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Maravattam, Kadampuzha, Malappuram Dist. Kerala

Approved by AICTE, New Delhi, Govt. of India - Affiliated to State Board of Technical Education, Govt. of Kerala

DEPARTMENT OF CIVIL ENGINEERING

SEMESTER 5-2021 REVISION

5013-TRANSPORTATION ENGINEERING

SOLVED MODEL QUESTION PAPER

MODEL QUESTION PAPER 1

Transportation Engineering

Time : 3 Hour

Max.Marks :75

PART A

I. Answer all questions in one word or one sentence (9 x 1 = 9 Marks)

- 1 Indian Road Congress (I.R.C.) was founded as per the suggestion of -----
· **Answer:**
Jayakar committee
- 2 The position or the layout of the center line of the highway on the ground is called -----
· **Answer:**
Highway alignment
- 3 ----- is also called design gradient.
· **Answer:**
Ruling Gradient
- 4 ----- layer provides structural support for the pavement surface.
· **Answer:**
Sub-Base course
- 5 The clear minimum perpendicular distance between the inner faces of the two rails is called.....
· **Answer:**
Rail gauge
- 6 A mechanical installation which enabling trains to be guided from one track to another.....
· **Answer:**
Turnout
- 7 The end supports of the superstructure of the bridge is called-----
· **Answer:**
Abutment
- 8 ----- are the buildings used for servicing and repairs of the aircraft
· **Answer:**
Hangar
- 9 The solid parallel platform in a harbour with berthing facility on one side only is called.....
· **Answer:**
Wharf

PART B

II. Answer any eight questions

(8 x 3 = 24 Marks)

1. List the IRC classification of roads

Answer:

- National highways
- State highways
- Major district roads
- Other district roads
- Village roads

National Highways: These are the important roads of the country. They connect state capitals, Ports and foreign highways. They also include military importance. They are financed by Central Government.

State Highways: They are the important roads of a state. They connect important cities and district headquarters in the state, National highways and state highways of neighbouring states. They are financed by state Government.

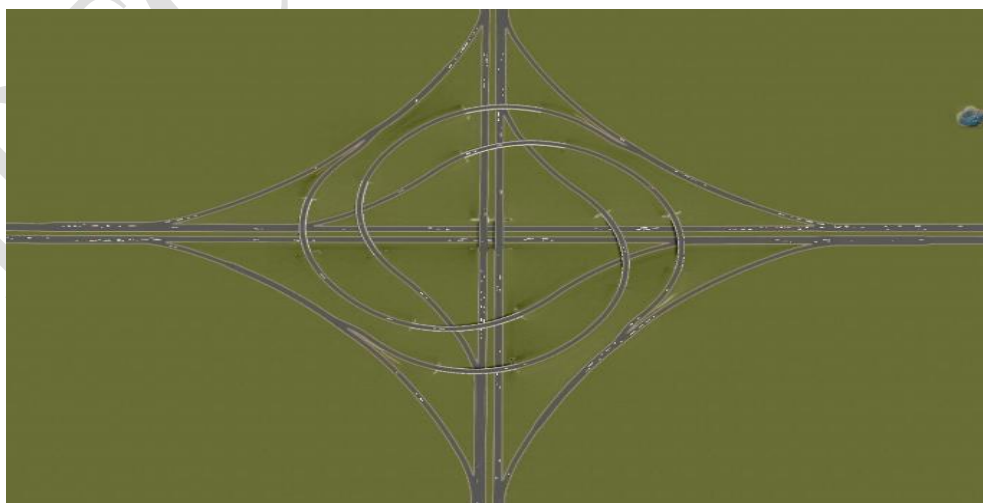
District Roads: These are roads within a district. They are financed by Zilapanishads with the help of grants given by state Government.

- a) Major District Roads: They are roads connecting district headquarters, taluk headquarters and other important towns.
- b) Other District Roads: They are district roads of less importance.

Village Roads: They connect villages with each other and to the nearest district roads, highway, or railway. They are financed by Panchayats with the help of Zilapanishads and state Governments.

2. Illustrate turbine junction in highway with the help of a neat sketch

Answer:



The **turbine interchange** is an alternative four-way directional interchange.

Minimum 18 overpasses needed

3. Explain super elevation.

Answer:

Super elevation is the amount by which the outer edge of a curve on a road is raised above the inner edge to counteract the imbalance caused by outward thrust.

Need for super elevation:

When a vehicle travels in a circular path or curved path, it is subjected to an outward force which makes a vehicle to overturn and skid due to Centrifugal force. To overcome this force and for safe travel of a vehicle, the outer edge of the road is raised above the inner edge. This is known as superelevation or banking of roads.

4. List the types of curves used in highway

Answer:

1.Horizontal curves:

➤ **Circular curves**

- (i) Simple curve
- (ii) Compound Curve:
- (iii) Reverse Curve:

➤ **Transition Curves**

- (i) Spiral
- (ii) Cubic parabola
- (iii) Lemniscate.

2.Vertical Curve:

- (i) Summit curves
- (ii) Valley/saga curves

5. State the desirable properties of bitumen.

Answer:

- **Adhesion:** A good binder must bring all construction material together and make it as single unit.
- **Waterproof:** It Should be insoluble in water and should serve as water proofing agent.
- **Strength:** Though aggregate are main bearing component binding material must have sufficient to resist wheel load.
- **Durability:** Binding material should bind all construction material together for long time (about 20 years) in adverse weather condition.
- **Versatile:** Binding material must be workable during construction and rigid in operation phase.
- **Economy:** Binding material must be available at low cost.

6. Explain the types of railways gauge.

Answer:

Gauge is defined as the clear minimum distance between the running faces of the two rails.

The different gauges in India are:

1. Broad gauge (width 1.676m)
2. Standard gauge (width 1.435m)
3. Meter gauge (width 1m)
4. Narrow gauge (width 0.762m)

7. List out the requirements of an ideal rail

Answer:

Requirements of a ideal permanent way are:

1. Gauge should be uniform and correct.
2. The rails should be in proper level.
 - (i) Straight track: Two rails must be at the same level.
 - (ii) Curves: Outer rail should have proper super elevation.
3. Track should have enough strength.
4. The radii and super elevation on curves should be properly designed and maintained.
5. Track should be resilient and elastic in order to absorb shocks and vibrations of running track.
6. Joints, including points and crossings which are regarded to be the weakest points of the railway track, should be properly designed and maintained.
7. There should be adequate provision for easy renewals and replacements.
8. Drainage system must be perfect.

8. Explain the necessity of tunnels.

Answer:

Necessity of tunnels:

- To meet the requirements of rapid transportation in big cities.
- To connect two terminals separated by a mountain by the shortest route.
- To reduce very steep gradient
- To avoid the excessive cost of maintenance of an open cut subjected to landslides or snow drifts.
- To avoid the expensive acquisition of valuable built up land, tearing up pavements and holding up traffic for long periods in large cities
- When the depth of ordinary cutting exceeds 20m and the gradient rises rapidly for a considerable distance afterwards.

9. **State the purposes of breakwaters.**

Answer:

- Break up and disperse heavy sea.
- Prevent the waves from exerting their destructive influence within the enclosed area of harbour.
- Wall of sufficient height and strength takes up the forces from the waves.
- Reduce beach erosion.

10. **Name the various parts of a bridge with its function.**

Answer:

Components of a Bridge:

The major parts of a bridge are:

1. Substructure
2. Superstructure
3. Adjoining structure.

Substructure:

- The structure of the bridge below the level of bearing is known as the Substructure.

It consists of the following:

- **Foundation:** Part of the structure that supports and transmits the load to the soil
- **Abutment:** It is the end part (support) of the super structure of a bridge. It transmits the load from the bridge to the foundation.
- **Wing walls:** Wing walls are provided at both ends of abutment to retain earth filling of the approaches.
- **Piers:** Piers provide intermediate support between two bridge spans

Superstructure:

- The components of the bridge above the bearing are known as superstructures.

It consists of the following:

- **Beams and girders:** Support the roadway and prevent bending.
- **Bearing:** Allow free movement or vibration of the top superstructure and reduce effective stress to reach the bridge foundation.
- **Arch & Cable**
- **Parapet Wall & Handrails**
- **Flooring**

Adjoining structure:

- **Approaches:** To provide smooth and easy entry or exit from the bridge.
- **Guard Stones**

PART C

Answer ALL questions. Each question carries 7 marks

(6 x 7 = 42Marks)

III Explain various traffic studies that can be conducted to analyse traffic characteristics.

Answer:

A traffic study is a survey undertaken to determine the volume and/or nature of traffic utilizing a particular route. A traffic survey can be manual or automatic information to be collected during traffic studies are:

1. **Volume of traffic:** It means number of vehicles, persons or animal passing a given point on a road during a specified period of time and is expressed as vehicles per day.
2. **Speed Surveys:** It is recorded by means of traffic counters.
3. **Nature of traffic:** It means whether the traffic is heavy during a certain period of the year due to some festival or harvest or during certain time within the day when the office workers and come back.
4. **Origin and destination of traffic:** it means the places from where traffic originates and where it terminates.
5. **Accidents:** It means collision of one road user with the other road user or with the fixed object lying with in the road pavement

OR

IV Explain the various types of sign boards that you have noticed in highways.

Answer:

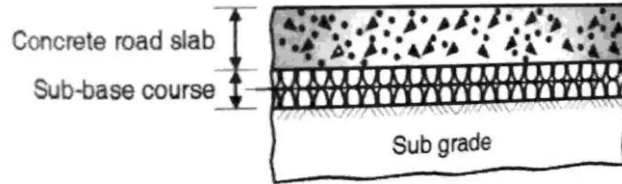
Road safety signs are:

1. **Mandatory Signs:** These signs indicate to the traffic to comply with certain regulations of traffic. Violation of these signs is an offence, as per law. Halt, Stop, Go, Slow, Keep left etc.
2. **Cautionary or warning Signs:** These signs make the road users conscious of hazardous conditions on the road beforehand. The drivers, accordingly, take necessary actions to handle the situation. Junction, sharp bent, hill or ghat road, schools zone etc.
3. **Informatory Signs:** These signs guide the road users about destinations, distance, alternative routes, directional signs, and prominent locations like fuel points, public toilets, nearby hospitals, etc.
4. **Prohibitory Signs:** these signs indicate to the traffic that the use of horns is prohibited like no parking, no entry, speed limit etc
5. **Temporary signs:** these are signs which are used at the time of repairs.

V Explain the construction procedure for cement concrete roads.

Answer:

The construction of cement concrete road involves the following operations:



- 1.Preparation of subgrade.
- 2.Provision of Sub-base.
- 3.Placing the Forms in Cement Concrete Road
- 4.Watering the Prepared subgrade or Sub-base.
- 5.Batching of Materials and Mixing.
- 6.Transporting and Placing of Concrete.
- 7.Compaction of Cement Concrete Road.
- 8.Floating.
- 9.Belting.
- 10.Brooming.
- 11.Edging.
- 12.Curing Process of Cement Concrete Road.
- 13.Fillings of Joints and Edging.
- 14.Opening to Traffic.

OR

VI Explain the various types of gradients used in highway.

Answer:

Gradient of a road is the rate of rise or fall along the length of x or n%.

Types of gradients:

1. Ruling gradient — it is the maximum gradient within which designer designs the vertical profile of a road. Desirable upper limit of gradient 1 in 20 to 30
2. Limiting gradient — it is the gradient used at places where topography compels adopting steeper gradients due to enormous increase in construction cost with gentler slope. The limit: 1 in 15 to 20
3. Exceptional gradient — in extra ordinary situation, it may be unavoidable to provide still steeper gradients at least for shorter duration. But length of stretch should not exceed 100 m at a stretch. The Limit: 1 in 12 to 15
4. Minimum gradient — minimum gradient is required to provide for drainage purpose. Limit is 1 in 100 to 200

| Terrain | Ruling | Limitings | Exceptional |
|---------------|--------|-----------|-------------|
| Plain/Rolling | 3.3 | 5.0 | 6.7 |
| Hilly | 5.0 | 6.0 | 7.0 |
| Steep | 6.0 | 7.0 | 8.0 |

VII Explain the various types of sight distances.

Answer:

Sight distance: It is the length of a road visible to a driver ahead of him. It is the next important element on a road from safety point of view.

1.Stopping sight distance: it is the distance needed by a drive travelling at design speed to stop his vehicle before colliding with an obstruction ahead. As per the IRC guideline, driver's eye level must be at 1.2m and obstruction height at 0.15m. It consists of two parts - reaction distance and braking distance,

$$SSD = 0.278Vt + \frac{v^2}{254f}$$

V - speed in km/h.

t - reaction time in sec.

f—Coefficient of friction.

2.Overtaking sight distance: It is the minimum distance that needs to be visible to a driver moving at design speed and intending to overtake a slow-moving vehicle ahead, with safety against the traffic in the opposite direction. IRC guideline - overtaking and overtaken driver's eye levels at 1.2m. It consists of three components - d1, d2 and d3.

d1- distance between overtaking and overtaken vehicle at the start of overtaking process.

d2- distance covered during actual overtaking process.

d3 - the clear distance required between overtaking vehicle and the vehicle coming in the opposite direction.

$$OSD = d1 + d2 + d3$$

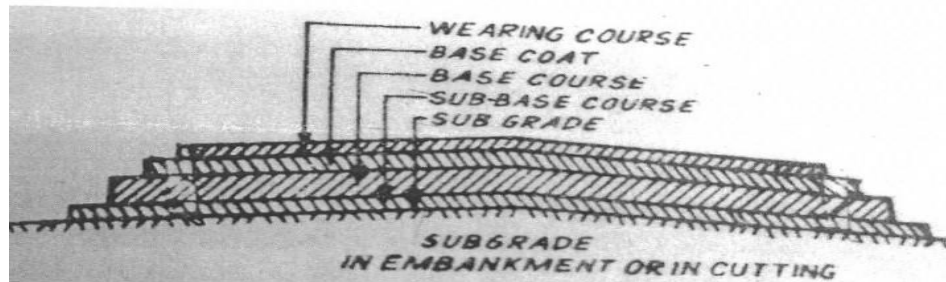
3. **Intermediate sight distance (ISD)** is defined as twice SSD.

4. **Head light sight distance (HSD)** is the distance visible to a driver during night driving under the illumination of head lights

OR

VIII Explain the structural layers of pavement with their functions.

Answer:



or

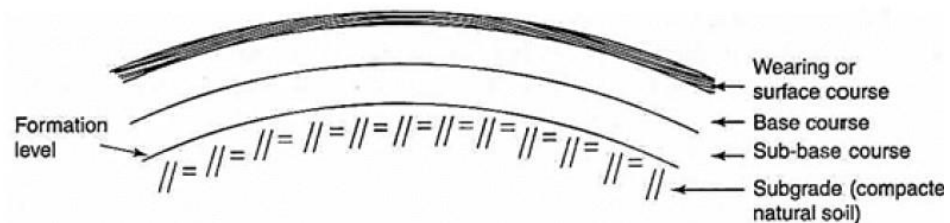


FIG. 7.1 Courses (layers) of a pavement

Wearing course: Wearing course is the layer directly in contact with traffic loads and generally contains superior quality materials.

The functions and requirements of this layer are:

- It provides characteristics such as friction, smoothness, drainage, etc.
- It will prevent the entrance of excessive quantities of surface water into the underlying base, sub-base and sub-grade.
- It gives strength to the road structure. It act as a cushion between wheel and base.

Base course: The base course is the layer of material immediately beneath the surface of binder course.

The functions and requirements of this layer are:

- It provides additional load distribution and contributes to the sub-surface drainage.
- It may be composed of crushed stone, crushed slag, and other untreated or stabilized materials.

Sub-Base course: The sub-base course is the layer of material beneath the base course. The functions and requirements of this layer are:

- It provides structural support, improve drainage, and reduce the intrusion of fines from the sub-grade in the pavement structure.

- If the base course is open graded, then the sub-base course with more fines can serve as a filler between sub-grade and the base course.

Sub-grade: The topsoil or sub-grade is a layer of natural soil prepared to receive the stresses from the layers above. The functions and requirements of this layer are:

- It is essential that at no time soil sub-grade is overstressed.
- It should be compacted to the desirable density.

IX Illustrate the cross section of railway in embankment

Answer:

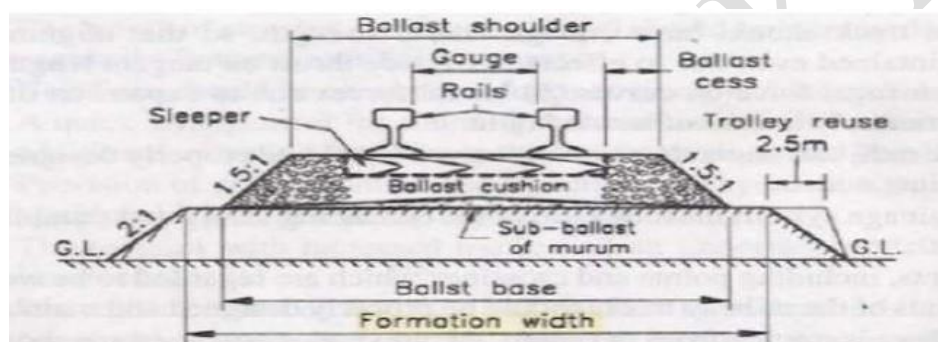


Fig. 3.1 Typical Cross-section of a Permanent Way on Embankment.

- **Rail** — Act as steel girders that carry the axle load of the train and transfer the load to sleepers.
- **Sleepers** — They are transverse members that support the rails in proper alignment and grade. They transfer load to ballast and subgrade.
- **Ballast** — It provides packing below and around the sleepers to transmit the loads from sleepers to formation and to provide drainage as well as longitudinal and lateral stability of the track.
- **Formation** — it is the foundation of the railway track over which entire track is constructed. It provides the strength and stability to the track.
- **Fasteners and fixtures** — fasteners and fixtures are used to keep the rails in proper positions, tilt and gradient.

OR

X Explain classification of station yards

Answer:

Station yards are the system of tracks laid on a level ground for receiving, storing making up new trains and dispatch of vehicles and for other purposes over which movements are not authorized by train timings.

Types of Station Yards:

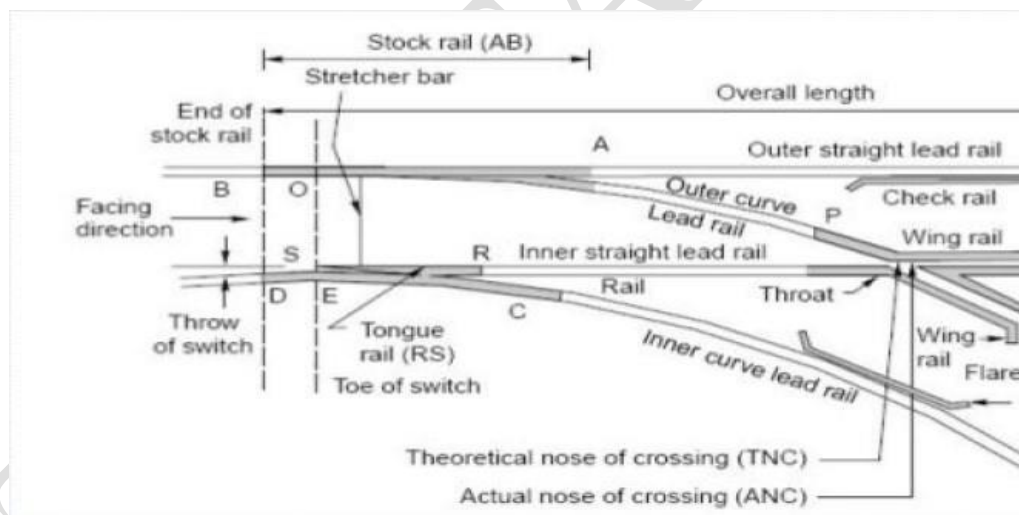
1. **Passenger bogie yard:** Provide facilities for the safe movement of passengers and vehicles. Passenger platforms are regarded as Passenger

Bogie Yard. Usually provided at terminal stations and junctions. Cleaning, washing, and storing of bogies are done.

2. **Goods yard:** Provide facilities for receiving, loading and unloading of goods, delivery of goods and movement goods-vehicles. All stations except flag stations are provided with goods yard. Loading, and unloading is done on goods platform and storing of goods in goods shed.
3. **Marshalling yard:** Loaded and empty trains are received from different tracks for booking in different directions. Wagons are separated, sorted, and dispatched in the form of full trains for each track. Wagons are arranged in order so that required wagons can be conveniently detached at wayside stations.
4. **Locomotive yard:** Place where locomotives are housed. Fueling, watering repairing, oiling, cleaning etc. are provided. Installed at station junctions on the same side of marshalling yard. Number of tracks lead to engine shed, ash pit, repair pit, inspection pit, turn table etc.

XI Illustrate a right hand turn out with the help of a neat sketch.

Answer:



Turnout: It is an arrangement of points and crossings with lead rails by means of which the rolling stock may be diverted from one track to another.

Point (Switch): The device that is used to divert the wheels from one track to the other.

Tongue rail: It is a tapered movable rail, made of high-carbon or -manganese steel to withstand wear. At its thicker end, it is attached to a running rail. A tongue rail is also called a switch rail.

Stock rail: It is the running rail against which a tongue rail operates. Points or switch: A pair of tongue and stock rails with the necessary connections and fittings forms a switch.

Crossing: A crossing is a device introduced at the junction where two rails cross each other to permit the wheel flange of a railway vehicle to pass from one track to another.

OR

XII Explain the importance of interlocking of signals.

The levers operating the various signals and points are mechanically connected in order to avoid the possibility of pulling wrong levers and to ensure safe movement of trains. This is known as inter-locking of signals.

- The main objective of inter-locking is to eliminate human error in the operation of signals and points. At each station there are number of points and signals.
- At the time of operating points their corresponding signals should be lowered. If points are set for one track, and signal is lowered for other track it may cause serious accidents.
- Therefore, all the levers of points and signals should be interlocked in such a way that if points are set for a track the man must be able to pull the lever for lowering the signal only of the same track.

XIII Illustrate the various configurations of runways.

Runway: A rectangular area on land prepared for the landing and take-off of aircrafts.

There are four types of Runway Configurations:

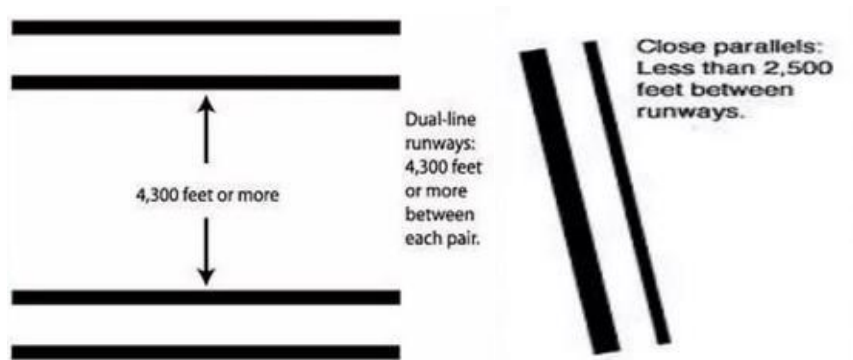
1. Single Runway:

- One single runway used for the landing and take-off of aircrafts.
- Simplest runway.



2. Parallel Runways:

- There are 4 parallel runways.
- These are named according to how closely they are placed next to each other.



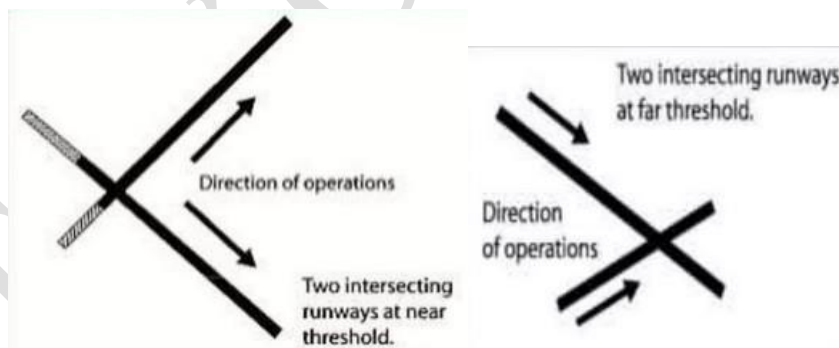
3. Open-V runways

Two runways that diverge from different directions but do NOT intersect form a shape that looks like an "open-V" are called open-V runways.



4. Intersecting runways

Two or more runways that cross each other are classified as intersecting runways.



OR

XIV Draw the layout of a harbour and mark all the component parts

