

**CE 6604 RAILWAYS, AIRPORT AND
HARBOUR ENGINEERING
(REGULATION-2013)**

**UNIT – I
RAILWAY PLANNING**

1. Define Permanent way?

The combination of rails, fitted on sleepers and resting on ballast and sub grade is called the Railway track or Permanent way.

2. Define Gauge?

The „Gauge“ of a railway track is defined as the clear distance between inner or running faces of two track rails.

3. Define Rails?

The rails on the track can be considered as steel girders for the purpose of carrying axle loads. They are made of high carbon steel to withstand wear and tear.

4. What are the different types of rail sections?

1. Double headed rails (D.H.Rails)
2. Bull headed rails (B.H.Rails)
3. Flat footed rails (F.F.Rails)

5. What are the different types of rail joints?

1. Supported rail joints.
2. Suspended rail joints.
3. Bridge joints.
4. Base joints.
5. Welded joints.
6. Square joints.

6. Define Creep?

Creep is defined as the longitudinal movement of rails with respect to sleepers in a track.

7. Classify Sleepers?

1. Wooden sleepers
2. Metal sleepers
 - a) Cast iron sleepers
 - b) Steel sleepers
3. Concrete sleepers
 - a) Reinforced concrete sleepers
 - b) Prestressed concrete sleepers

8. What are the uses of Fish plates?

Fish plates are used in rail joints to maintain the continuity of the rails and to allow for any expansion or contraction of the rail caused by temperature variations. They maintain the correct alignment of the line both horizontally and vertically.

9. What is the use of Spikes?

1. For holding the rails to the wooden sleepers.
2. Spike should be strong enough to hold the rail in position.
3. Spike should be as deep as possible, easy in fixing, removal, cheap in cost.

10. What is the use of Keys?

Keys are small tapered pieces of timber on steel to fix rails to chairs on metal sleepers.

11. What are the different materials used for Ballast?

Broken stone, Gravel. Ashes (or) Clinker, Sand, Moorum, Kanbar, Brick Ballast, Blast furnace slag, Selected earth.

12. Define track alignment?

The direction and position given to the center line of the railway track on the ground is called the track alignment.

13. Write the different surveys required for railway projects?

1. Traffic survey.
2. Reconnaissance survey.
3. Preliminary survey (or) survey for initial location.
4. Detailed survey (or) survey for final location.

14. Define super elevation?

When a train moves round a curve, it is subjected to centrifugal force acting horizontally at the center of gravity of each vehicle radially away from the center of the curve. This increases the weight on the outer rail. To counteract the effect of centrifugal force, the level of the outer rail is raised above the inner rail by a certain amount to introduce the centripetal force. This raised elevation of outer rail above the inner rail at a horizontal curve is „called super elevation“.

15. What are the different types of curves?

1. Simple curve.
2. Compound curve.
3. Parabolic curve.
4. Transitional curve.

Part-B

1. Describe in detail about the types of rail joints, rail fixtures and fastening used in a track
2. When and where the soil suitability analysis is carried out and explain
3. Define gradient and super elevation; List out its types and explain clearly.
4. Compare and contrast the different type of sleepers used in Indian railways.
5. Discuss in detail about points and crossings.

6.
 - i. A BG curved railway track has a 4° curvature and 12cm cant. Maximum Permissible speed on the curve is 85Km/hr. Calculate the length of the transition curve.
 - ii. An 8° curve track diverges from a main curve of 5° in an opposite direction in the layout of a B.G. yard. Calculate the super elevation and the speed on the branch line, if the maximum speed permitted on the main line is 45 Km/hr.
radius of curvature and super elevation
 - ii. Explain in detail the importance of Indian Railways in the National Development in terms of economic, social and political contributions.
8. Explain in detail about
 - (a) Ballast less Track
 - (b) Negative super elevation.
 - (c) Widening of gauge
 - (d) Grade Compensation
9. Design and draw a neat sketch of permanent way cross section and explain the functions of its components.
10. Compare the conventional and modern methods of surveying for route alignment and justify which one is the best.

UNIT – II

RAILWAY CONSTRUCTION AND MAINTENANCE

1. What are the necessities of points and crossings?

Points and crossings provide flexibility of movement by connecting one line to another according to requirements.

They also help for imposing restrictions over turnouts, which necessarily retard the movements.

2. What are the two types of Switches?

1. Stub switch.
2. Split switch.

3. Define Crossings?

A „Crossing“ or a „Frog“ is a device, which provides two flange ways through which the wheels of the flanges may move, when two rails intersect each other at an angle.

4. Classify the Crossings?

A) On the basis of shape of crossing.

- 1) Acute angle crossing or “V” crossing or Frog.
- 2) Obtuse angle crossing or Diamond crossing.
- 3) Square crossing.

B) On the basis of Assembly of crossing.

- 1) Spring or movable wing crossing.
- 2) Ramped crossing.

5. What you mean by Diamond crossing?

When straight tracks or curved tracks of the same or different gauges cross each other at an angle less than 90 degree, a diamond shape is formed. So this crossing is called as diamond crossing.

6. Define cross-over in track junction?

When two adjacent parallel or diverging tracks, which may be straight or curved, are connected by two sets of turnouts, with or without a straight length between them, the connecting line is known as cross-over.

7. Define Ladder tracks?

When a number of parallel tracks are branched off from the straight track in continuation of a turnout, it is called a gathering line or ladder track.

8. What are the different classifications of railway stations?

A) Operational classification

- 1) Block station.
- 2) Non-Block station.
- 3) Special class station.

B) Functional classification

- 1) Way side station.
- 2) Junction station.
- 3) Terminal station.

9. Define Platforms?

A raised level surface, from where either passengers board and alight from trains or loading and unloading of goods is done, is known as a „Platform“.

10. Define station yards?

A yard is defined as a system of tracks laid usually on a level within defined limits, for receiving, storing, making up new trains, dispatch of vehicles and for other purposes over which movements are not authorized by a time table. The various movements on a system of tracks are governed by prescribed rules, regulations and signals.

11. Define Buffer stop?

The dead end of a siding or the end of any track of terminal station is not kept bare but a form of stop or barrier is provided at the end of the track, to prevent the vehicles, from running off the track. This stop or barrier provided at the end, across the track of a siding or at terminal station is known as “Buffer stop”.

12. What are the three stages of construction of new railway track?

- 1) First stage. Earth work – formation and consolidation.
- 2) Second stage. Plate Laying – laying of a railway track.
- 3) Third stage. Laying of ballast on the track.

PART B

1. Describe in detail about plate laying techniques.
2. When and where should a tunnel be provided and explain the methods of tunnel construction in soft ground.
3. List out the type of railway stations and explain each one of them in detail.
4. Discuss in detail about the modern methods of maintenance.
5. Summarize how poor soil is being stabilized and explain the methods in detail.
6. Classify the stages in construction of railway track and explain in detail.
7.
 - i. Calculate the quantity of all the materials required for track laying.
 - ii. Compare the advantages and disadvantages of conventional maintenance and modern maintenance techniques
8. Explain in detail about Directed Track Maintenance and Measured Shovel

Packing

9. Design and draw a neat sketch of marshaling yard and explain in detail.
10.
 - i. On what situations will mono rails, metro rails be selected. Explain
 - ii. Explain in detail about how ventilation and drainage should be provided in tunneling

UNIT – 3

AIRPORT PLANNING

1. List out the advantages and disadvantages of air transport.

Advantages:

Accessibility, Continuous journey, Emergency use Engineering use, Saving in time

Disadvantages:

Flight rules, Operating expenses, Unsafe Weather conditions

2. What are the drawings should be prepared for construction of new airport?

Drainage plan, Grading plan, Lighting plan, Master plan, Obstruction plan, Paving plan, Topographic plan

3. Define apron.

It indicates a defined area of the airport to accommodate aircrafts for loading and unloading of cargo and passengers, parking, refueling, etc. It is usually paved and is located in front of the building or adjacent to hangers.

4. Define wind coverage.

The percentage of time in a year during which the crosswind component remains within the limit of 25km p.h. is called the wind coverage of the runway.

5. What are the four basic patterns of runway?

1. Single runway
2. Parallel runways
3. Intersecting runways
4. Divergent or Open-V runways

6. What are the different types of parking of aircraft?

1. Nose -in parking.
2. Angled nose -in parking
3. Nose-out parking
4. Angled nose-out parking
5. Parallel parking

7. What is the main function of hangar?

The main function of a hangar is to provide an enclosure for housing and repairing of the aircraft. They are constructed of steel framework covered with the galvanized iron sheets.

8. Define crosswind component.

It is not possible to get the direction of opposite wind parallel to the center-line of the runway length everyday or through out the year. For some period of the year at least, the wind may blow making some angle θ with the direction of the center-line of the runway length. If V km ph is the velocity of the inclined opposing wind, its component $V \sin \theta$, which is normal to the centerline of the runway length, is called the crosswind component.

9. What are the factors should be consider for layout of taxiway? 1. Arrangement, Busy airports, crossing, Higher turn-off speeds, Route

10. What do you mean by airport capacity?

The number of aircraft movement, which an airport can handle within a specified period of time.

11. What are the phases of Master plan by FAA recommendation?

Phase I: Airport Requirements

Phase II: Site selection

Phase III: Airport plans

Phase IV: Financial plans

12. What are the advantages of head wind?

1. During landing, it provides a breaking effect and the aircraft comes to a stop in a short length of the runway.

2. During take off, it provides greater lift on the wings of the aircraft.

13. What are the corrections required for runway length?

1. Correction for elevation

2. Correction for gradient

3. Correction for temperature

14. Define holding apron.

The portion of paved area which is provided adjacent to the ends of runway incase of busy airports is known as the holding apron.

15. What is the necessity of surveying in construction of new airport?

1. To ascertain the characteristics of soil.

2. To workout the detailed estimate of the project.

3. To prepare suitable drawings

4. To make provision for future extension of the airport

5. To give an idea of the meteorological conditions prevailing at the proposed site

16. What is wind rose diagram?

The diagram showing direction, duration and intensity of wind over a certain period in a specified region is known as wind rose diagram.

17. What are the aims of Airport drainage?

1. It grants longevity to the pavements.

2. It increases the efficiency of the airport.

3. It is essential for proper and safe functioning of the aircraft.

4. It reduces the maintenances of an airport.

18. Define clear zone.

The term clear zone is used to indicate the innermost portion of the approach zone and it is to be provided at the ends of runways.

19. What are the two types of zoning?

1. Height zoning
2. Land-use zoning

20. Define Turning zone.

The turning zone is the area of airport other than the approach area and it is intended for turning operations of the aircraft in case of emergencies like failure of engine or trouble in smooth working of aircraft experienced at the start of the takeoff.

PART B

1.

(i) List the factors to be considered for the selection of site for a commercial airport

(ii) Explain the importance of airport planning.

2. What are flight rules? Discuss the advantages and disadvantages of each system.

3. Describe the necessity, functions and special characteristics of airport drainage.

4. Summarize briefly the various runway geometrics as recommended by ICAO.

5. Describe the motor vehicle parking area and its parking patterns in airports

6. Briefly explain the Night- time aids provided at Airports.

7. (i) Describe briefly the salient features and functions of aprons in an airport.

(ii) What are the passenger facilities, required at an airport terminal? Explain using sketches.

8. Explain the characteristics of commercial airport layout and military airport layout

9. Draw a typical layout of any international airport in India and explain its concept.

10. Discuss the importance of air traffic control and list the various equipment's needed for en-route air traffic control.

UNIT -4 AIRPORT DESIGN

1. Mention the purposes of installing visual aids at the airport?

1. To avoid accidents during landing of the aircraft.
2. To maintain an orderly flow of aircraft without any congestion.
3. To satisfy the visual requirements for takeoff and taxiing.
4. To grant safety to the persons and properties
5. To direct the pilot to make the landing of the aircraft in the landing area only.

2. What are the airport markings?

1. Apron marking
2. Landing direction indicator
3. Runway marking
4. Shoulder marking
5. Taxiway marking
6. Wind direction indicator

3. Define Hangar.

The large shed erected at the airport for the purpose of housing, servicing, and repairing of aircrafts is known as hangar.

4. What are the guidance and information required by the pilots during landing operation?

1. Alignment guidance
2. Height information
3. Visual parameters

5. What are the factors, which affect the type and intensity of airport lighting?

1. Airport classification
2. Amount of traffic
3. Availability of power
4. Nature of airport using the airport
5. Type of night operations planned
6. Type of the landing surfaces provided
7. Weather conditions

6. Give the elements of airport lightings.

1. Airport beacon
2. Approach lighting
3. Apron and hanger lighting
4. Boundary lighting
5. Lighting of land direction indicator
6. Lighting of wind direction indicator
7. Runway lighting
8. Taxiway lighting
9. Threshold lighting

7. Define heliport.

The area for landing and taking off helicopter is known as heliport.

8. What are the three factors which affect the size of an apron?

1. Gate position
2. Number of gates
3. Systems of aircraft parking

9. Define terminal building.

The building or buildings which are meant for providing facilities to all passengers, for serving as office for airport management and for carrying out other non-aeronautical functions are known as terminal buildings. They act as the focal points of the terminal area.

10. What are the markings made on the runways?

1. Runway centerline marking
2. Runway edge stripes
3. Runway numbering
4. Touch down or landing zone
5. Threshold marking
6. Two or more parallel runways

11. What are the two arrangements adopted for approach lighting?

1. Calvert system
2. ICAO system

12. Define the term visibility.

The term visibility is defined differently for day and night in the meteorology. During the day, it is the distance that a black circular target subtended by a visual angle of 1 can be seen. At night; it is the distance from which a human can see a 25 candela light.

13. Define ceiling.

The meteorological visibility is also generally associated with the height of the underside of a dense cloud above the airport surface. The height is referred to as the ceiling.

14. What are the broad principles that are to be observed in the design of a terminal building?

1. Arrival and departure areas
2. Baggage delivery
3. Information
4. Movement

15. What are the systems of aircraft parking?

1. Frontal or linear system
2. Open- apron or transporter system
3. Pier or finger system
4. Satellite system

16. What are the importances of air traffic control?

It avoids the possibility of occurrence of the accidents in the air.

It grants the economic and efficient utilization of the aircraft and the airports.

17. What are the three components of an air traffic control network?

1. control centers
2. control towers
3. Flight service stations.

18. What are the types of air traffic control aids?

1. En route aids or airway aids
2. Landing aids or terminal aids.

19. Define passenger flow.

The design of the terminal building should be such that an uninterrupted flow route is formed for the passengers to follow on or off an aircraft without offending or disturbing each other.

20. What are the basic requirements to be kept in mind while deciding the site for a terminal building?

1. It should be centrally located with respect to the runways.
2. It should have convenient and easy access to the highway.
3. The site should have easy facility of natural

PART B

1. What are the basic patterns of runway configurations? Discuss each pattern.
2. Describe about Exit taxiway and factors to be considered for the location of an Exit taxiway.
3. Explain the steps in the determination of proper orientation for runway
4. Discuss in detail about wind rose diagram? Explain different types of wind rose diagrams.
5. Distinguish between Type I and Type II wind rose diagrams. Explain how the optimum runway orientation is determined.
6. The typical wind data for an airport site is given in the following table. Determine the best orientation of the runway with the help of a wind rose diagram given in

7. (i) The length of a runway at mean sea level, standard temperature and zero gradients is 1600m. The site has an elevation of 320m, with a reference temperature of 33.6°C. The runway has to be constructed with an effective gradient of 0.25%.

Calculate the actual length of the runway at site

(ii) The length of runway under standard conditions is 1620m. The airport site has an elevation of 270m. Its reference temperature is 32.90°C. If the runway is to be constructed with an effective gradient of 0.20%. Determine the corrected runway length

8. Explain in brief:

1. Clear Zone.
2. Approach zone
3. Turning zone.
4. Buffer zone.

9. Describe the importance of runway lighting. Explain threshold lighting with the help of sketches.

10. (i) Explain the various runway and taxiway markings.
- (ii) What are different control surfaces at an airport? Explain the concepts of airport zoning with the help of sketches.

UNIT V

HARBOUR ENGINEERING & OTHER MODES OF TRANSPORT

1. Advantages of water transport -Cheapest mode of transport
 - High load carrying capacity
 - Powerful defense of national security
 - To encourage consumption of foreign goods.
2. Disadvantages of water transport -Slow Operation
 - Use only when water is available
 - Accidents due to ocean storms.
 - Water level fluctuations will affect the transport.
3. Define Harbour :

Harbour can be defined as a basin of navigable waters well protected naturally (or) artificially from action of wind and waves, and it is situated along the sea - shore (or) river.
4. Classify Harbour :
 - (i) Based on protection needed:
 - (a) Natural
 - (b) Semi - Natural
 - (c) Artificial
 - (ii) Based on the Utility:

(a) Harbour of refuge	(b) Commercial	(c) Fishery
(d) Military	(e) Marina	
 - (iii) Based on Location:

(a) Canal	(b) Lake	(c) River	(d) Sea
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5. Define Port:

The term port is used to indicate a harbour where terminal facilities such as stores, loading of passengers and cargo etc.
6. Classification Ports:
 - (i) Based on Location

(a) Canal Port	(b) River Port	(c) Sea Port
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 - (ii) Based on Size

(a) Major	(b) Intermediate	(c) Minor
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7. Define Sea water waves:

The periodic rise and fall of sea water surface is termed as sea water waves.
8. Define Littoral Drifts:

The process of carrying and depositing materials by waves on the shore line.

Such process of movement and deposition of sand is called Littoral Drifts.

9. Define Clapotis :

When tidal wave is reflected back by solid wall of marine structure, the reflected water may fall on the incoming tidal wave, increasing height of water surface, which looks like a wall of water, such a wall of water is called as clapotis.

10. What is tidal range ?

The difference in water level of high tide and low tide levels.

11. Define Break water:

The protective barrier constructed to enclose harbours and to keep the harbour waters undisturbed by the effect of waves and winds is called breakwater.

12. Different Layout of ports

(i) Square layout

13. Classify Docks

i) Wet docks

ii) Dry docks

14. Define quays

It is a solid structure constructed along the shore for Loading & Unloading facilities.

15. Define Piers:

It is a solid structure perpendicular (or) oblique from shore for loading & unloading facilities.

16. Define Pier heads:

A pierhead is a structure constructed at a tip of break water near the harbor entrance.

17. Define - Dolphins:

The construction in the form of a cluster of closely spaced piles is known as dolphins. It is used for tying up ships and also for transferring cargo from one ship to another when moored along both of their sides.

18. Differentiate between wharf and Jetty.

The Wharf is a berth parallel to the shore, and wharf has berth on one side only as it has a backfill of earth.

A Jetty is perpendicular to shore or break water and it may have berths on two faces.

19. Define dredging:

It is defines as excavation of bed below water.

PART B

1. Draw a neat sketch of a harbour layout & show the Various Components.

Mention the objectives of each.

2. What do you Understand by the term “Navigational Aids”? Why are they provided in harbours? Explain with a sketch any one of them.
3. Define dredging? Explain the reasons for its adoptions. How dredged Materials are disposed off?
4.
 - i. Discuss the factors to be considered while selecting a suitable site for the construction of a port?
 - ii. Distinguish Between Pier Wharf. Explain their utility with the help of sketches?
5.
 - i. What are the functions of wet Docks? Explain with Sketches, their working & main features.
 - ii. Explain with sketch the features of a composite Breakwater
6. Classify harbours on broad basis and on the basis of utility and explain them.
7.
 - (i).Classify different types of break water. Explain any one in brief.
 - (ii) Define a port and bring out the differences between a port and a harbor.
What are the requirements of good port?
8. Explain the concept of littoral drift and how it affects the location of harbor.
9. Discuss the tides and wave effects and its action on coastal structures.
10. Explain the different natural phenomena to be studied before the design of harbours