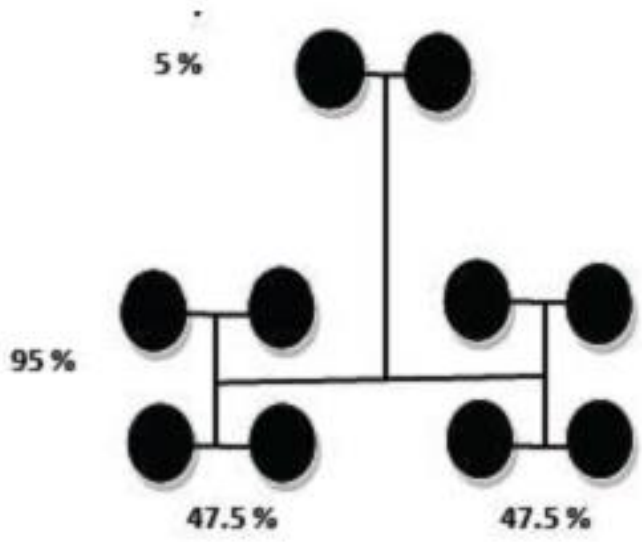
Example:- Take-off weight of an aircraft =300 kips (Twin Tandem Tricycle)

Solution:

· Each main gear support = 0.475 *300=142.5 kips

· Load on each tire of the main assembly =142.5/4=35.625 kips

· Kips= 1000 lb



Aircraft Characteristic

4-Turning Radii:

1-For determining aircraft positions on the apron adjacent the terminal building and establishing the paths of aircraft at other locations on the airport , it is important to understand the geometry of movement of an aircraft.

2- Turing Radii; are a function of the nose-gear steering angle (the larger angle , the great are the radii) from the center of rotation the distances to the various parts of the aircraft such as the wing- lips . The nose gear or the tail result than number of radii.

3- The largest radius is the most critical from the standpoint of clearance to building or adjacent aircraft. The min. turning radius corresponds to the max. nose-gear steering angle specified by the aircraft manufacture.

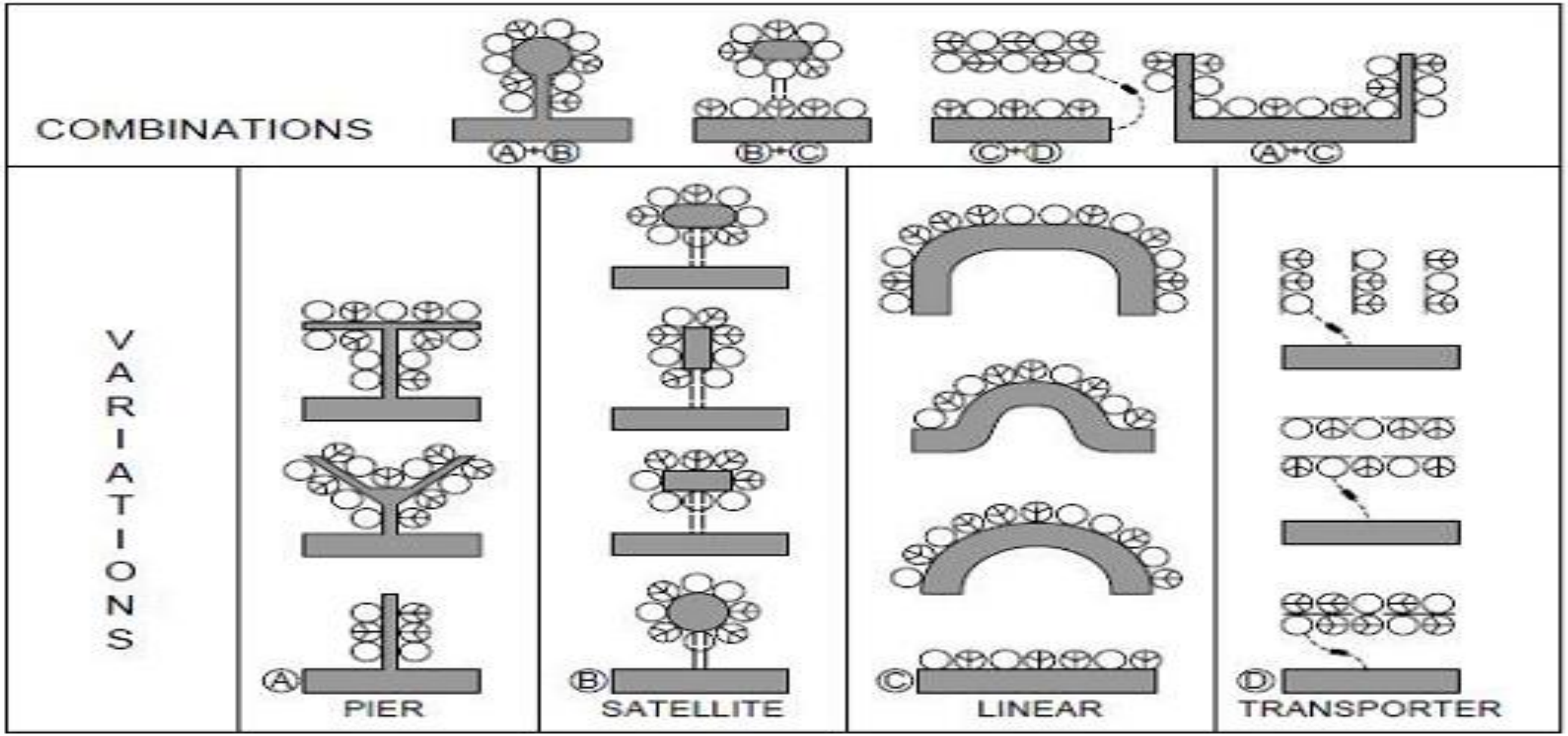
4- The max. angle varying from (60 – 80o)

5- Determine center of rotation by drawing a line through the axis of the nose gear at whatever steering angle is desired .The intersection of this line with a line drown through the axis of 2 main gear (when more the 2 main gear (B-747), the axis is drown midway between the gears.

Note:- Min. turning radii are not used in practice very often because the maneuver produces excessive tire wear and in some instances results in scuffing of the pavement surface. (Accordingly lesser angles on the order of 50o are more proper).

Aircraft Characteristic

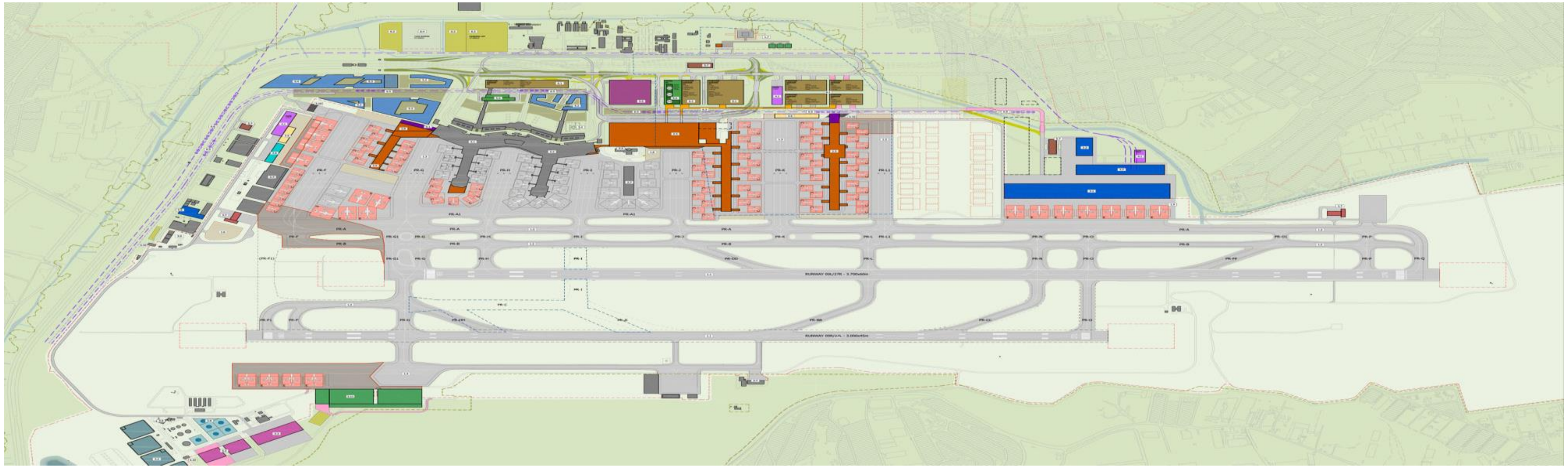
- **Horizontal Distribution Concepts for Passengers (Parking Apron):**
  1-Linear Distribution 2-Pier Distribution 3-Stellite Distribution 4-Transporter Distribution



Terminal Configuration

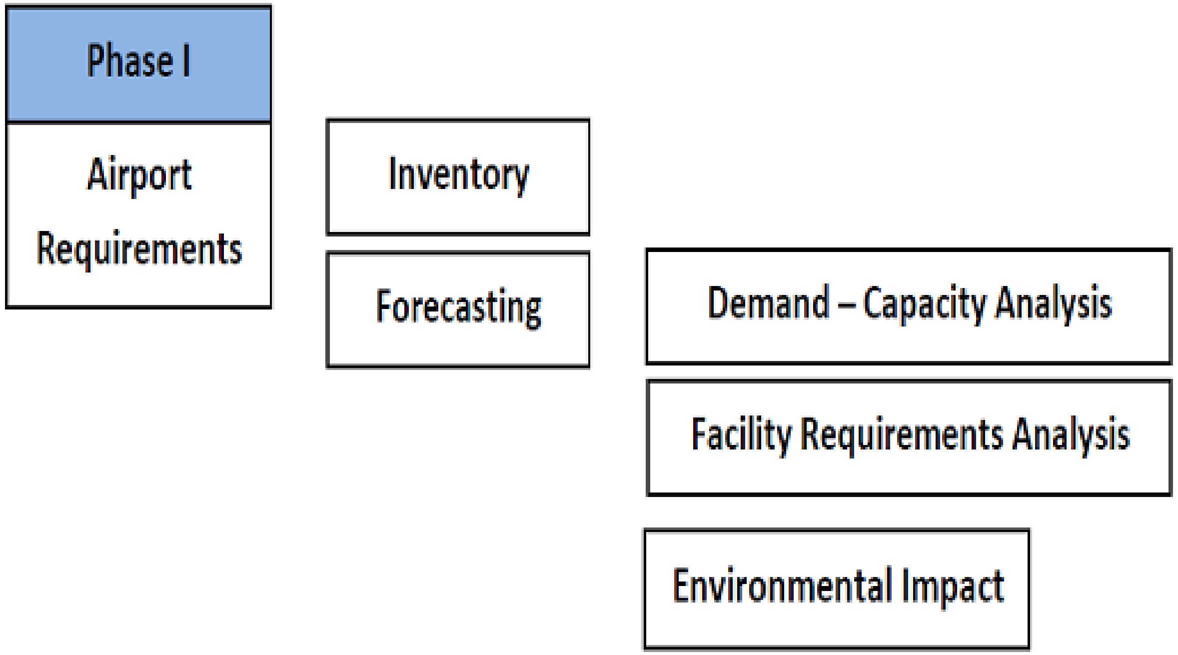
The Airport Master Plan

- Airport master plan is a concept of the ultimate development of an airport. The term development includes the entire airport area, both for aviation and no aviation uses, and use of land adjacent to the airport.
- A Master Plan generally comprises a report or statement and land use and development proposals, with maps, charts, diagrams, and text.
- The overall objective of the airport master plan is to provide guidelines for future development which will satisfy aviation demand and be compatible with the environment, community development, and other modes of transportation. The typical airport master plan has a planning horizon of 20 years.
- The Federal Aviation Administration notes that for a master plan to be considered valid it must be updated every 20 years or when changes in the airport or surrounding environment occur, or when moderate and major construction may require federal funding.



Elements of the Master Plan

- An airport master plan typically consists of the following elements:



Elements of the Master Plan

Phase II
Site Selection

- After airport needs have been established the FAA recommends that there are at least ten factors which should be considered when analyzing potential airport sites:

1 - Convenience to users: If it is to be successful, an airport must be conveniently located to those who use it.
2- Availability of land &land cost: Vast acreages are required for major airports, and it is not uncommon for new airports in large cities to require more than 10000 acres.

3- Design and layout of the airport: In considering alternate potential airport sites, the basic layout and design should essentially be constant.
4- Airspace and obstruction: to meet essential needs for in-flight safety two requirements must be met.
a- Adjacent airports must be located so that traffic using one in no way interferes with traffic using the other.
b- Physical objects such as towers, poles, buildings, mountain ranges,……

Elements of the Master Plan

5- Engineering factors: an airport site should have fairly level topography and be free of mountains, hills, further the terrain should have sufficient that adequate drainage can be provided.

6- Social factor: one of the most difficult social problems associated with airport location is that of noise. Airports are not good neighbor and some control in the development of land surrounding an airport should be exercised.

7- Availability of utilities: airports must depend upon existing utilities. The site should be accessible to water, electrical service, telephones, gas lines, etc. and these utilities should be of the proper type and size.

8- Atmospheric conditions: such as fag, smoke, snow, or glare that may rule out the use of some potential airport site.
9- Hazards due to birds: airport should not be situated near birds on natural preserves and feeding grounds.

10- Coordination with other airports: heavily populated metropolitan areas indicate that more than one major airport will be required to meet future air travel needs.

Elements of the Master Plan

Phase III

Airport Layout Plans

- Airport Layout Plans
- Land Use Area Plan
- Terminals Area Plan
- Airport Access Plans

Phase IV

Financial Plan

- Development and Cut
- Economic Feasibility
- Financing

The Airport System

- It is divided into two major components (air side and land side) as shown in the figure below.