TED-2015
RIVISION 2015 (6014) TRANSPORTATION ENGG. 1
VERSION-B

12

1.1
(i) National Highways
(ii) State or provincial Highways
(iii) District Roads
(a) Major District Roads
(b) Other District Roads
(iv) Village Roads

1.2

2.6 ...

2.3 ROAD CAMBER :

Camber or cross slope is the convexity provided to the section of a straight road. It is expressed in terms of the slope of the line. Joining the crown (centre of the carriage way) to the edge. It is an either ellipse or more often a parabola. The primary function of the camber is to provide surface drainage. The camber to be provided will depend on the surface of the

2.6 GRADIENT :

Gradient is the rate of rise or fall of a road level along its length, expressed as a ratio of difference in level to the total horizontal length in which it occurs. It was started that least motive power should be aimed at to be expanded in the use of an alignment. The condition therefore places a limit on the permissible grades for roads. It is expressed as ratio or as a percentage. The different kinds of highway gradients are

(i) Ruling gradient

1.3

6.1 GAUGE :

The Perpendicular distance between the inner faces of heads of the two rails forming the track is known as the 'Gauge'.

1.4

13.10.2 Afflux :

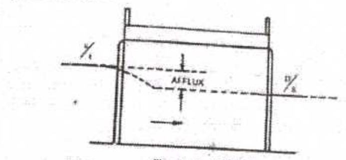


Fig. 13.2 AFFLUX

The sudden rise or heading up of water level on the upstream side of a bridge due to the obstruction caused by the bridge to the flow, is known as afflux while designing the water way of the bridge afflux should be kept *as low as possible* for the following *reasons.*

1.5

12.4 INTER LOCKING 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 interlocking of signals. The main object of inter locking is to eliminate human error in the operation of signals and points.

5x2=10

II a

2

Working Groups t...
ndiainfoline.com

deliberations of various aspects of road safety.

4 E's Road Safety :- The main thrust of accident prevention and control across the world has been on 4 E's vis (i) Education; (ii) Enforcement; (iii) Engineering; and (iv) Environment and Emergency care of road accident victims. The Government of India has been focusing on all these four approaches in its policies and programme.

Education :- Awareness is generated through various Road Safety Campaigns utilizing audio-visual and other print media and through NGOs. With the view to raise road safety awareness among the general public, the Government have been undertaking various publicity measures through DAVP and professional agencies in the form of telecasting/broadcasting of TV spots/Radio spots, display of cinema slides, distribution of posters, books on road safety signage & signs, organizing Road Safety Week, Seminars, Exhibitions, All India Essay Competition on Road Safety, etc., containing

Working Groups t...
ndiainfoline.com

Seminars, Exhibitions. All India Essay Competition on Road Safety, etc., containing
road safety messages for various segments of road users viz. Pedestrians, cyclists, school children, heavy vehicle drivers, etc. painting on road railings on themes of road safety, road safety games, calendars depicting road safety messages, etc.

Enforcement :- The Motor Vehicles Act 1988 and Central Motor Vehicles Rules 1989 contain a number of provisions, which if enforced correctly, would curb traffic violations by drivers. The enforcement of these provisions is primarily the responsibility of the concerned State Government. The States have been advised from time to time to enforce various provisions of the Motor Vehicles Act 1988 in the right earnest to improve road safety scenario in the country.

The control of National Highways (Land and Traffic) Act, 2002 provides powers to Highway Administration for control of land within the National highways, Right of Way and traffic moving on the National Highways

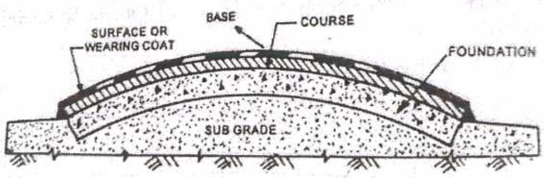
II b

2.1.4 Wearing Coat

This is the top most layer of a road which is in direct contact with the traffic. It should be capable of withstanding the wearing effects of the traffic and also impervious. Its functions are

(i) To provide a smooth surface for the traffic.

(ii) To drain away rain water and prevent percolation of water.



COMPONENTS OF THE ROAD STRUCTURE

fig -3
exp -3

II c 3

(i) To prevent the softening of the road surface and formation of ruts.

(ii) To prevent the sub grade from loosing its bearing capacity.

(iii) To prevent erosion of surface and side slopes of formation.

(iv) To prevent slipping of side slopes of formation.

II d

6.4 ADVANTAGES OF ...

(i) Railways help to unite the people of different religions, castes and customs to achieve the National integrity.

(ii) Railways net work will help the control administration to become more easy and effective.

(iii) Railways will help to migrate the people from one region to other region.

(iv) Railways will help during wars for transportation of war equipment and army.

(v) Railways provide convenient, safe and cheap mode of transport through out the country.

(vi) Railways provide the transport to the masses to visit religious places in India.

(vii) Railways will help the labour from the places of unemployment to Industrial areas.

(viii) The finished goods from the Industries can be quickly transported to any place in India.

(ix) Railways will help in transporting food grains and clothes to the affected areas.

6x1=6

II e

key type sleepers can also prevent creep and do not allow change ...

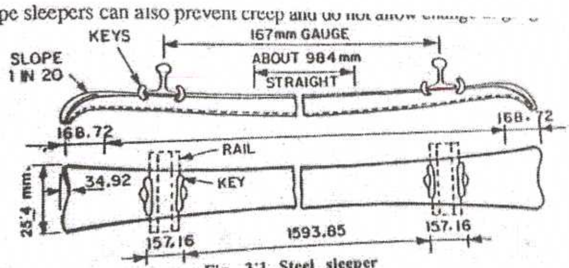


Fig. 3·1 Steel sleeper

... rails are first inserted in lugs ar...

ballast. The rail seat is given a slope ...

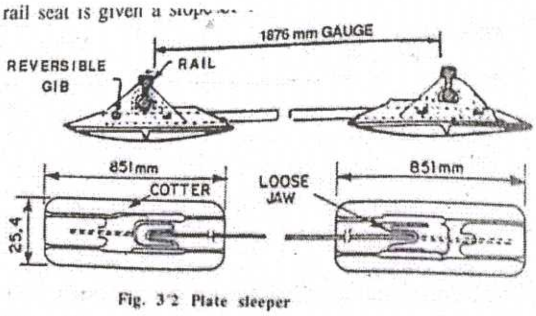


Fig. 3·2 Plate sleeper

ogether by a tie bar with necessary fittings such as keys, gibs and cotters. Gibs nd cotters are so casted that by interchanging them gauge is slackened by ·18 mm.

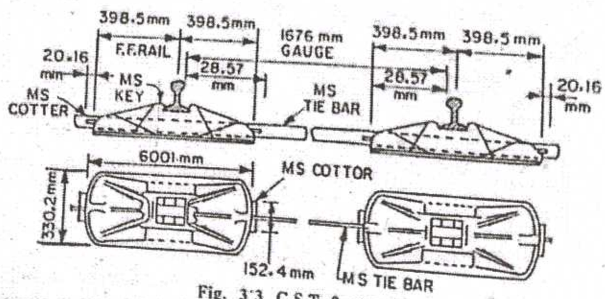


Fig. 3·3 C.S.T.-9 sleepers

fig. -6

II f

4

(a) *Straight wing-walls.* These are used in small bridges and culverts meant for crossing drains. These are cheaper as compared with return-walls.

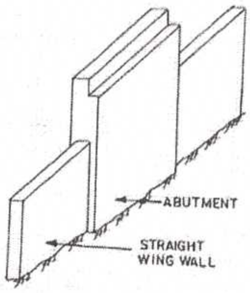


Fig. 4·17 Abutment with straight wing-walls

(b) *Splayed wing-walls.* These provide smooth entry of the water under the bridge. This type of wing-wall is also very useful when road approaches are curved in plan as shown in the figure. Splayed wing-wall can be used on small as well as high bridges.

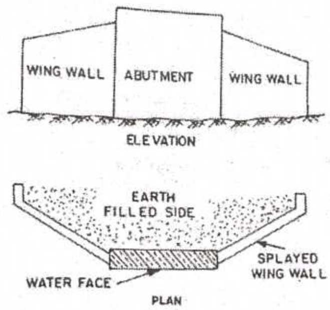


Fig. 4·18

4·13 DESIGN OF WING-WALLS AND RETURN WALLS

The wing-walls are the splayed extension of an abutment of a bridge on a culvert. The main function of the wing-walls is to retain the embankment soil and side slope of the embankment. The wing-walls also serve the purpose of the guide for allowing the water to pass through the desired openings. The top of the wing-wall is kept level with the shoulder of the embankment and then, it is constructed at the natural angle of repose of the earth fill material to a height of 0·6 to 1·2 m above the ground level or water level.

3+3

II g

Compared to the alternate available routes.

1. In the areas of snowfall, freedom from snow and iceberg hazards.
2. Due to the reduction of the distance overall cost will be less.
3. Easier gradients can be provided.
4. Reduction in maintenance cost.
5. Avoids interference with surface air rights.
6. The movement of traffic is most convenient with high speed.

6×1

5

3A

curves. Sight distance can be :

1. Crossing sight distance or safe sloping sight distance.
2. Non-passing or non-overtaking sight distance.
3. Passing or overtaking sight distance.
4. Lateral sight distance.

(1) *Crossing sight distance.* On roads and highways, two vehicles coming in opposite directions, on seeing each other have to reduce their speed to enable each other to use the pavement edges or shoulders, as the case may be. This distance in such a case is taken as twice the distance required for a vehicle to come to stop and is called crossing sight distance. So on horizontal and vertical curves, this minimum sight distance must be provided to avoid any collision of two vehicles coming from opposite directions.

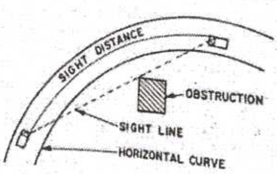
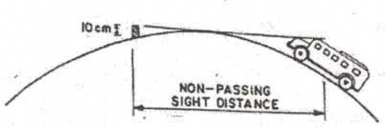


Fig. 2·12 Crossing Sight Distance

Referring to Fig. 2·12, Tables 2·5 and 2·6 give the minimum setback distance '*s*' required at horizontal curves on two lane roads for safe sloping sight distance.

(2) *Non-passing or non-overtaking sight distance.* It is defined as the longest distance at which a driver whole line of sight is 1·2 m above the road surface can see the top of an object 10 cm high on the surface of the road.



(3) *Passing or overtaking sight distance*. One two and three lane highways, opportunities to pass a slow moving vehicle should be provided at intervals.

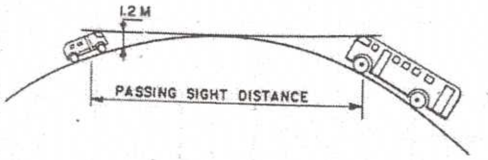


Fig. 2·14 Passing Sight Distance

On four-lane highways this facility is not required. *The passing or overtaking sight distance* is defined as the longest distance at which a driver whose line of sight is supposed to be 1·2 m above the road surface, can see, the top of an object 1·2 m above the roadway. This will help in overtaking the slow moving vehicles easily and without any risk.

Table 2·7 gives the stopping sight distance and overtaking (or passing) sight distance for various speeds of the vehicles.

3B

(iv) *Clover leaf interchange* : These are the superior type of interchanges. In this type of grade separators Right hand movements are eliminated. This will avoid major source of accidents. To cope up with the modern traffic the radii of loop ramps are to be increased the clover leaf covers a large area.

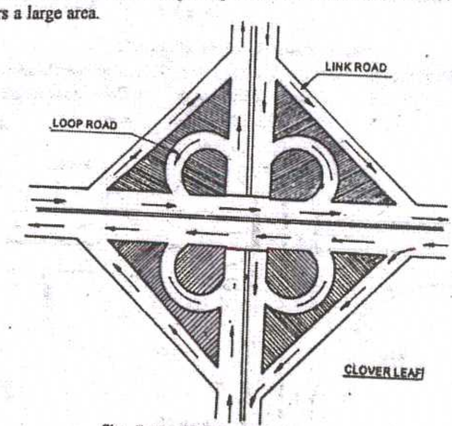


Fig. 5.17 GRADE SEPARATOR

(Chapter-5)

fig - 4
exp - 4

IV A

5.7

5.4.2 Classification of Intersections or Junction : (Merging, Diversing, Crossing)

There are many different types of road junction having their own advantages and disadvantages.

The following are the some types of Road intersections.

(i) Square Junctions (ii) Acute Junctions
(iii) T-Junctions (iv) Y-Junctions
(v) Staggered Junctions (vi) Multiple Junctions

(i) *Square Junctions* : When two roads meet or cross each other at right angles which are having equal width.

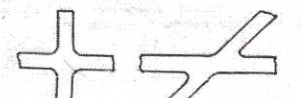
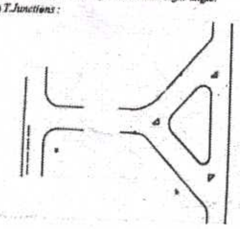


Fig. 5.1 SQUARE JUNCTION Fig. 5.2 ACUTE CROSSING

(ii) *Acute Junctions* : These are the junctions where two main roads meet or cross each other and angle other than right angle.

(iii) *T-Junctions* :



avg 4 = 7

7

(iv) *Y. Junctions :* These are the junctions when two roads meet but do not cross at angle other than a right angle 'Y' junction is formed.

Fig. 5.4 Y-JUNCTIONS

(v) *Staggered Junction :* When two roads meet another road on either sides at right angles. It is called as staggered junctions.

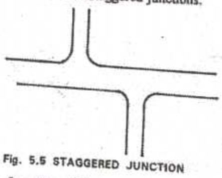


Fig. 5.5 STAGGERED JUNCTION

(vi) *Multiple Junction :* When more than two roads meet, the Junction is known as Multiple Junction.

Fig. 5.6 MULTIPLE JUNCTION

5.4.3 Traffic Islands :

These are also called as Rotaries or Round abouts. These are provided

IV B

The different types of markings may be classified as :

(a) Pavement markings

(b) Kerb markings

(c) Object markings

(d) Reflector unit markings

5.7.1 Pavement Markings :

Pavement markings may generally be of white paint. But to indicate parking restrictions yellow colour markings are made. Longitudinal solid lines are used to as guiding or regulating lines and are not meant to be crossed by the driver. Transverse solid lines indicate the position of stop lines for vehicular traffic .

Some of the important pavement markings are as follows :

(a) Centre lines : These are the lines to indicate to separate the opposing streams of traffic on undivided two way roads. On four or six lane undivided roads two solid continous parallel lines of 0.1 m width and 0.05 to 0.10 m space in between are painted.

(b) Lane line : These are the lines drawn to designate traffic lanes.

These are meant to guide the traffic and to properly utilise the carriage way.

(c) Turn markings : These markings are useful to indicate to designate lateral placement of vehicles near intersection before turning to the different directions.

(d) Cross walk lines : These lines are required at particular places where the pedestrians are to cross the pavement.

(e) No passing zone markings : These markings are provided to indicate the drivers that overtaking is prohibited in that portion of the road.

(f) Approach to obstructions : These markings are provided to indicate the obstructions such as transmission tower with in the carriage way or any other obstructions to prevent vehicles from colliding the obstructions.

(g) Parking space limit markings : These markings are required to indicate proper utilisation of parking facility.

5.7.2 Kerb Markings :

These markings are provided to indicate certain regulations like parking regulations. The markings on the Kerb and edges of Islands with alternate black and white lines increase the visibility from a long distance.

5.7.3 Object Markings :

The traffic markings provide to physical obstructions on or near roadways are known as object markings. Typical obstructions are supports for bridge - level crossing gates, narrow bridges, guard rails, trees etc. These markings should be given for their clear visibility from a long distance.

5.7.4 Reflector Marking :

Reflector markings are used as hazard markers and guide markers for safe driving during nights. Hazard markers reflecting yellow light should be visible from a long distance of about 150 metres.

3+4

VA

drains and the road.

Type of gradients. The gradients which are provided in different portions of a road length are as follows :

1. Maximum Gradient.
2. Ruling Gradient.
3. Minimum Gradient.
4. Average Gradient.
5. Exceptional Gradient.
6. Floating Gradient.

(1) *Maximum Gradient.* It is maximum or steepest gradient which is to be permitted on the road, which on no account is to be exceeded, as steeper gradients are very inconvenient to the traffic, specially to the slow moving traffic. This is also called *Limiting Gradient.* Its value has been fixed as 1 in 15 for *Hill Roads* and 1 in 20 for other roads. These steeper gradients are sometimes to be provided to avoid deep excavations and avoid long detours.

(2) *Ruling Gradient.* It is the permissible gradient in the alignment of a road. This gradient is such that vehicles, whether they are animal driven or power driven, can overcome long distances of this gradient, without much fatigue or uneconomical fuel consumption. *Ruling Gradient* is, therefore, defined as the suitable gradient within which the Engineer must endeavour to design the road. The Indian Road Congress has recommended the value of ruling gradient as 1 in 20 in hills and 1 in 30 in plains.

(3) *Minimum Gradient.* It has also been found that for efficient drainage of water from the road surface, a certain minimum gradient is essential. Such an essential gradient which has to be provided for the purpose of road drainage, is called *Minimum Gradient* and its value is usually fixed as 1 in 200. However, the minimum gradient will depend upon the nature of the ground as well as on the rainfall of the particular area. For cement concrete roads, a minimum gradient of 1 in 330 can be provided.

(4) *Average Gradient.* It is defined as the total rise or fall between any two points chosen on the alignment divided by the horizontal distance between the two points. The determination of the average grade is useful in carrying out the first paper location of preliminary survey.

(5) *Exceptional Gradient.* During the alignment of a road, there may come certain patches of length, where a gradient may have to be provided which may be either less than the minimum gradient or more than the maximum gradient. Such a gradient is known as *Exceptional Gradient.* Such a gradient becomes necessary to avoid deep cuttings or excavations. Exceptional gradient should not be provided in a length more than 100 metres, in any case.

(6) *Floating Gradient.* When a motor vehicle descends a gradient, some tractive effect is required to maintain it at uniform speed, but to the descent, there is the negative tractive force or resistance. This resistance will be equal to the tractive effort required to maintain the vehicle at a uniform speed with a particular gradient, such a gradient is called *Floating Gradient.*

VB

6·7 CONSTRUCTION OF W.B.M. ROAD

The stages of construction of a W.B.M. road are as follows :

(*i*) *Subgrade and Kerbs.* After the construction of embankments or cutting is completed, the subgrade is prepared in the shape of required camber and gradient. It is properly compacted by light rollers or hand rammers. Earthen kerbs of 15 cm × 15 cm section are prepared along the edges of the proposed road to hold the materials.

(*ii*) *Base or foundation layer.* The base or foundation course consists of 12 to 18 cm size boulders or broken pieces of stone, large size kankar, overburnt brick-bats or flat bricks. Stone boulders or bricks are each placed by hand, firmly bedded in position with as little voids as possible. In the case of bricks the larger edge of bricks is placed transverse to the direction of the roadway. In the case of stone base the voids if any should be properly filled with stone pieces and the surface be lightly rolled with a 10 ton roller. The width of the foundation should be 60 cm wider than the pavement, projecting 30 cm on each side.

(*iii*) *Wearing course.* This is also known as metalling course and can be laid in one or two layers depending upon the total thickness required. The thickness of the loose metal in each layer should not exceed 15 cm. It is because of the reason that ordinary rollers will not be able to roll more than 15 cm thick layer. If very heavy rollers are used, the metal will be crushed. The wearing course is prepared in the following order : 7.

(*a*) First of all stone metal is evenly spread over the proposed surface in the required thickness. After spreading, the metal is hand packed properly to the required camber and gradient. Generally 1 in 30 to 1 in 40 camber is provided.

(*b*) The layer of stone metal is then rolled by 8 ton rollers. Rolling should first be started form the edges and gradually shifted towards the centre. This dry rolling will provide interlocking of aggregates.

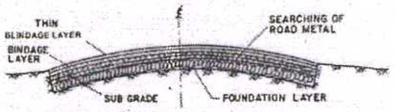


Fig. 6·2 Waterbound Macadam Road

(*c*) After dry rolling, stone screening or 12 mm grit is evenly sprinkled on the surface at the rate of 1 cu. metre per 100 sq. m. It is known as bindage layer. This surface is now rolled dry, and then sufficient quantity of water, to wet the aggregates, is sprinkled, and the surface is again rolled. During the process of rolling proper camber and gradient should be maintained.

(*d*) The next day final coating of sandy soil containing clay and moorum and 75% sand is spread in a thickness of 5 mm and the surface is wetted by copious quantity of water. This layer of sandy soil is known as bindage layer. Nearly 40 to 60 litres of water is used per sq. metre of the surface. The surface is then rolled. During rolling water is sprinkled on the roller wheels so that the metal should not stick to the roller surface. The object of spreading so much of water is that the material such as sand, clay etc., should reach interstices of stone.

The rolling is continued on the next day also. Some quantity of sand at the rate of 1 cu. metre per 160 to 180 sq. m. of road surface is spread. The surface is then kept wet for about seven days and then it is opened for traffic.

6·8 CAUSES OF DISINTEGRATION

VI A

2.5.2 Essential Requirements of any Drainage System :

(i) Adequate camber and minimum gradient for the road surface to ensure quick drainage of surface water.

(ii) Side drains of required capacity to drain off all water likely to accumulate at a given point.

(iii) Provision of suitable bridges, or culverts to drain away the maximum discharge likely to pass through.

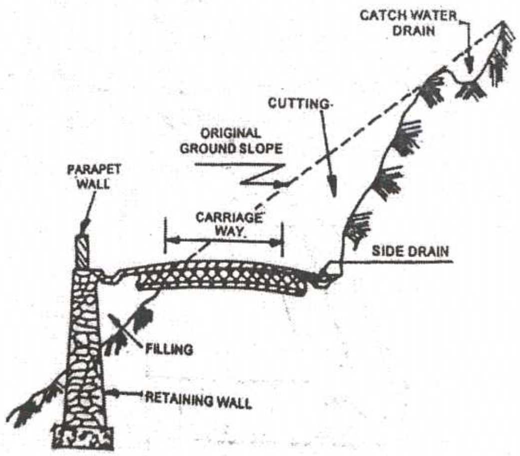
(iv) All sub soil water including water from springs coming to the road structures to be tapped and drained off by sub - surface drainage.

(v) Flow of surface water across the road and along pipes should not cause formation of cross ruts or erosion.

(vi) Highest level of ground water table should be kept well below the level of subgrade preferably by atleast 1.2 metres.

(vii) In water logged areas special precautions are to be taken if flooding is likely to occur.

VI B



8

VII A

which movement of trains is controlled by prescribed rules, regulations and signals.

Railway yards have been classified as follows :

1. Passenger yards.
2. Goods yards.
3. Marshalling yards.
4. Locomotive yards.

9·14 PASSENGER YARDS

This yard provides all the facilities for the convenience of the passengers. The chief requirements of a passenger yard are as follows :

1. Booking office, cloak-room and luggage booking room.

2. Space for parking all sorts of vehicles outside the station.

3. Enquiry office.

4. Signals for the reception of the trains from different directions at the same time, so that all the trains, which are required to be connected with one another may be received and connected in a short time.

5. Signals for the departure of trains in various directions at a time.

6. Facilities for passing a through-train at the full speed without interference.

7. Sufficient number of shunting necks for withdrawal and placement of rakes without causing interference to other trains.

8. Sufficient number of platforms.

9. Sufficient number of sidings with platforms, so that extra carriage after detaching from trains, can be kept till they are attached to other trains.

10. Facilities for charging batteries of trains.

11. Washing lines, sick-lines and stabling-lines in required numbers.

9·15 GOODS YARD

The chief requirements of a goods yard are as follows :

1. Approaches with roads for the movement of trucks and other vehicles to each platform with ramps for loading and unloading of the goods.

2. Gathering line taking off the main line of loop line with a number of parallel dead-end-sidings with buffer stops.

4 ports.
(4)

10. Vacuum testing machine.....

10

16 MARSHALLING YARDS

One author has described marshalling yards as "hearts that pump the flow of commerce along the track". These are places where trains are born. The unit of loading on railways is usually wagon, but the unit of transport is a train. Therefore, before despatch, all the wagons are associated in the form of a train. All the wagons should be arranged station-wise so that there should be no difficult in detaching them at stations. This is the function of marshalling yards *i.e.* to short out and combine isolated wagons into train loads.

Marshalling yards are very costly in construction and maintenance. The following are the drawbacks of marshalling yards :

9·19 LOCOMOTIVE YARDS

The following are the chief requirements of a locomotive yard :

1. It should be located near the passenger-yard and goods-yard, so that both incoming and outgoing engines may take less time.

2. Escape line to admit train engines immediately after a train has arriv-

3. Water column.

4. Ash pits, inspection pits.

5. Hydraulic jack for lifting the engines while repairing.

VII B

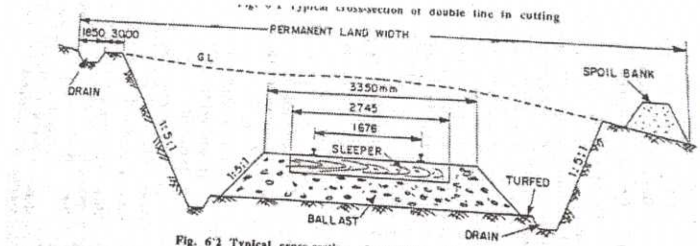


Fig. 6·2 Typical cross-section of single line in cutting

(8)

VIII A

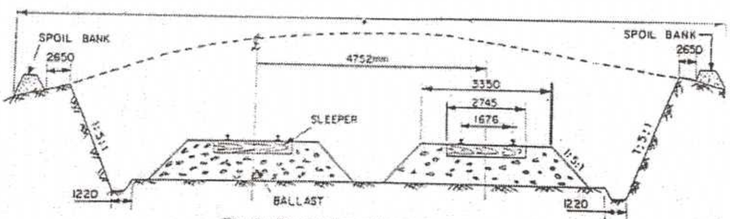


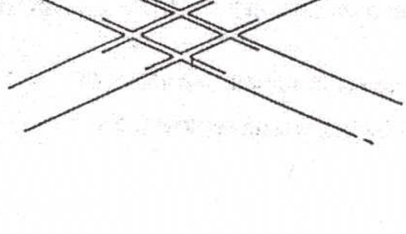
Fig. 6·1 Typical cross-section of double line in cutting

(7)

VIII B

11·13 DIAMOND CROSSING

When two tracks of same of different gauges cross each other at any angle, diamond crossing is provided. It essentially consists of four crossings. The length of the gap at crossing between two noses of a diamond crossing increases as the crossing angle decreases.



bvg. 4
exp. 4

11

IX A

...UGH BRIDGES :

(i) *Deck bridge* : When the flooring of bridge is supported on the top of the supporting system of the bridge is called *deck bridge.*

(ii) *Through bridge* : When the flooring of a bridge is supported or suspended at the bottom of the supporting system, the bridge is known as *through bridge.*

(iii) *Semi through bridge* : When the flooring of a bridge is supported at an intermediate level between the top and bottom of the supporting system, the bridge is known as *semi through bridge.*

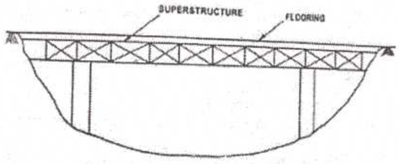


Fig. 15.1 DECK BRIDGE

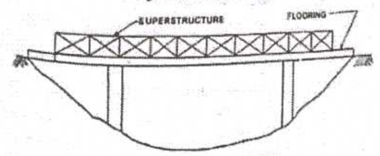


Fig. 15.2 THROUGH BRIDGE

—(Chapter-15)

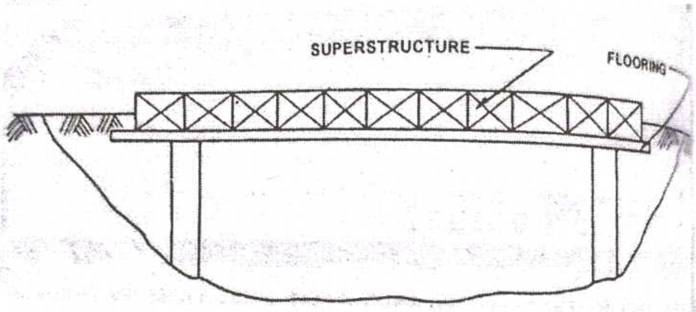


fig-4
exp-3

IX B

...rators, ...
...nagement and other non aeronautical functions. Terminal buildings are ...be designed according to the type of airport.

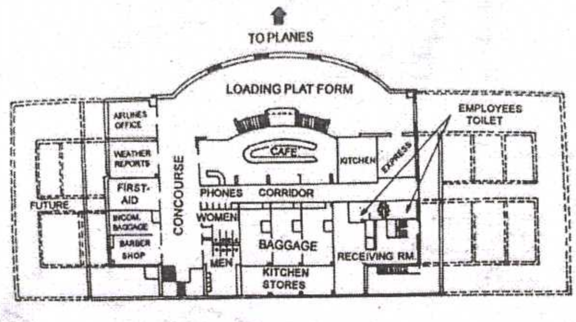
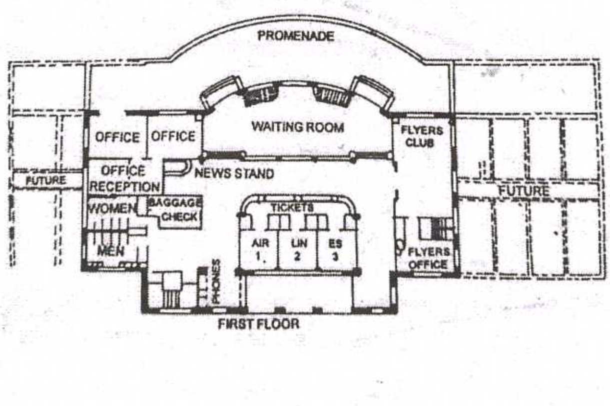


Fig. 18.8



8.

There are three kinds of alignment

(i) Square alignment

(ii) Skew alignment

(iii) Curved alignment

13.5.1 Square Alignment :

This alignment is done at right angles to the axis of river. It is the best alignment.

13.5.2 Skew Alignment :

This alignment is done at other than right angle to axis of the river, skew alignment should be avoided as far as possible because (a) construction and maintenance are difficult (b) flow will be turbulent causing excessive scour and greater pressure on the piers.

13.5.3 Curved Alignment :

This should also be avoided as far as possible. Because (a) construction and maintenance are difficult. (b) It has to resist an additional force namely centrifugal force.

Skew and curved alignments may some times have to be adopted in order to avoid costly and difficulty approaches.

7.

X B

18.5.1 Regional Plan :

The airport site selected should fit well in to the Regional Plan. It should form an integral part of the national network of air port.

18.5.2 Use of Airport :

The use of airport whether for civilian or military is an important factor for the selection of site. Even if it is civilian airport it will be taken over by defence in emergency. Hence the site should provide natural protection to the area from air raids. If thick bushes are there in the site, the planes can be stored in the bushes such that they are unnoticed.

18.5.3 Proximity to other airports :

The site selected for Airport should be at a considerable distance from the existing airports. The air craft landing in one air port should not interfere with the movement of aircraft at other airport with the movement of aircraft at other airport.

18.5.4 Accessibility to Ground :

The site selected should be adjacent to main highway. The time required to reach an airport in a passenger car should normally not exceed half an hour.

18.5.5 Topography :

This includes natural features like ground contours, trees, streams etc. A hill top or raised ground will be an ideal site for an Airport.

The site should have less obstructions in approach zone and turning zones and there should be uniform wind and better visibility due to less fog.

18.5.6 Obstructions :

Approach areas for the selected site should be kept free of obstructions. The obstructions may be fences, trees, pole lines buildings and other natural or man made objects. The future growth of undesirable structures is to be controlled.

18.5.7 Visibility :

The poor visibility lowers the traffic capacity, fog, smoke and haze should be less in the locality. Fog generally settles where the wind is less (i.e.) in valley. Smoke and haze will be more in the Industrial areas.

Future development of industries also should be studied.

(8)