

TED (15) 6014
REVISION 2015

VERSION A



TRANSPORTATION ENGG :

1.1 India is a vast country and to connect its different parts with a good network of roads is essential. India's deficiency in agriculture and economic progress is also due to the lack of good roads, especially in villages. The vast difference of culture between different parts of this country. In villages mostly fair weather roads are there i.e., those roads which can be used only in fair weather, and disconnect the villages from towns and railway stations during rainy season. Hence for the uplift of villages and economic development of this country, good and up-to-date roads are very essential.

1.2 Necessity for Road Drainage :

- (i) To prevent the softening of the road surface and formation of
- (ii) To prevent the sub grade from losing its bearing capacity
- (ii) To prevent erosion of surface and side slopes of formation.
- (iv) To prevent slipping of side slopes of formation.

1.3 CONING OF WHEEL

The wheels of a train are not made flat. They are made in the form of a frustrum of a cone having a slope of 1 in 20. This is known as coning of wheels.

On curves the outer wheel has to travel greater distance than the inner wheel. Coning of wheels are done for this purpose.

1.4 A bridge is a type of structure which allows passage to cross over openings such as streams, river, valley or low ground. The passage may be for Road, Railway or canal or for pedestrians

Culvert: Culvert is a bridge having a gross length of 6m or less length.

1.5 Run way : A long and comparatively narrow strip which is paved for small aerodromes

Apron A defined area which is used to accommodate air crafts for loading and unloading of passengers and cargo packing refueling etc.

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(i) National Highways - These are the important roads of the country. They connect State Capitals, Ports and foreign highways. They also include roads of military importance. They are financed by the Central Government. The Highway connecting between Calcutta and Madras through Visakhapatnam is N.H. 5. Delhi - Chandigarh - Amritsar is denoted as N.H. 1. Bombay - Agra Road is N.H. 8. Bangalore - Varanasi through Hyderabad - N.H. 7.

(ii) State Highways - They are the important roads of a State. They connect important towns and district headquarters in the State, National Highways and State highways of neighbouring States. They are financed by State Government. Roads and Buildings department of the State Government constructs and maintains these roads.

(iii) District Roads - These are roads within a district. They are financed by Panchayats with the help of grants given by State Government.

(iv) The Major District Roads - They are roads connecting district headquarters, taluk head - quarters and other important towns in the district, production and market centres, with each other and with State and National Highways and Railways.

(v) Other District Roads - They are district roads of less importance.

(vi) Village Roads - They connect villages with each other and to the nearest district road - highway or railway. They are financed by Panchayats with the help of Panchayats and State Government.

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The actual studies point to right approach for planning and studies should be carried out if the highway programme is to be proper, consistent and short sighted policies.

The planning surveys are to be done in the following order:

- Economic studies
- Financial studies
- Traffic or road use studies
- Engineering studies

1.4.1 Economic Studies :

In the highway development programme economic studies are important role. In these studies it is desirable to find the service given road system to the population and products of the area.

The details to be collected are as follows :

- Population of each village, town or other locality in which is planned
- Trend of population growth
- Industrial products and Agricultural products in classified area wise
- Industrial and agricultural development and future trend

1.10 Transportation Engineering

(v) Existing facilities regarding communication and education

(vi) Per Capita in care.

1.4.2 Financial Studies :

To study the various financial aspects like sources of income and the manner in which funds are to mobilised, the financial studies are required.

These include

- Sources of income and revenue from taxation on road transport
- Standards of living
- Toll taxes, vehicle registrations and resources at local level
- Future developments in financial aspects.

1.4.3 Traffic Studies :

Traffic surveys should be carried out in whole area and on selected routes and the following particulars are to be collected

- Volume of traffic in vehicles per hour annual average daily traffic, peak and design hourly traffic volume
- Origin and destination studies
- Traffic flow patterns
- Mass transportation facilities
- Accidents their cost analysis and causes and goods traffic
- Future trend and growth in traffic volume and goods traffic
- Growth of passenger trips and the trend in the choice of modes.

1.4.4 Engineering Studies :

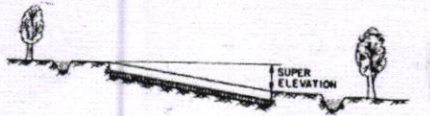
In Engineering studies, the details of topography, soil particulars, drainage and construction and maintenance problems should be investigated before suggesting the programme.

These studies include

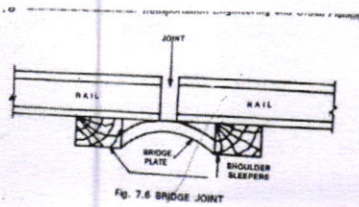
- Topographic surveys
- Soil surveys
- Location and classification of existing roads
- Present

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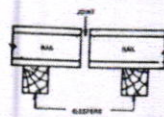
transverse inclination given to the cross-section of the road surface, throughout the length of the horizontal curve to reduce the effect of centrifugal force on the running wheels. It is also sometimes termed as *Cant* or *Banking*. It is expressed as the difference of heights of two edges of the carriageway to the width of the carriageway. Thus a super elevation of the 1 in 20 means that for a 20 metre wide road the outer edge of the carriageway is 1 metre above the inner edge at the vertex of the horizontal curve.



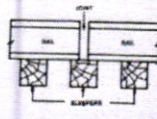
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- (ii) Types according to position of sleeper
- (a) Suspended joints - Commonly used.
 - (b) Supported joints - Not in use.
 - (c) Bridge joints - Not being favoured.
 - (d) Suspended Joints - A rail joint placed at the centre of two consecutive sleepers is known as suspended joint. It is commonly adopted.



- (e) *Supported Joint* - A rail joint placed exactly above a sleeper is known as a supported joint. It is found that in this type the rail ends get battered. It is not in use now.



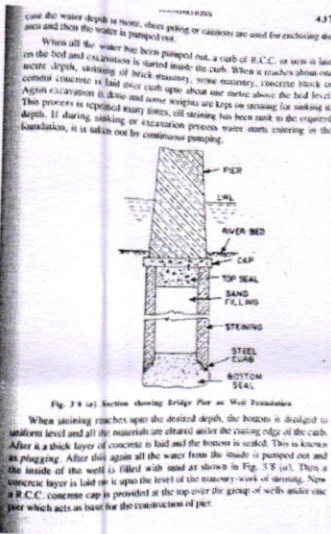
- (f) *Bridge Joint* - The rail joint supported by a bridge of metal which runs on two sleepers is known as 'bridge joint'. The idea is to prevent stress in the rail. It is not achieved as the sleepers yield. At present bridge is not favoured.

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7.3.1 Functions of Ballast :

- (i) To provide a hard and level bed for the sleepers to rest on.
- (ii) To hold the sleepers in position.
- (iii) To transmit and distribute over a large area the load from sleepers to the formation.
- (iv) To provide an easy means of adjusting track levels.
- (v) To provide elasticity to the track.
- (vi) To protect the surface of the formation.
- (vii) To drain away the rain water and prevent its percolation into the formation.
- (viii) To discourage the growth of vegetation over the formation.
- (ix) To prevent the disturbance to track levels due to heaving of formation.

6x1



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- (v) *Confluence of tributaries* : The bridge site should be away from the confluence of tributaries so as to be beyond their disturbing influence.
- (vi) *Straight approaches* : Straight approaches are necessary atleast for a length of 15 metres on either side. They should not involve heavy expenditure.
- (vii) *Availability of sufficient free board* : If the river is used for navigation purpose, the bridge be such that sufficient free board should be available for the passage of boats, steamers or ships for navigation purpose.
- (viii) *Water way* : There should be minimum obstruction to natural water ways at the site of bridge.
- (ix) *Velocity of flow* : It is to be noted that velocity at the bridge site is proper. If the velocity is lower than particular value silting will occur. If the velocity is more than particular value there will be scouring. Therefore the velocity of flow under the bridge should be non silting and non scouring.
- (x) *Availability of materials and labour* : The availability of materials and labour should also be considered such that they are available nearby to reduce the cost of construction.
- (xi) *Easy diversion for the stream* : There should be sufficient space to divert the stream such that there is minimum work under water to get on with construction.

A suitable site for bridges is selected to ensure safety of the bridge structure and achieve effective economy in its construction.

Factors to be considered for selection of site for a bridge.

(i) *Minimum width* : There is direct relation between the span of the bridge and cost of construction. Hence the span of the bridge should be minimum possible. So the site should be selected at a place.

Where the width of river is minimum.

(ii) *Good Foundation* : Availability of suitable foundation at reasonable depth is the greatest consideration. Necessary investigation is to be done to find the type of soil available and to decide the type of foundation.

(iii) *Straight reach and firm banks* : The bridge should be located on straight reach. The well defined banks at upstream and down stream provide safety against changing the direction of river course. By having the firm banks of the river the cost of river training works is reduced.

(iv) *Square alignment* : The crossing should be square (i.e.) right angles to the river flow. Skew crossing should be avoided as far as possible.

A right angle crossing is desirable to ensure uniform flow and less erosion.

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angles. In this type all converging vehicles are compelled to move round an island in one direction.

The traffic Islands may be

- (1) Circular (2) Elliptical (3) Rhombus
- (4) Turbine (5) Tangent shape

Circular Island : This is the best type of Island. It is suitable where two roads of equal importance and width intersect.

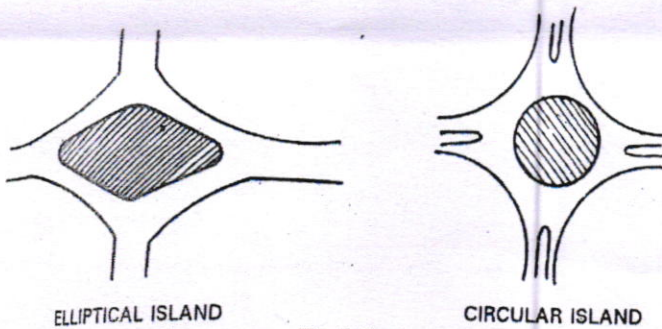


Fig. 5.7

Elliptical Island : This is used where the traffic of one road is more than that on the other.

Rhombus Island : This is similar to the elliptical Island.

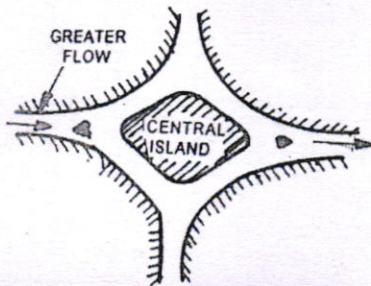


Fig. 5.8 RHOMBUS ISLAND

Turbine Island : In this type of Island the traffic is forced to slow down while entering the rotary as it has to take a left hand turn. During leaving it has a tangential exit

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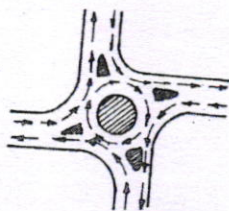


Fig. 5.9 TURBINE ISLAND

Tangent Island : In this type of Island more than two roads enter a rotary and leave it tangentially.



5.5.1 Types of Traffic Signs :

The traffic signs are of the following types :

- (i) Warning signs or cautionary signs
- (ii) Mandatory Signs
- (iii) Prohibitory Signs
- (iv) Informatory Signs
- (v) Temporary Signs

(i) *Warning Signs* : These signs indicate to traffic where some precaution is required for the safety traffic.

Ex : Junction, sharp bend, hill or ghat road, School zone etc.

(ii) *Mandatory Signs* : These signs indicate to the traffic to comply with certain regulations of traffic.

Ex : halt, stop, go slow, keep left etc.

(iii) *Prohibitory Signs* : These signs indicate to the traffic, that the use of horns is prohibited or parking at a certain place is prohibited etc.

Ex : No entry, speed limit, no-U-Turn, no parking etc.

(iv) *Informatory Signs* : These signs convey certain information.

Ex : Route identification, directional signs etc.

(v) *Temporary Signs* : These are the signs which are used at the time of repairs etc.

Ex : Diversion works, Repair works.

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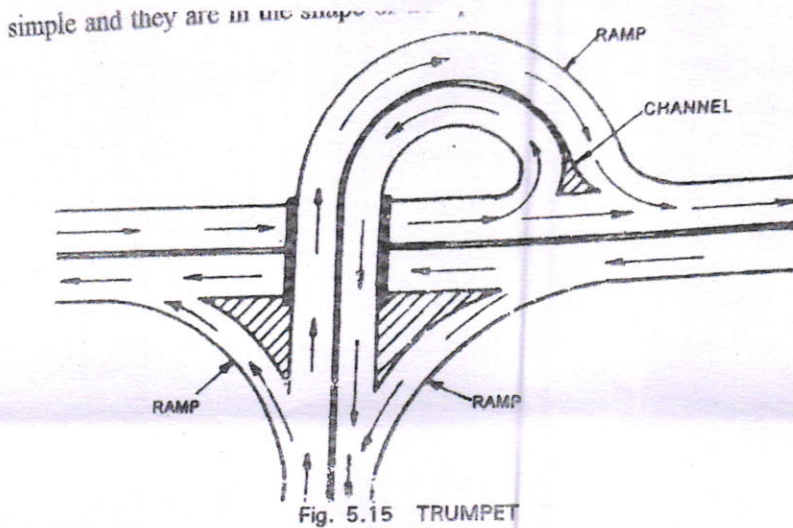
control of the local bodies.

1. An extra tax should be put on the petrol consumers to develop a road development fund, called the Central Road Fund.
2. A semi-official body should be formed to pool technical ideas, knowledge from the various parts of the country and to act as an advisory body on various aspects of roads.
3. A research organisation should be organised to carry out the research and development work.

As a result of these recommendations a central Road Fund was formed by the year 1929, a semi-official body called Indian Roads Congress

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IV B



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V a

(ii) Vertical Curves

2.10.1 Horizontal Curves :

It is a curve in plan to provide a change in the direction of the central line of a road. It is a circular curve with or without transition ends. Different types of circular curves are :

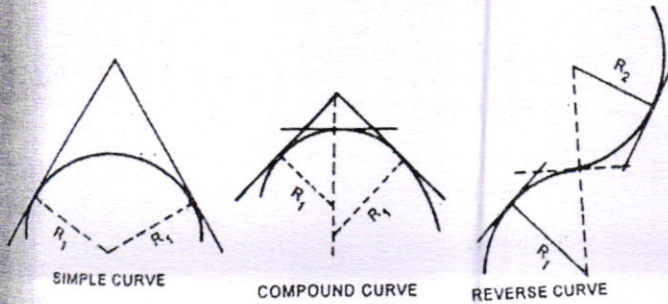


Fig. 2.19 CURVES

1. *Simple Curve* : This is a Curve of Single arc of uniform radius connecting two tangents. This Curve is designated as degree of the curve which is the angle is degree subtended at the centre by a chord of 30 metres lengths. This Curve is suitable for slow moving traffic and large radius. Such a curve may lie within two tangent lengths or two transition Curves.

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2. *Compound Curve* : This is formed by joining two or more simple Curves of same or different radii which turn in the same direction. In this curve the adjacent simple curves have a common tangent. This type of Curve is used in order to avoid cutting in hard rock or heavy filling.

3. *Reverse Curve* : Reverse Curve which is also called as serpentine curve consists of two simple curves of same or different radii and turn in the opposite direction. In this curve the adjacent simple curves have a common tangent and their centres lie on opposite sides of the Curve.

2.10.2 Vertical Curves :

V b

Advantages :

- (i) It is dust free and easy to clear.
- (ii) It provides good riding surface.
- (iii) Wear and tear of the tyres is minimum.
- (iv) Visibility is high.
- (v) Frictional resistance is less and hence less consumption petrol.
- (vi) Its maintenance cost is less.
- (vii) When C.C. road fails or becomes insufficient for traffic, it can be used as a base course.
- (viii) It is not slippery when clean.
- (ix) It has long life.
- (x) It can withstand heavy stresses.

Disadvantages :

- (i) Its normal cost is high.
- (ii) It requires skill in construction.
- (iii) The time taken for construction and curing is more.
- (iv) It causes glare from reflected sun light.

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- (v) It requires joints which are a source of trouble.
- (vi) Laying of cables, pipes after the construction of cement concrete road is difficult.
- (vii) It produces noise under iron tyred traffic such as carts.
- (viii) Repairs of local damages cannot be done.

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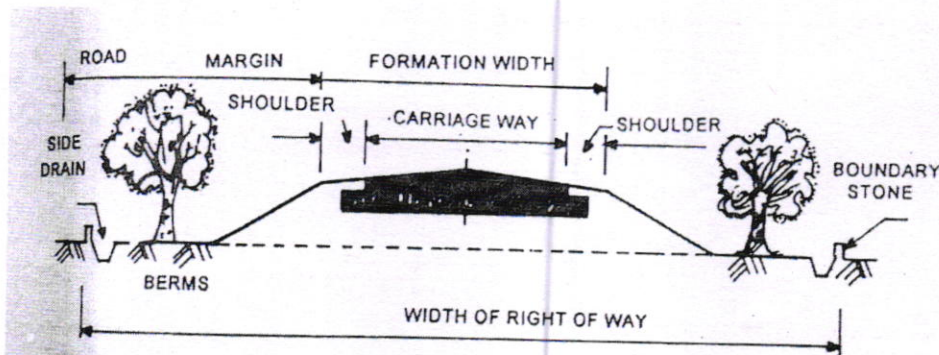


Fig. 2.2 CROSS SECTION OF ROAD IN EMBANKMENT

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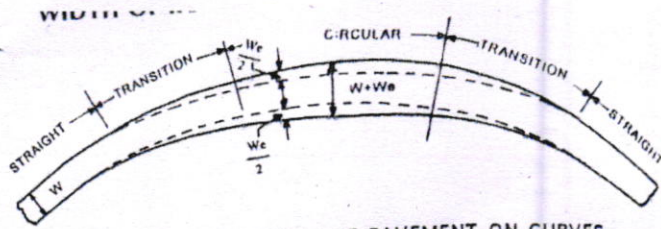


Fig. 2.21 EXTRA WIDENING OF PAVEMENT ON CURVES

The width of road on horizontal curves is increased when the radius of the curve is small. The reasons for widening the road are :

- (i) on a curve a vehicle occupies more width as the rear wheels do not follow the same path as the front wheels.
- (ii) The drivers have a tendency to keep away from the edge of the road while driving on curves.
- (iii) The clearance required between vehicles passing each other is more on curves than on a straight road.
- (iv) Extra width is required to increase visibility.

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VII a

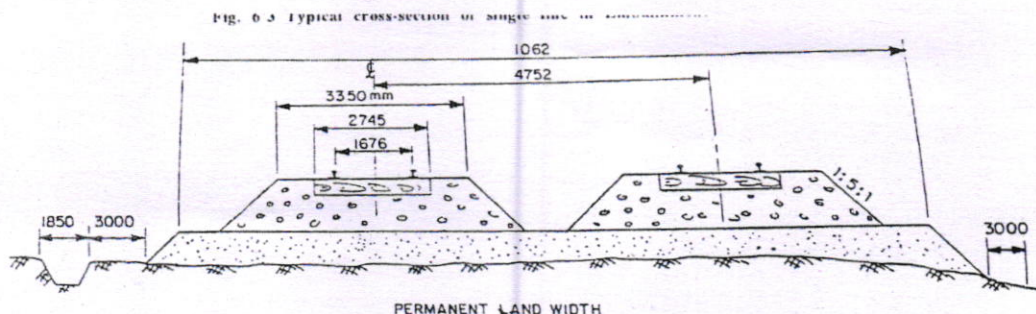


Fig. 6'4 Typical cross-section of double line in Embankment

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VII b

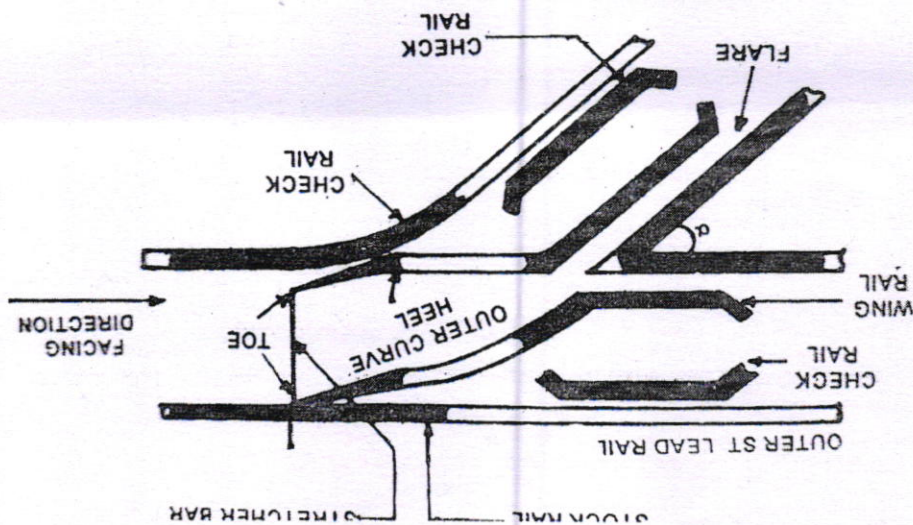


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VIII a

(A) Economical Advantages

- (a) Due to railways industrial development in far off places is possible, increasing the land values and standard of living of the poor people.
- (b) Due to easy movements of the products in all parts of the country, the price stabilisation could be possible, giving relief to the common man.
- (c) During famines the essential goods, food and clothing can be speedily sent to the effected areas.
- (d) Congestion of the cities has been relieved due to increase in mobility of the people, who can come from long distances daily to the places of work.
- (e) Finished products of industries can be easily and cheaply distributed.
- (f) Raw materials can be easily, economically and speedily brought to the industrial areas.
- (g) Completion of big national projects such as Dams, Canals, Power Houses etc. was possible due to railways only, as labour and materials could be brought from long distances speedily.

(B) Political Advantages

- (a) Only due to effective countrywide network of railways, the Central Government administration has become easy and effective.
- (b) Railway have created the national mentality among the people of different religions, areas, tastes, customs and traditions.
- (c) During war the railway can easily and speedily move military from one place to another in time.
- (d) Railway can also help in mass migration of people during emergency i

VIII b

Generally one of the following three methods are used in plate laying.

- (i) Side Methods or tram line
- (ii) Telescopic Method
- (iii) American Method

8.2

(i) This method is used in doubling the track when the single track is available. The material required are carried by trains and the materials are transported to site by manual labour. New track also can be laid by one of the following ways.

(a) A road parallel to the track can be laid and the materials are transported either by lorries or bullock carts or heavy trucks.

(b) A temporary line known as 'tram line' can be laid parallel to the track. This method is called as 'Tram Line'.

(ii) Generally the work starts from a junction of existing railway track. From the junction the materials are transported by manual labour, bullock carts or by trucks. The central stores will be situated at the junction. When the length of the track is completed, the original depot is

IX a

RESISTANCE OF CIRCULAR SECTION IS DIFFICULT WITH OTHER

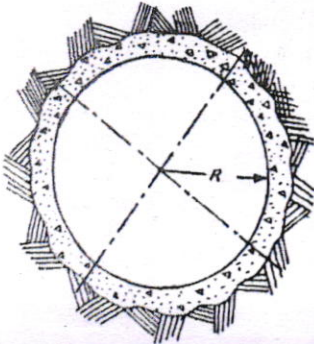


Fig. 3.1 Circular

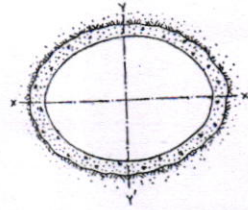


Fig. 3.4 Elliptical section

Egg-shaped. This section is commonly used for sewers, because it gives self-cleaning velocity even in Dry Weather Flow (D.W.F.). This section is also good for resisting external as well as internal pressure.

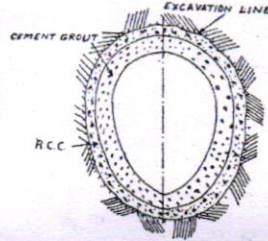
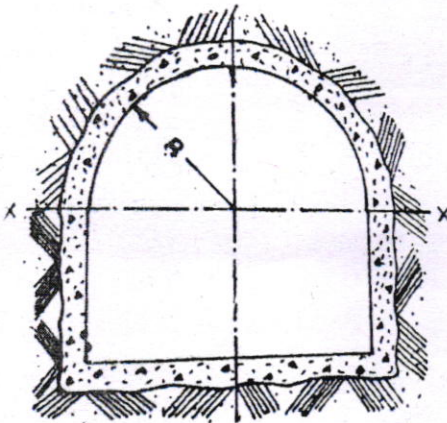


Fig. 3.5 Egg-shaped section



IX b

Accord the type of Airport and according to the traffic volume, Runway layout are designed as follows

- (i) Single runway
- (ii) Open parallel runway
- (iii) Offset parallel runway
- (iv) Two intersecting runways
- (v) Three intersecting runways
- (vi) Tangential runway

(Chapter-18)

Fig 7

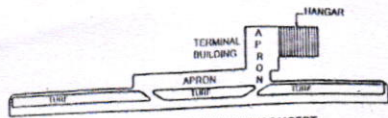


Fig. 18.2 SINGLE RUNWAY CONCEPT

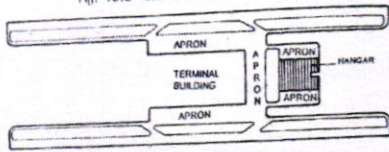


Fig. 18.3 OPEN PARALLEL CONCEPT

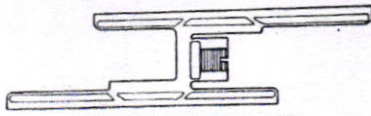


Fig. 18.4 OFFSET PARALLEL CONCEPT

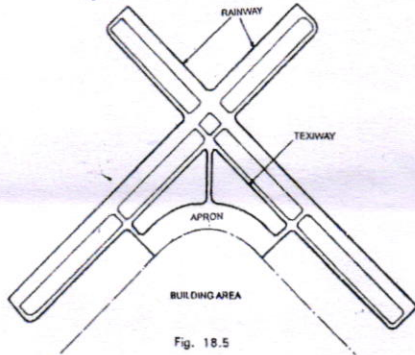


Fig. 18.5

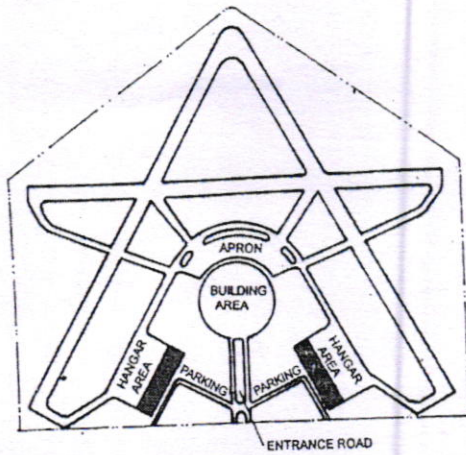


Fig. 18.6 THREE INTERSECTING RUNWAYS

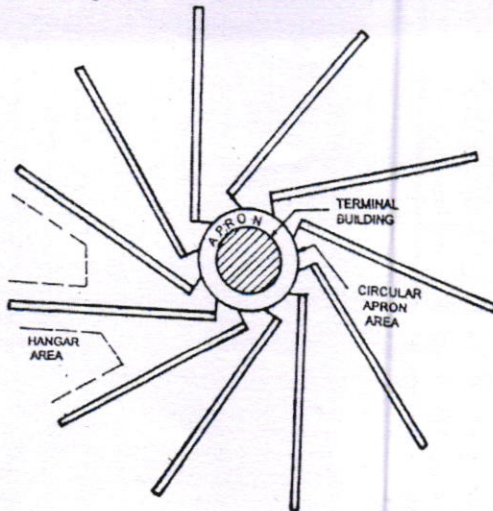


Fig. 18.7 TANGENTIAL CONCEPT

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with temperature reinforcement are used for lining.

9.2 OBJECTS OF THE LINING

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Following are the main objects of the permanent lining of the tunnels :

1. It provides the correct shape of the tunnel.
2. It withstands the soil, pressure and prevent the collapse of soils in case of soft ground.
3. It keeps the inside of the tunnel free from water percolation as suitable outlets are provided.
4. It binds and keeps the loose rock pieces in position and keeps the tunnel safe.
5. It prevents the rock from air slake.
6. It reduces the maintenance cost of the tunnel, because if lining is not done even in case of hard rocks, the loose pieces may fall from time to time and make the tunnel unsafe for traffic.
7. In case of water and sewer tunnels the lining will reduce the friction against the flow and will also reduce the turbulence of flow which may be caused due to projecting pieces of stone.
8. In soft ground the lining gives strength to the structure and makes it safe.

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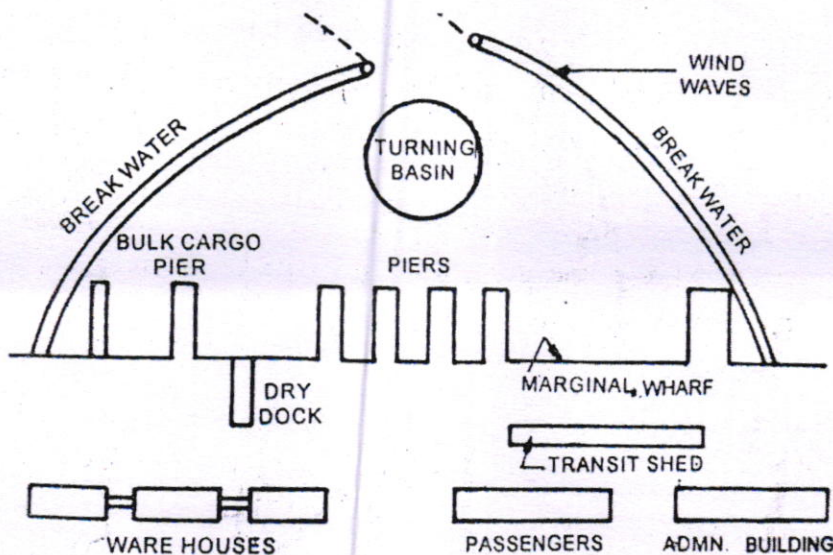


Fig. 19.3 LAYOUT OF AN ARTIFICIAL HARBOUR

A natural vessel has to take shelter within a tract or area of close to the shore. This tract should have good hold for anchoring provided by natural or artificial harbour walls. Such berthing conditions constitute a Roadstead. Roadstead may be either natural or artificial.

Natural Road Stead: A deep channel with protective natural banks can be a good example for natural roadstead.

Fig. 5
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