CMR
INSTITUTE OF
TECHNOLOGY

Internal Assessment Test 1 – March 2017
Solutions

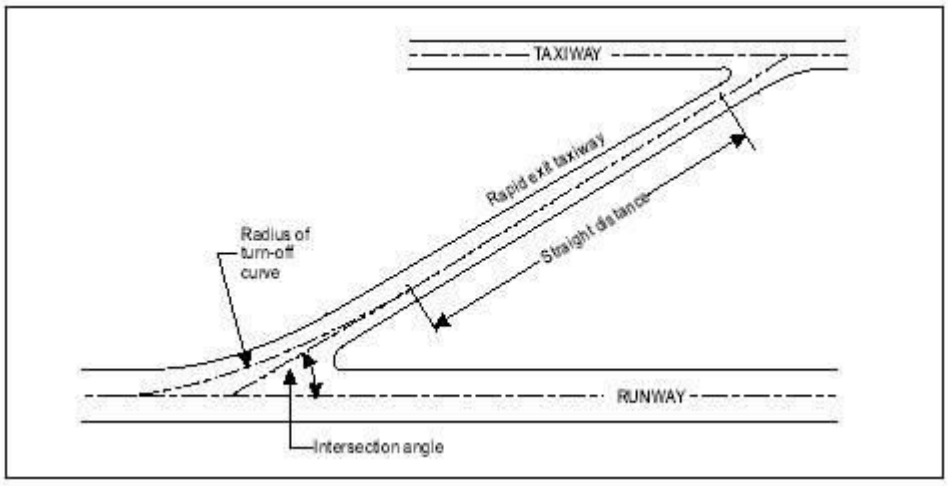
Sub: Transportation Engineering II **Code:** 10CV63

Sem: VI **Branch:** CIVIL

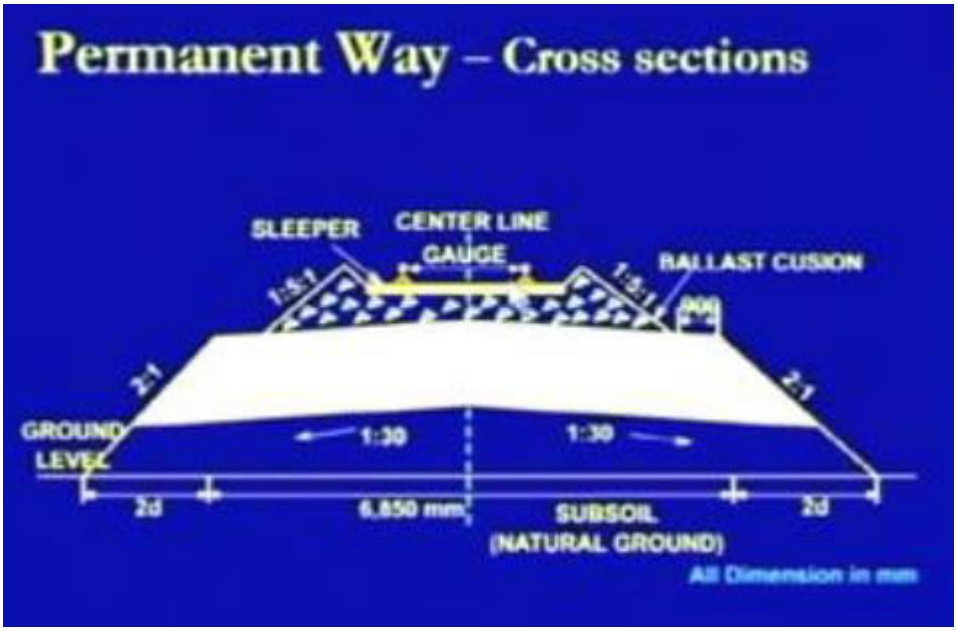
1. **Design of exit taxiway** :

Radius of the central curve = R2 = v^2 / (125f) = 394 m
Radius of the entrance curve = R1 = 731m
Length of the entrance curve = V^3 / (45.5CR2) = 73.23m
Δ 1 = 180 L1 / ΠR1 = 5°44°
Δ2 = Angle of turn - Δ 1= 30 °- 5°44°= 24°16°
L2 =Δ2 * Π* R2 /180 = 166.87m
Sight distance = V2 / (25.5d) = 251m
Length of exit taxiway = 330m

Fillet radii is 30m and 60m respectively for 30° and 150 ° turn.



2. **Permanent Way:**



The combination of sleepers fitted on sleepers and resting on ballast and subgrade is called the railway track or permanent way. Sometimes temporary tracks are also laid for conveyance of earth and materials during construction works. The name permanent way is given to distinguish the final layout of track form these temporary tracks.

In a permanent way, the rails are joined in series by fish plates and bolts and then they are fixed to sleepers by different types of fastenings. The sleepers properly spaced, resting on the ballast are suitably packed and boxed with ballast. The layer of ballast rests on the prepared subgrade called the formation.

The rail acts as girders to transmit the wheel load to the sleepers. The sleepers hold the rails in proper position with respect to the proper tilt, gauge and level and transmit the load from rails to the ballast.

The ballast distributes the load over the formation and holds the sleepers in position.
On curved track, super elevation is maintained by ballast and the formation is leveled. Minimum ballast cushion is maintained at the inner rail, while the outer rail gets kept more ballast cushion. Additional quantity of ballast is provided on the outer cess of each track for which the base width of the ballast is kept more than for a straight track.

3.

(3) B.R.L = 1650 m

alt = 200 m

ΔRT = 25°C

eff gradient = 0.2%

Elevn:

$$\frac{7}{100} \times \frac{200}{800} \times 1650 = 77 \text{ m}$$

$$1650 + 77 = 1727.$$

Temp.

Std temp = $15^\circ - 0.0065 \times 200$

= 13.7°

Rise in temp = $25^\circ - 13.7^\circ = 11.3^\circ$

Correction i/c for 1°C

$$\frac{1}{100} \times 11.3 \times 1727 = 195.15$$

∴ corrected Length = 1727 + 195.15 = 1922.15 m

Check $\frac{1922.15 - 1650}{1650} = 16.5\%$

Eff. gradient

$$\frac{20}{100} \times 1 \times 1922.15 \times 0.2 = 76.89 \text{ m}$$

∴ corrected Length = 1922.15 + 76.89

= 1999.04 ≈ 2000 m

4. AIRCRAFT CHARACTERISTICS AFFECTING THE DESIGN AND PLANNING OF AIRPORT

Factors affecting design:

- Type of propulsion
- Size of an aircraft
- Minimum turning radius
- Minimum circling radius
- Speed of aircraft
- Capacity of aircraft
- Aircraft weight and wheel configuration
- Jet blast
- Fuel spillage
- Noise

Type of propulsion:

There are two types of propulsion:

- tractor type – engine and propeller are in front
- Pusher type – engine and propeller are behind the wing

Performance characteristics of an airport and basic runway length depend upon the type of propulsion.

Size of an aircraft:

The following table shows the dimensions of the aircraft and the corresponding design factor it influences.

Dimensions	**Design factor**
Wing span	Width of taxiway, separation between two parallel taxiways, size of apron and hangars, width of hangar gate
Fuselage length	Widening of taxiways on curves, width of exit taxiway, size of aprons and hangars
Height	Height of hangar gate and other installations in the hangar
Distance between main gear i.e. gear tread Wheel base Tail width	Minimum turning radius of the aircraft

Minimum turning radius:

The minimum turning radius influences the following

- Radius of taxiways
- Position of aircrafts in loading aprons and hangars
- Establish the path of movement of aircraft

Hence it is mandatory to study the minimum turning radius.

Turning radius of an aircraft:

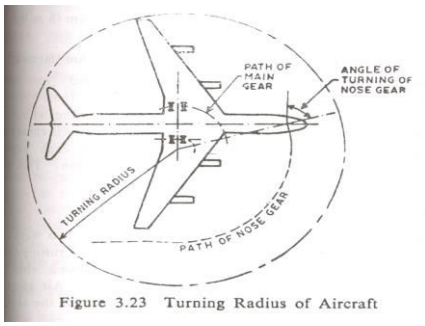


Figure 3.23 Turning Radius of Aircraft

Procedure:

- Draw a line through the axis of the two main gear
- Draw another line through the axis of the nose gear at maximum angle of rotation
- The point of intersection between the two is centre of rotation
- Distance between the farther wing tip from the centre of the rotation represents the minimum turning radius
- Theoretical Maximum angle of rotation - 90°
- Practically restricted to some extent to prevent wear and tear of the main gear.

Minimum circling radius:

- Certain minimum circling radius is required for an aircraft to take turn in space.
- The radius depends on type of aircraft, air traffic volume and weather conditions
  - The following are the recommended values :
  - Small general aviation aircrafts (under VFR rules) -1.6 km
  - Bigger aircrafts (under VFR conditions) – 3.2km
  - Piston engine aircrafts (under IFR conditions) – 13 km
  - Jet engine aircrafts (under IFR conditions) – 80 km
    - Separation between two nearby airports should be adequate
    - If not possible, the arrival and departures of aircrafts are timed accordingly to avoid interference which naturally reduces airport capacity.

Speed of aircrafts:

There are two types of speeds determined for an aircraft

- ✓ Cruising speed – speed of the aircraft with respect to the ground when the aircraft is flying in air at its maximum speed.
- ✓ Air speed – speed of the aircraft relative to the wind.

Hence if the speed of the aircraft – 500 kmph and the Head wind – 50 kmph then the air speed will be 500 – 50 kmph = 450 kmph

Aircraft capacity:

- It influences the capacity of runway systems and passenger processing terminal facilities
- Aircraft capacity denotes the number of passengers, baggage, cargo and fuel that can be accommodated in the aircraft.

Weight of aircraft:

- The weight of the aircraft influences length of runway, structural requirements like thickness of runway, taxiway, apron and hangars.
- It depends on weight of the passenger baggage, cargo, fuel carried and its structural weight and finally the fuel which is continuously decreasing during the course of the flight.

Wheel configurations:

- The wheel configuration greatly influences the pavement thickness. The figure shows the different wheel configurations.

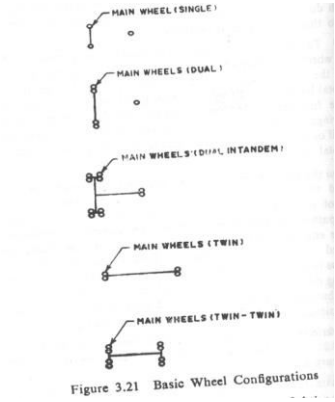


Figure 3.21 Basic Wheel Configurations

Jet blast:

- It influences the type of pavement, pavement thickness, position, size and location of the gates
- At high velocities aircrafts eject hot exhaust gases at 300 kmph which causes inconvenience to passengers.
- Jet blast deflector and blast fences are provided to prevent this.
- And also it damages the bituminous pavements hence it is desirable to provide concrete pavements at the touch down points.

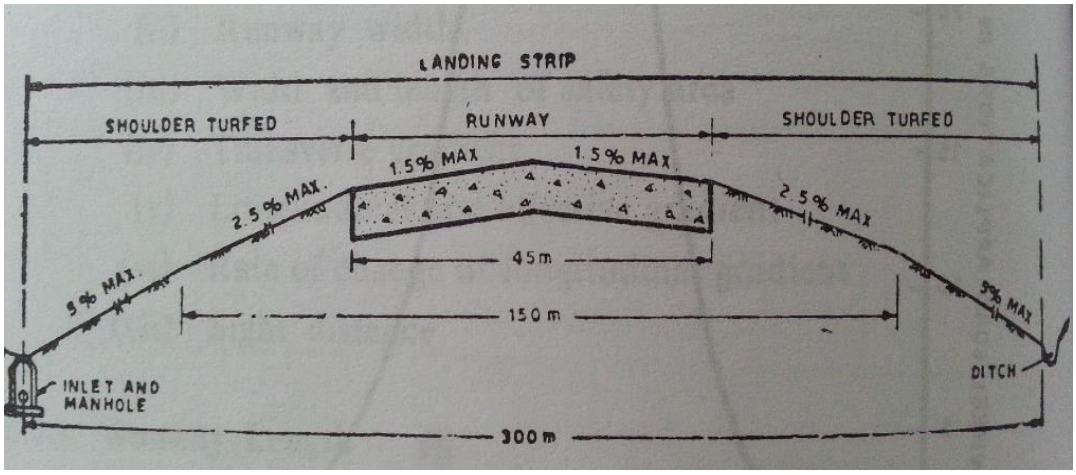
Fuel spillage:

- Fuel spillage affects the bituminous pavements
- Hence constant supervision is required at loading aprons and hangars, fueling inlets, the engines and the main landing gears.
- It is difficult to avoid it completely but should be kept within minimum limits.

Noise:

- The noise factor influences decision on airport layout and capacity.
- A correct assessment of future noise patterns is required to minimize the effect of surrounding communities and to provide optimal layout of the runways.

5. (a)



C.S. Of ILS Runway

(b) The following factors govern the layout and location of exit taxiway:

 Number of taxiways- the number of taxiways governs the layout of exit taxiway. If there are two taxiways it is provided at the ends of runway and if more number of taxiways are present, it is distributed along the runway length.

 Exit speed- the speed with which an aircraft leaves the runway and enters the taxiway is called exit speed. The speed of landing and turning depends on the type of aircraft. The time taken for the landing speed to reduce to turn off speed governs the layout of exit taxiway.

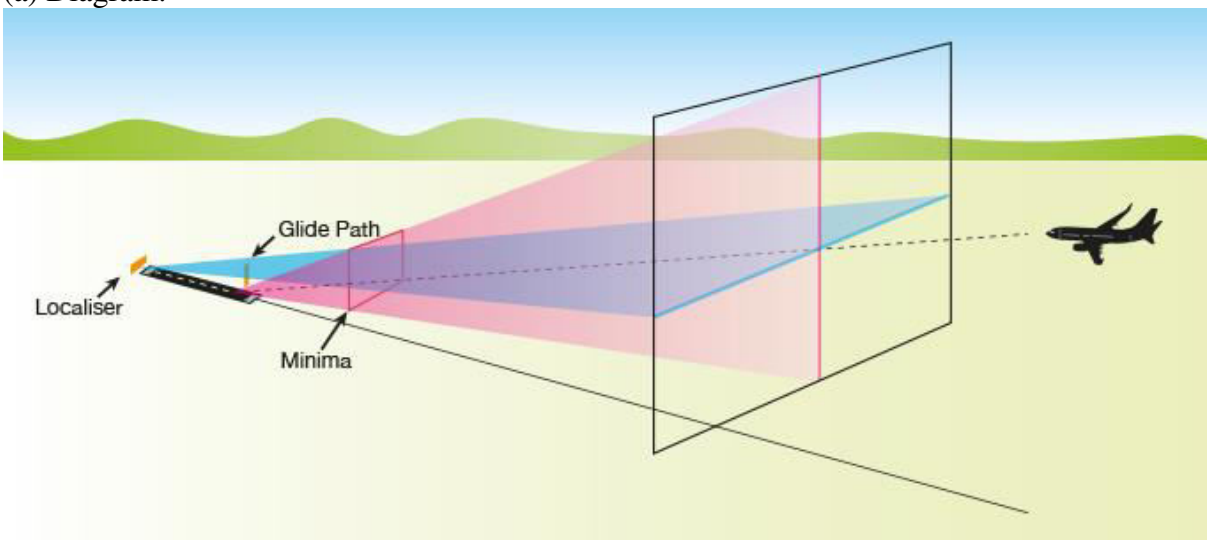
 Type of aircraft- since the speed of landing and turning depends on the type of aircraft; it also affects the location of exit taxiway.

 Weather conditions-conditions like fog, rainfall etc that affect the visibility must be considered while selecting the location.

 Topographical features- if it is located at an elevation of valley, visibility gets affected and so the layout or location of exit taxiway will also be affected.

 Pilot variability – though the rules of landing or any procedure is the same for all but the factors like reaction time, point of landing in the touchdown area, application of brakes can differ with pilot. Hence pilot variability is also an important factor.

6. (a) Diagram:



Instrument Landing System

(b) The following factors influence the airport site selection

Regional plan: The site selected should fit well into the regional plan. Thereby forming it an integral part of the national network of the airport.

Airport use: Whether it is to be used for civilian or for military purposes.

Proximity to other airports: It should be at a considerable distance from the existing airports so that aircraft landing in one airport does not interfere with other aircraft movements. The required separation between the airports depends on volume of air traffic, the type of aircraft and the air traffic control.

Ground accessibility: It should be readily accessible to the users.

Topography: This includes ground features like ground contours, trees, streams etc. A raised ground is generally considered to be an ideal site for an airport due to natural drainage, more uniform wind and better visibility due to less fog.

Obstructions: Obstructions like fences, trees, pole lines, building and other natural and man made obstructions should not be present.

Visibility: poor visibility lowers the traffic capacity of the airport. It should be free from visibility reducing conditions such as fog, smoke and haze.

Wind: Runway is oriented such that landing and takeoff is done by heading into the wind. Wind data i.e. direction, duration and intensity of wind should be collected over a period of five years.

Noise nuisance: The landing and take off paths of the aircrafts pass over the land which is free from residential or industrial development.

Grading, drainage and soil characteristics: they play an important role in the construction and management of airport.

Future development: Larger area should be acquired initially taking into account the anticipated future developments in the airport.

Availability of utilities from town: Airport should be provided with facilities like water supply, sewer, telephone, electricity etc.