UNIT IV
AIRPORT PLANNING AND DESIGN

AIRFIELD : It is an area where an aircraft can land and take off, which may or may not be equipped with any navigational aids or markings. Many grass strips are also designated as airfields.

AERODROMES A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

Airport Master Plan: An Airport Master Plan is a study used to determine the long-term development plans for an airport. Because air transportation is a vital community industry, it is important that the requirements for new or improved airports be anticipated. The master planning process considers the needs and demands of airport tenants, users, and the general public. The guiding principle of the airport master planning process is the development of a safe and efficient airport. It must also be responsive to area-wide comprehensive transportation planning.

The draft plan includes the following elements:

- Background and Inventory of Facilities
- Aviation Activity Forecasts
- Airfield Design
- Building and Development
- Finance and Implementations

Objectives given by FAA:

- To provide and effective graphical map representation of ultimate development of the airport
- To establish a schedule of various phases for various important improvements in proposed plant
- To present the relevant backup information and data which is essential to the development of master plan.
- To describe the various concepts and alternatives which are considered in the establishment of proposed plan.

Recommendation for airport master plan :

The FAA recommended four different phases to develop airport master plan.

Phase I: AIRPORT REQUIREMENTS: the first phase is essential and examination of these scale and timing of new facilities with respect to expect demand and the status of existing facilities in the context of expected environment suggestions.

PHASE II: SITE SELECTION: for the construction of new airports or the major expansion of existing facilities has been established by evaluation of the surrounding site, environment impact, development, access and availability of utilities, land cost, site development cost and political aspects.

PHASE III: AIRPORT PLANS : the proposed facilities is represented by the following points.

Airport layout plan: it indicates the configuration location and the size of all physical facilities.

Land use plan: the details of land used within the proposed airport boundary and the land use of areas outside the boundaries that are affected by the sitting airport.

Terminal area plan: it shows the size and location of the various buildings and activities within the terminal area.

Airport axis plan: it shows the proposed routing for the various axis modes to the transportation information of that particulate region.

PHASE IV: FINAL PLAN: the final phase involves collection of the data in the four principle areas of financial importance.

Schedules of proposed development: it indicates the short term, intermediate and long term planning's of development for time-time with the demands and estimations.

Estimation of development cost : to plan the schedule and conform the development stages.

Economy feasibility analysis: it examines whether the expected revenue generation will be covered the expected cost.

Financial feasibility analysis : it undertake to determine whether the scale of facilities considered can be finalized by authority involved.

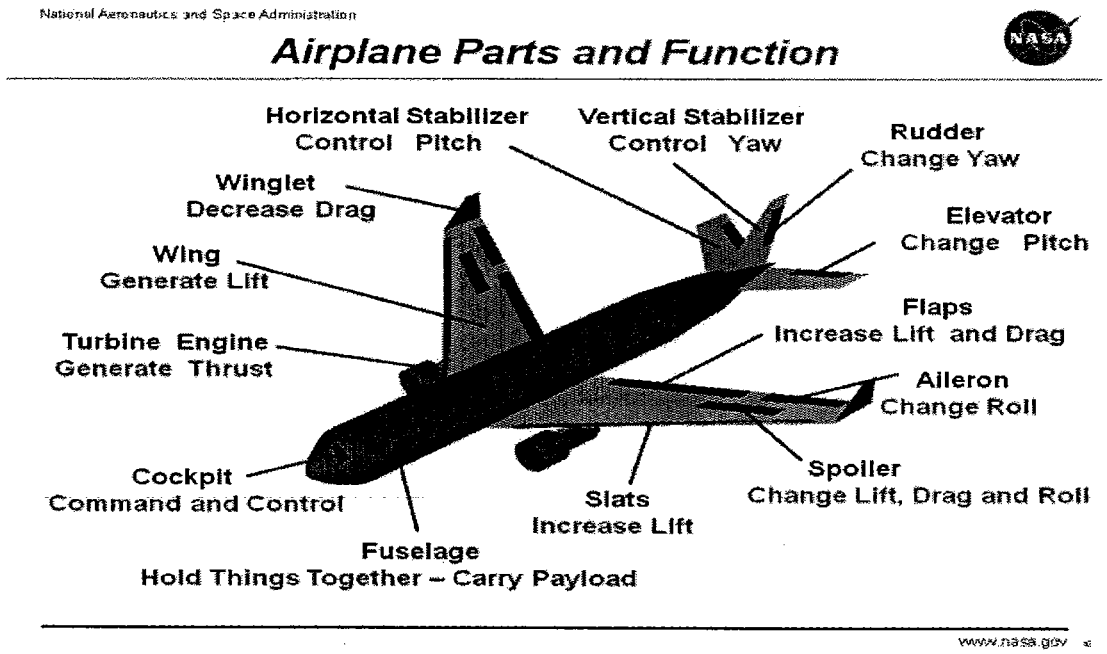
Factors affecting selection of site for Airport

- Regional plan
- Airport use
- Proximity to other airports
- Ground accessibility
- Topography
- obstructions
- visibility
- wind
- noise, nuisance
- grading, drainage and soil characteristics
- future development
- availability of utility for towns

- economic considerations

Airport Layout Plan (ALP) : The Airport Layout Plan (ALP) serves as a critical planning tool that depicts both existing facilities and planned development for an airport. ... By definition, the ALP is a plan for an airport that shows: • Boundaries and proposed additions to all areas owned or controlled by the sponsor for airport purposes.

AIRCRAFT PARTS:



Aircraft Characteristics

- Type of propeller or propulsion
- Size of aircraft
- Minimum turning radius
- Minimum circling radius
- Speed of aircraft
- Capacity of aircraft
- Weight and wheel configuration
- Jet blast
- Fuel spillage
- Noise

Type of propeller or propulsion : The size of aircraft, its circling radius, speed characteristics, weight carrying capacity, noise nuisance etc. depend upon the type of

propulsion of the aircraft. the basic runway length also depends on the type of propulsion used in aircraft.

Size of aircraft: The Size of aircraft involves following important dimensions,

(i) wing span
(ii) height
(iii) distance b/w main gears i.e. gear tread
(iv) wheel base & tail width.

Minimum Turning radius: In order to decide the radius of taxiway, its very essential to study the geometry of turning movement of aircraft

• While taking a turn, the nose gear is steered and therefore, makes an angle with the axis of the main gear, called angle of rotation. The point of intersection of main gear and line through axis of steered nose gear is called point of rotation.

• The maximum angle of rotation is 50°- 60°

• The line joining the center of rotation and the tip of the farthest wing of the aircraft is known minimum turning radius

Minimum Circling Radius: There is certain minimum radius with which the aircraft can take turn in space. Its radius depends upon the type of aircraft, air traffic volume & weather conditions. The radii recommended for different types of aircraft are as follows.

Small general aviation aircraft = 1.6 km

♣ Bigger aircraft = 3.2 km
♣ Piston engine aircraft = 13 km
♣ Jet engine aircraft = 80 km

Speed of Aircrafts: The speed of aircraft can be defined in two ways. i.e. Cruising speed or air speed. Cruising speed is the speed of aircrafts with respect to the ground, when the aircrafts is flying in air at its maximum speed. Air speed is the speed of aircraft relative to the wind. If the aircraft is flying at a speed of 500 kmph & there is a head wind of 50 kmph, air speed will be 450 kmph.

Aircraft capacity: The number of passengers, baggage & fuel that can be accommodated in the aircrafts depends upon the capacity of aircraft.

Weight of aircraft & wheel configuration: Weight of the aircraft directly influence the length of the runway as well as the structural requirements i.e. the thickness of the runway, taxiway, apron & hangars.

Jet Blast: This is the blast that comes out of the jet engine at the rear of the aircraft and provides the force movement of the aircraft. But, if we consider it in case where the aircraft is standing and the jet blast is coming from the rear, that is so hot and it creates a severe condition for the things on which it will be falling. So the severity is going to depend on two things; one is the

• height of the tail pipe from the round
• angle of the tail pipe through which this jet blast will be coming out at the tail end.
So if it is in the upward direction then it will go up if it is in the downward direction it will create a pro effect on the pavement on which the aircraft is standing and therefore there is a need to erect the blast fences which can control the damage to the building or damage to the pavement.

Fuel spillage: At loading aprons & shelter it is difficult to avoid spillage completely, but effort should be made to bring it within minimum limit. The flexible pavements are seriously affected by the fuel spillage

Airport Classification :

1)Based on Take-off & Landing

→Conventional Take off & Landing Airport
Runway length > 1500 m
→Reduced Take-Off & Landing Airport
Runway length 1000 to 1500 m
→ Short Take-Off) & Landing Airport
Runway length 500 to 1000 m
→Vertical Take-Off) & Landing Airport
Operational area 25 to 50 sq.m

2) ICAO Classification: Based on Geometric Design

The classification has been done by using code letters viz.) A to E in which the A type of airport has the longest runway length and E type has the shortest length

ICAO Classification: Based on Length of Runway.

Code No	Basic Runway Length (L) in meter
1	<800
2	800 m up to but not including 1200 m
3	1200 m up to but not including 1800 m
4	1800 m & over

FAA Classification: Based on Aircraft Approach Speed.

Approach Category	Approach Speed Knots (1 knots = 1.9 km/hr)
A	< 91
B	91 - 120
C	121 - 140
D	141 - 165
E	165 or greater

Based on Function

Civil Aviation:

International & Domestic

Military Aviation

Classification Based on Pavement Strength

Code	Single Isolated Wheel Load in kg	Wheel Pressure kg/m2
1	45360	8.4
2	34020	7.0
3	27220	7.0
4	20410	7.0
5	13610	6.0
6	6800	4.90
7	2270	2.90

Runway Orientation : The orientation of a runway depends upon the direction of wind & to some extent on the area available for development. Runway are always orientated in the direction of prevailing wind. Determination of a runway orientation is a critical task in the planning & design of an airport. The direction of the runway controls the layout of the other airport facilities, such as passengers terminals, taxiways/apron configurations, circulation roads & parking facilities.

Cross wind component: It is not possible to obtain the direction of wind along the direction of the centre line of runway throughout the year, On some day of the year or hour of the day, the wind may blow making certain angle with the centre line of runway. If the direction of wind is at an angle to the runway will be Vcos α & that normal to the runway centre line will be Vsin α where V is the wind velocity. The normal component of the wind is called cross wind components

The maximum permissible cross wind component : It depends upon the size of the aircraft and the wind configuration.Θ FAA - 15 kmph for small aircrafts - 25 kmph for mixed traffic ICAO – 35 kmph for big aircrafts

Wind Coverage: Wind coverage or usability factor of airport is the percentage of time in a year during which the cross wind component remains within the limits as specified above is wind coverage

Calm Period: This is the period for which the wind intensity remains below 6.4 km/hr This is common to all direction & hence can be added to wind coverage for that direction Calm period = 100 – Total wind coverage

Wind Rose: The wind data i.e direction, duration & intensity are graphically represented by a diagram called wind rose diagram. Application of Wind Rose diagram is for finding the orientation of the runway to achieve wind coverage. The area is divided in to 16 parts using an angle of 22.5^0 . Average wind data of 5 to 10 years is used for preparing wind rose diagram

Wind Rose – Methods;

Type – I: Showing directionΘ & duration of wind.

Type –II: Showing direction, durationΘ & intensity of wind.

Type – I : Showing direction& duration of wind.

- The radial lines indicate the wind direction and each circle represents the duration of wind.
- From the wind data it is observed that the total % of time in a year during which the wind blows from north direction is 10.3%.
- This value is plotted along the north direction in figure. Similarly other values are also plotted along the respective directions.
- All plotted points are then joined by straight lines.
- The best direction of runway usually along the direction of the longest line on wind rose diagram.
- In the figure the best orientation of runway is NS direction.

Type –II ;Showing direction, durationΘ & intensity of wind.

- Each circle represents the wind intensity to some scale.
- The values entered in each segment represents the % of time in a year during which the wind having a particular intensity.
- Procedure: draw 3 equi-spaced parallel lines on a transparent paper strip.
- Place the transport paper strip over the wind rose diagram in such a way that the central line passes through the centre of the diagram.
- With the centre of wind rose, rotate the tracing paper & place it in such a position that the sum of all the values indicating the duration of wind, within the two outer parallel lines, oriented is the maximum.

- The runway should be thus oriented along the direction indicated by the centre line.
- The wind coverage con be calculated by summing up all the % shown in segment.
- Read the bearing of the runway on the outer scale of the wind rose where the central line on the paper.
- That is the best orientation of runway.

Terminal area: An airport terminal is a building at an airport where passengers transfer between ground transportation and the facilities that allow them to board and disembark from aircraft. Within the terminal, passengers purchase tickets, transfer their luggage, and go through security.

Design:

Due to the rapid rise in popularity of passenger flight, many early terminals were built in the 1930s–1940s and reflected the popular art decostyle architecture of the time. One such surviving example from 1940 is the Houston Municipal Airport Terminal. Early airport terminals opened directly onto the tarmac: passengers would walk or take a bus to their aircraft. This design is still common among smaller airports, and even many larger airports have "bus gates" to accommodate aircraft beyond the main terminal.

Pier : A pier design uses a small, narrow building with aircraft parked on both sides. One end connects to a ticketing and baggage claim area. Piers offer high aircraft capacity and simplicity of design, but often result in a long distance from the check-in counter to the gate

Satellite terminals: A satellite terminal is a building detached from other airport buildings, so that aircraft can park around its entire circumference. The first airport to use a satellite terminal was London Gatwick Airport. It used an underground pedestrian tunnel to connect the satellite to the main terminal. This was also the first setup at Los Angeles International Airport, but it has since been converted to a pier layout.

Semicircular terminals:

Some airports use a semicircular terminal, with aircraft parked on one side and cars on the other. This design results in long walks for connecting passengers, but greatly reduces travel times between check-in and the aircraft

Zones

Pre-Security

- Check-in counters
- Retail stores and restaurants
- Baggage claim

Post Security

- Duty-free shops
- Retail stores and restaurants
- Airport lounges
- Airport customs

Important Components of An Airport Layout

1. Runway
2. Terminal Building
3. Apron
4. Taxiway
5. Aircraft Stand
6. Hanger
7. Control Tower
8. Parking

1.Runways: A runway is the area where an aircraft lands or takes off. It can be grass, or packed dirt, or a hard surface such as asphalt or concrete. Runways have special markings on them to help a pilot in the air to tell that it is a runway (and not a road) and to help them when they are landing or taking off. Runway markings are white. Most runways have numbers on the end. The number is the runway's compass direction. (For example, runway numbered 36 would be pointing north or 360 degrees). Some airports have more than one runway going in the same direction, so they add letters to the end of the number R for right, C for center, and L for left.

2. **Terminal Building:** An airport terminal is a building at an airport. It is where passengers are able to get on and off aircraft. Inside the terminal, passengers can buy tickets, leave or pick up their luggage, and be checked by security staff. The buildings that provide access to the airplanes through gates are usually called concourses.

3.APRON : The airport apron or apron, also known as tarmac, is the area of an airport where aircraft are parked, unloaded or loaded, refueled, or boarded. Although the use of the apron is covered by regulations, such as lighting on vehicles, it is typically more accessible to users than the runway or taxiway.

4.taxiway : A taxiway is a path for aircraft at an airportconnecting runways with aprons, hangars, terminals and other facilities. They mostly have a hard surface such as asphalt or concrete, although smaller general aviation airports sometimes use gravel or grass.

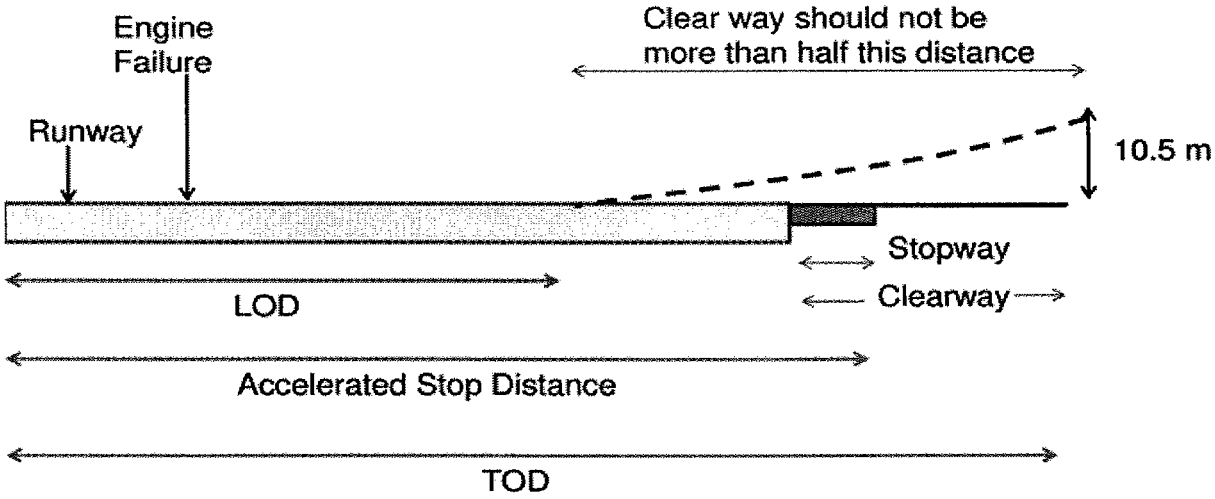
5. Aircraft Stand : A stand guidance system is a system which gives information to a pilot attempting to park an aircraft at an airport stand, usually via visual methods, leading to the term *Visual Docking Guidance System* (VDGS) and also *A-VDGS* (the A standing for advanced) This allows them to remain clear of obstructions and ensures that jetways can reach the aircraft.

6. Hanger: A hangar is a closed building structure to hold aircraft, or spacecraft. .Hangars are used for protection from the weather, direct sunlight, maintenance, repair, manufacture, assembly and storage of aircraft, aircraft carriers and ships.

7.control tower : A control tower is a building at an airport from which instructions are given to aircraft when they are taking off or landing. You can also refer to the people who work in a control tower as the control tower.

8.parking : there should be adequate parking for passenger vehicles and the parking place designed by demand of the airport and average population of the day.

Runway design :



Change in direction of runway : It may not be always possible to orient the runway exactly along the direction as determined from the wind rose. Slight adjustment in the directions may be imperative because of the following reasons.

1. **Obstructions**
2. **Excessive grading**
3. **Noise nuisance**

Basic runway length

It is the length of the runway under the following assumed conditions at the airport

1) Airport altitude is at sea level
2) Temperature at the Airport is standard (15'C)
3) Runway is levelled in the longitudinal direction
4) No wind is blowing on runway
5) Aircraft is loaded to its full loading capacity
6) There is no wind blowing enroot to the destination
7) Enroot temperature is standard

The basic runway length is determined from the performance characteristics of the aircrafts using the airport. The following cases are usually considered

- ✓ Normal landing case
- ✓ Normal take-off case
- ✓ Engine failure case
- ❖ For jet engine aircrafts all 3 cases are considered
- ❖ For the piston engine aircraft only 1st and 3rd cases are considered
- ❑ The case which works out the longest runway length is finally adopted.

1) Normal landing case The landing case requires that aircraft should come to stop within 60% of the landing distance. The runway of full strength pavement is provided for the entire landing distance.

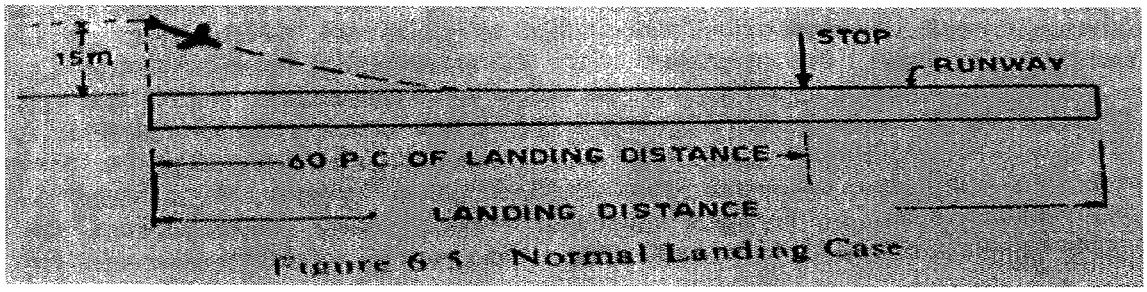


Figure 6.5 Normal Landing Case

2) Normal take-off case : The normal take-off case requires a clearway which is an area beyond the runway and is in alignment with the centre of runway. The width of clearway should not be less than 150 m and is also kept free from obstructions.

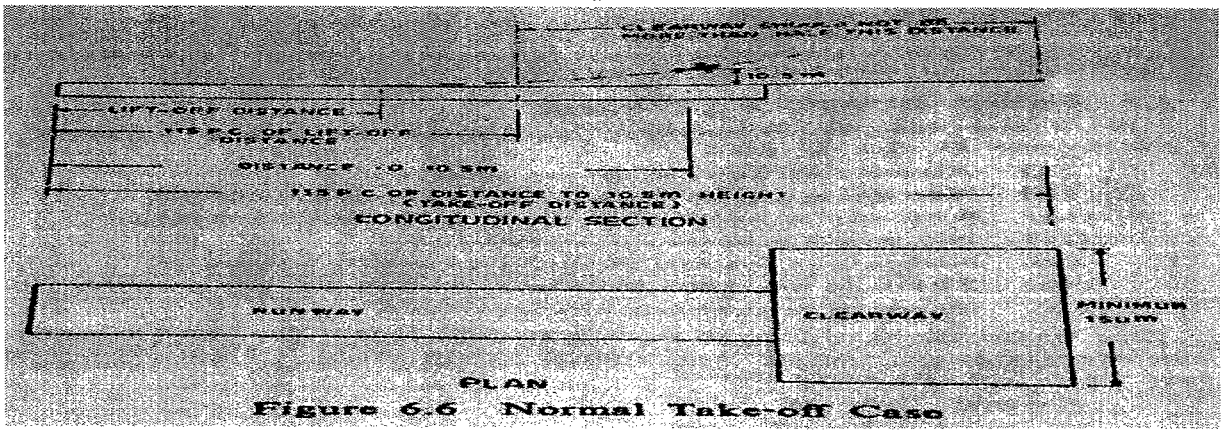


Figure 6.6 Normal Take-off Case

3) Engine failure case The engine failure case may require either a clearway or a stop way, or both. Stop way is described as an area beyond the runway and centrally located in alignment with the centre of runway. It is used for decelerating during an aborted (terminated) take-off.

The strength of stop way pavement should be just sufficient to carry the weight of aircraft without causing any structural damage to the designated engine failure speed, the pilot decelerate the aircraft and makes use of the stop way.

Runway length design procedure:

Correction for Elevation, Temperature & Gradient

1) Correction for elevation:-

As the elevation increases, the air density reduces. This in turn reduces the lift on the wings of the aircraft and the aircraft requires greater ground speed before it can rise into the air.

To achieve greater speed, longer length of runway is required.

ICAO recommends that the basic runway length should be increased at the rate of 7% per 300 m rise in elevation above the mean sea level.

2)Correction for temperature:-

Airport reference temperature

Where Ta- Average daily temperature

Tm- Maximum daily temperature

ICAO recommends that the basic runway length after having been corrected for elevation should be further increased at the rate 1% for every 1°c rise of airport reference temperature above the standard atmospheric temperature at the elevation.

3) Check for the total correction: for the elevation plus temperature: ICAO further recommends that's, if total corrections exceeds 35% of the basic runway length, these corrections should be further checked up by conducting specific studies at the site by model tests.

4) Corrections for gradients:-

$$\frac{\textit{maximum difference in elevation between the highest \& lowest point}}{\textit{total length of runway}}$$

- ✓ Steeper gradient results in greater consumption of energy & as such longer length of runway is required to attain the desired ground speed.
- ✓ **ICAO** does not recommends any specification for the correction of gradients.
- ✓ **FAA** recommends that the runway length after having been corrected for elevation & temperature should be further increased at the rate of 20% for every 1% of effective gradients.

Runway Geometric Design

ICAO gives various geometric standards for the airport design.

1) Runway length
2) Runway width
3) Width & length of safety area

4) Transverse gradients
5) Longitudinal & effective gradient
6) Sight distance

1) **Runway length**

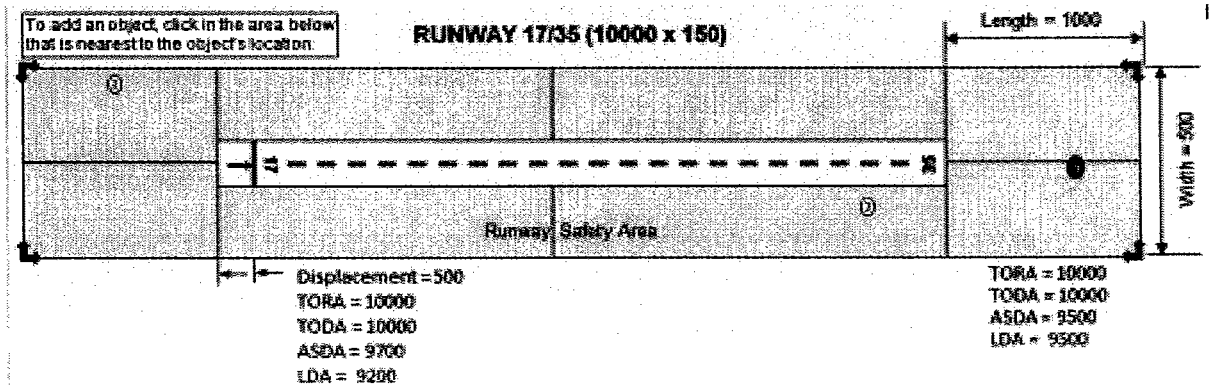
The basic runway length as recommended by ICAO for different types of airport are there. To obtain the actual length of runway, corrections for elevation, temperature & gradient are applied to the basic runway length.

2) **Runway width**

✓ **ICAO** recommends the pavement width varying from **45 m - 18 m** for different types of aircraft.

- ✓ The aircraft traffic is more concentrated in the central 24m width of the runway pavement.
- ✓ 3) Width & Length Of Safety Area safety area consists of the runway, which is paved area plus the shoulder on either side of runway plus the area is cleared, graded & drained as shown in fig.
- ✓ The shoulder are usually unpaved as they are used during emergency.
- ✓ ICAO recommends.

	Types of airport	Width of safety area
Non-instrumental runway	**A,B&C**	**150 m**
	D&E	**78 m**
Instrumental runway	**A,B,C,D&E**	**Mini. 300 m**



4) Transverse gradient :Transverse gradient is essential for quick drainage of surface water. If surface water is allowed to pond on the runway, the aircraft can meet severe hazards. ICAO recommends that the transverse gradient of runway pavement should not

exceed 1.5% for A,B, C & D 2 % for D & E types. ICAO does not recommends that the minimum transverse gradient of runway pavement but it should not greater then 0.5 %.
5) Longitudinal & Effective Gradients The longitudinal gradient of runway increases the required runway length. ICAO recommendation as follows

Types of airport	Longitudinal gradient	Effective gradient
A,B & C	1.5 %	1 %
D & E	2 %	2 %

6) Sight distance (is the length of roadway visible to a driver) :
Two runways or a runway & taxiway intersect each other, there are chances of collision of aircraft, if sufficient sight distance are not available.
ICAO recommends that for A,B & C types of airports, any two points 3 m above the surface of runway should be mutually visible from a distance equal to ½ the runway length.
For D & E types of runway there should be unobstructed line of sight from any point 3 m above runway and to all other point 2.1 m above runway within a distance of at least ½ the length of runway.

TAXIWAY: The main function of the taxiway is the inter connection between runway and loading apron or service hanger
Following consideration decide the layout of taxiway.

- Not interfere with the landing and take-off aircrafts
- At busy airports, taxiway should be located at various points along the runway so that the landing aircraft leaves the runway as early as possible and keeps it clear for use by other aircrafts. Such taxiway are called exit taxiways
- The route for taxiway should be so selected that it provides the shortest distance from the apron to the runway end.
- As for as possible the intersection of taxiway and runway should be avoided.
- Exit taxiways should be designed for high turn-off speed.

Taxiway Geometric Design:
ICAO gives various geometric standards for the airport design.

1) Taxiway length
2) Taxiway width
3) Width & length of safety area
4) Transverse gradients
5) Longitudinal & effective gradient

6) Sight distance
7) Turning radius

Length of taxiway: As short as possible.
Increased number of taxiways have to be provided along the runway.

Width of taxiway:
It is observed that the width of a taxiway is much lower than the runway width, as aircraft is not airborne and speeds are small.
Varies between 22.5 m & 7.5 m

Width of taxiway:

Airport Code	Taxiway width
A	22.5 m
B	22.5 m
C	15.0 m
D	9.9 m
E	7.5m

Longitudinal gradient:
Level taxiway are operationally more desirable.
If gradient is steep, it affects fuel consumption.
As per ICAO, maximum longitudinal gradient is 1.5% for
A&B type of airports & 3.0% for C,D&E type of airports.

Rate of change of longitudinal gradient:
Available sight distance on the pavements is affected by the rate of change of longitudinal gradient.
As per ICAO, the maximum change in pavement longitudinal
gradient is 4% for A&B category of airport & 3.33% for C,D&E category of airports.

Sight distance:
As speed of aircraft on taxiway is lower than the speed on runway, the smaller value of sight distance will be sufficient on
the taxiway.

Sight distance:

Airport Code	Y	X
A	1.5 m	150 m

B	2.0 m	200 m
C,D&E	3.0 m	300 m

Transverse gradient: Adopted same as recommended for runway. Transverse gradient is essential for quick drainage of surface water. ICAO recommended that the transverse gradient of pavement should not exceed 1.5% for A,B&C & 2% for D&E types. Shoulder are usually provided with steeper gradients .

Width of safety area: Safety area is made up to partially paved shoulders on pavement plus the area which is graded & drained.

Turning radius: The design should be such that the aircraft can negotiate the curve without significantly reducing the speed.

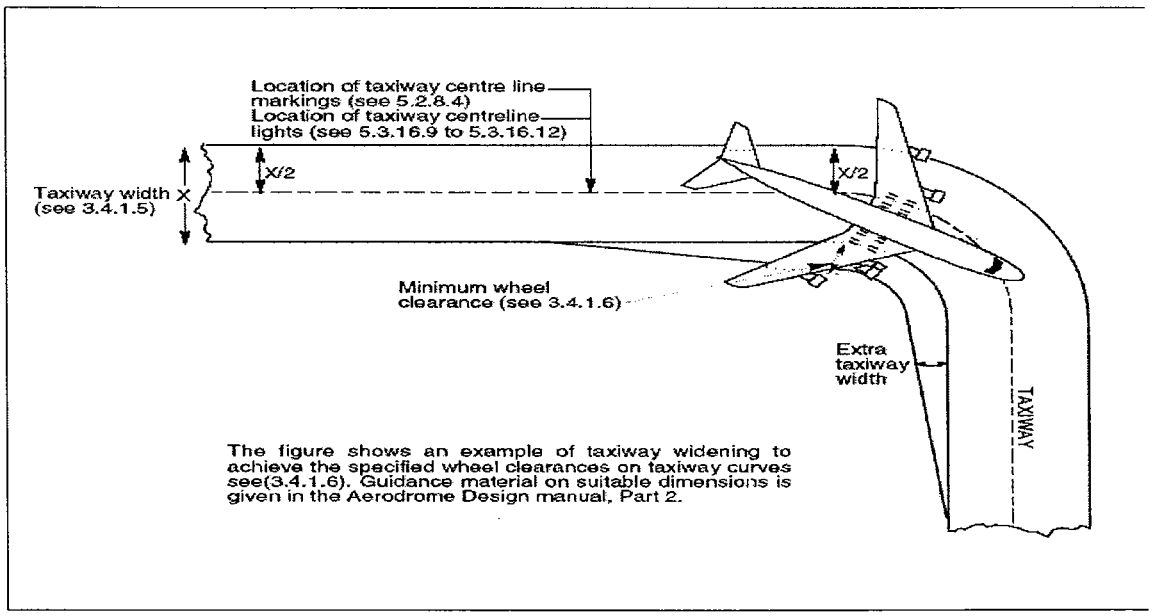
Circular curve of large radius is provided.

Recommended radii corresponding of taxing speeds of small,

Subsonic & supersonic airplanes is 60 m,135 m & 240 m respectively.

$R^2 = V^2/125f$,

Where, R=radius in meter, V=speed in KMPhr F=Friction btw tire and pavement

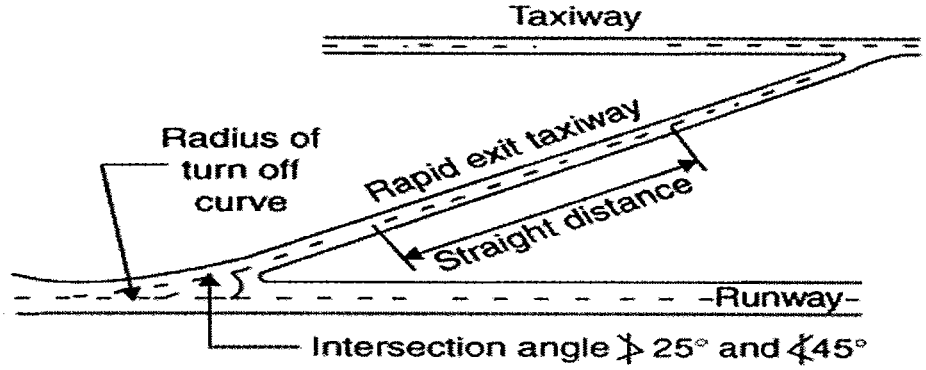


Exit Taxiways

Location of exit taxiway

- This depends upon several factors
  - Number of exit taxiways
  - Exit speed
  - Types of aircrafts

- ❖ Weather conditions
- ❖ Topographical features
- ❖ Pilot variability



Location of exit taxiway

- ❖ This depends upon several factors
  - ❖ **Number of exit taxiways**: the number of taxiways to be provided decides their location. If there are only two exit taxiways they should be provided at the runway ends. If there are more than it should be ditributed along the runway length.
  - ❖ **Exit speed:** the maximum speed with which an aircraft can take a turn and enter the exit taxiway is limited for each aircraft. The aircraft requires certain length of runway to reduce its speed from the landing speed to the turnoff speed. Thus this affects the location of taxiway.
  - ❖ **Types of aircrafts:** different types of aircraft lands at different speed. Therefore the distance required by different aircrafts, to reduce their speed to the exit speed value, varies with the type of the aircraft, Thus in turn affects the location of taxiway.
  - ❖ Weather conditions
  - ❖ Topographical features
  - ❖ Pilot variability

DESIGN OF EXIT TAXIWAY CONNECTING RUNWAY & PARALLEL TAXIWAY

1) The most significant factor is the exit speed of aircraft.
2) Slightly widened entrance of 30 m will be provide.
3) Total angle of turn is $^{3}3^{3}0^{00}\text{-}^{0}4^{c}5^{-0}$
4) The turning radius should be calculated by the following formula

$$R = \frac{v2}{125\ X f}$$

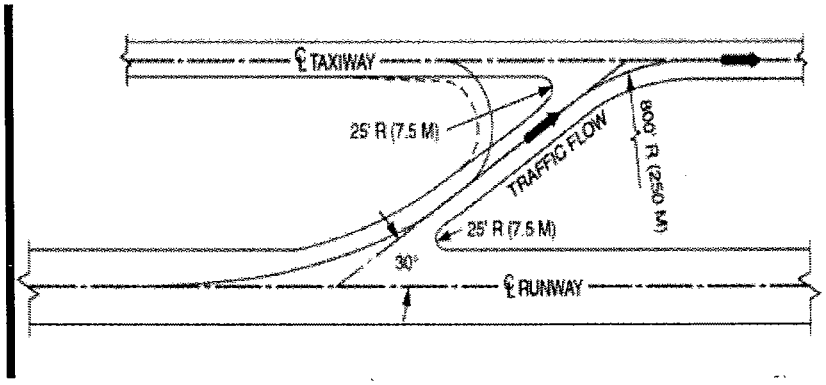
5) A high turn-off speeds of 65-95 kmph a compound curve is necessary to minimize the tire wear on the nose gear.
6) The length of longer radius curve can be roughly obtained by
7) valve of C=0.39

$$L1 = \frac{v3}{45.5\ X\ C\ X\ R2}$$

8.Stopping distance (SD)
Where d- deceleration distance

$$SD = \frac{v2}{25.5\ X\ d}$$

Design of exit taxi way



Zoning laws: Zoning is the way the governments control the physical development of land and the kinds of uses to which each individual property may be put. Zoning lawstypically specify the areas in which residential, industrial, recreational or commercial activities may take place.

- Airport zoning regulations (AZR) restrict the heights of buildings, structures and objects (including natural growth, such as trees) on regulated land. ... ensure that future development near an airport stays compatible with the safe operation of aircraft and of the airport itself.
- The basic purpose and function of zoning is to divide a municipality into residential, commercial, and industrial districts (or zones), that are for the most part separate from one another, with the use of property within each district being reasonably uniform.

- The purpose of zoning is "to promote the health, safety, morals, and general welfare of the community, to protect and conserve the value of buildings, and encourage the most appropriate use of the land."
- Zoning is the term used for designating permitted uses of certain parcels of land by local governments. The word is largely self-explanatory: the local government will designate various zones for different uses of land, such as industrial, agricultural, commercial, and residential
    - Recreational - fun, non-essentials like parks.
    - Transport - roads, railways, and airports.
    - Agricultural - farmland.
    - Residential - housing.
    - Commercial - businesses and factories.

REGIONAL PLANNING :

An overall planning of airports for all the regions of a country is called "regional planning". The planning of an airport should be done considering the traffic needs of the nation as a whole rather than an individual locality. the regional planning airport system plan is a representation of the aviation facilities required to meet the immediate and future transportation needs of the country and their timely and orderly development. Regional planning recommands the general location and characteristics of new airports and nature of expansion for existing airports. It relates the airport system planning to the policy and coordinate transportation planning for the area, land use planning and urban development, to establish a viable integrated network of airports ar the national level.

Objectives of regional planning:

1. To develop a balanced regional multimodal transportation system plan, with coordinated airport facilities.
2. To provide a framework for individual airport development programme consistent with short, intermediate and long term airport system requirements.
3. To implement zoning laws in the areas where new airports are needed in future
4. To develop fiscal plans and establish appropriate priorities for airport financing in short and long term government budgeting.
5. To optimize the use of land and airspace and preserve the existing airport facilities which are consistent with overall objectives of the long term planning.
6. To protect and enhance the environment through the location and expansion of aviation facilities.

Advantages of regional planning :

- It enables to implement the zoning laws in the areas where the new airports are coming up in future.
- There is proper coordination of airports.
- The efficiency of airports in handling the air traffic is greatly increased.
- It avoids close spacing of airports.
- It helps in preservation of environment.
- Intrusion of acceptable noise levels and air pollution into the community area are avoided.
- It is possible to optimise land use and air space through regional planning

INFORMATION REQUIRED FOR THE REGIONAL PLANNING

- The planning period
- Population
- Geography and topography of the area
- Existing airports in the vicinity
- Air traffic characteristics
- Development of new airports
- Ownership and operation of airports

FACTORS AFFECTING AIRPORT SITE SELECTION :

1. Regional plan
2. Airport use
3. Presence of other airports
4. Topography of the area'
5. Ground accessibility
6. Obstructions
7. Visibility
8. Wind
9. Noise nuisance
10. Geological factors
11. Environmental factors
12. Future development
13. Availability of construction material
14. Availability of utilities
15. Social considerations
16. Economic considerations
17. Avoiding hazards

Visual aids:

- Land marks which are required so as to provide an aid to the pilots Ensures the smooth operating of the air craft
- Required both in good weather and bad weather as well as during day and night
- The runways of the conventional aircraft appears as long and narrow strip with straight sides and free of obstacle

These are available in different forms of markings in the airport and airfield

1.Airport markings

2. Airport lighting

3. Signage

Markings are provided on any of the component of airport in different forms mentioned below

- Strips
- Patches
- Solid lines
- Hollow lines
- Cart lines

Airport markings can be divided into following groups

- Apron marking
- Landing direction indicator
- Runway marking
- Shoulder marking
- Taxiway marking
- Wind direction indicator

Certain guidelines are marked on the apron to help the pilots in maneuvering the most critical aircrafts.

Generally they are related to the path to be traversed during parking in or out operation near terminal location or nose etc.

Yellow colour is used at such locations

It should be fuel resistant as aprons are likely to be subjected to fuel spillage.

AIRPORT LIGHTING :

A line of lights on an airfield to guide aircraft in taking off or landing during night

As a guide to pilot

Emergency power supplies

General Airport Lighting

- Includes Beacon Lights on top of tower, buildings
- The Airport Beacon : large, powerful rotating light highly visible from miles away
- Rotate green and white
- Steady red beacon on top of airport building to aid in collision avoidance for low-flying aircraft

Taxiway Lighting :

- Taxiway Edge Lights: Blue, Lines taxiway
- Taxiway Center Light: Green Light
- Clearance Bar Lights: Steady yellow, visibility of hold line
- Stop Bar Lights: Steady red, ATC in low visibility situation, across taxiway at hold short line
- Runway Guard Lights: A pair of two steady yellow light at hold short line, may be flashing

Runway Lighting:

- Runway End Identifier Lights: white flashing light one on each side of approach end of runway
- Runway Edge Light Systems (HIRL/MIRL/LIRL):steady white light on edges of runway Runway Centerline Lighting System (RCLS)
- Touchdown Zone Lights (TDZL) :
- Define landing portion of runway, Up to midpoint Land and
- Hold Short Lights (LAHSO)
- Runway status light or Runway entry light(REL)

Factors Affecting Airport Lighting

- Airport classification
- Availability of power
- Amount of traffic
- Nature of aircraft
- Type of night operation plan
- Type of landing surface provided
- Weather condition

Type of Sign	Action or Purpose
	**Taxiway/Runway Hold Position:** Hold short of runway on taxiway
	**Runway/Runway Hold Position:** Hold short of intersecting runway
	**Runway Approach Hold Position:** Hold short of aircraft on approach
	**ILS Critical Area Hold Position:** Hold short of ILS approach critical area
	**No Entry:** Identifies paved areas where aircraft entry is prohibited
	**Taxiway Location:** Identifies taxiway on which aircraft is located
	**Runway Location:** Identifies runway on which aircraft is located
	**Runway Distance Remaining:** Provides remaining runway length in 1,000 feet increments

Type of Sign	Action or Purpose
	**Runway Safety Area/Obstacle Free Zone Boundary:** Exit boundary of runway protected areas
	**ILS Critical Area Boundary:** Exit boundary of ILS critical area
	**Taxiway Direction:** Defines direction & designation of intersecting taxiway(s)
	**Runway Exit:** Defines direction & designation of exit taxiway from runway
	**Outbound Destination:** Defines directions to takeoff runways
	**Inbound Destination:** Defines directions for arriving aircraft
	**Taxiway Ending Marker:** Indicates taxiway does not continue
	**Direction Sign Array:** Identifies location in conjunction with multiple intersecting taxiways