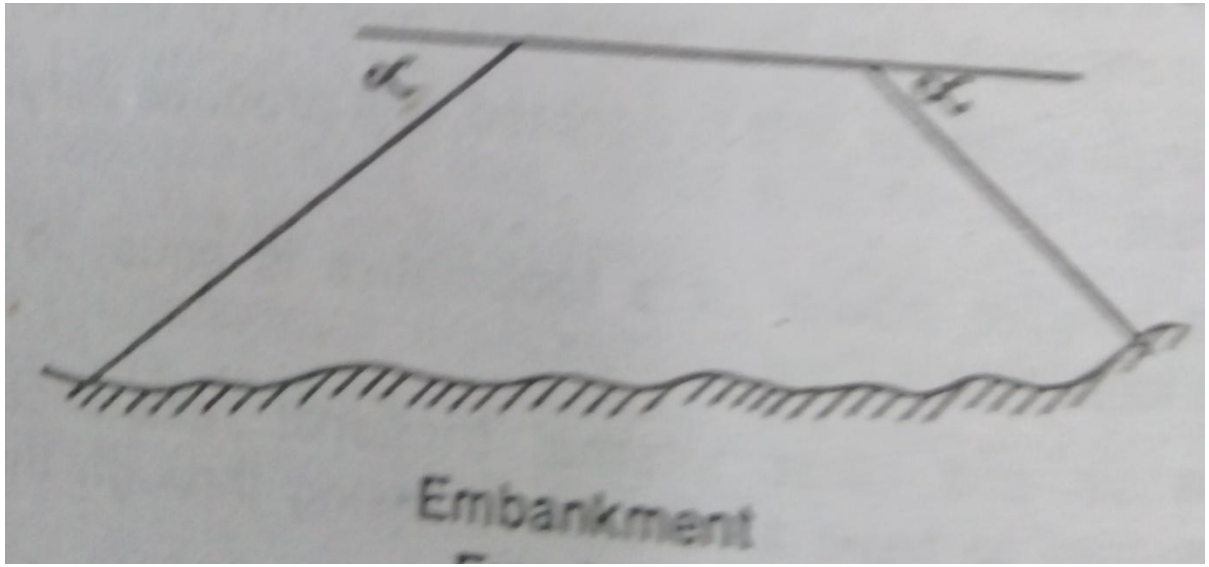
RAILWAY CONSTRUCTION AND MAINTENANCE

EARTHWORK

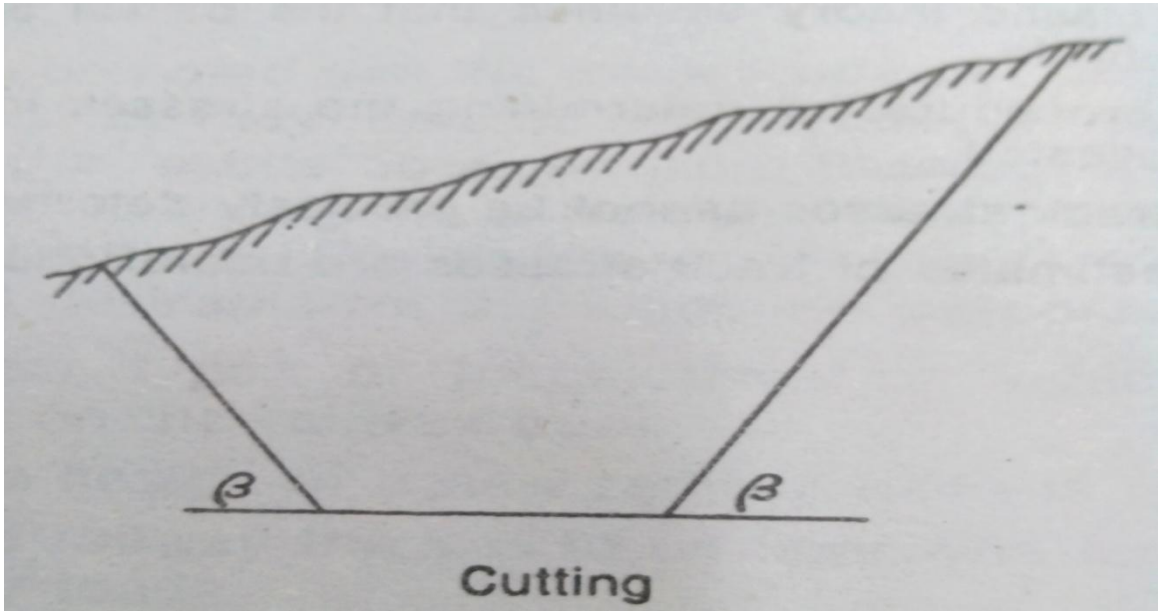
Usual forms of cross-sections:

- The naturally occurring soil is known as the subgrade and when it is prepared to receive the ballast and track, it is called the **formation**.
- When the formation is raised on bank of earth, it is called an **embankment**.



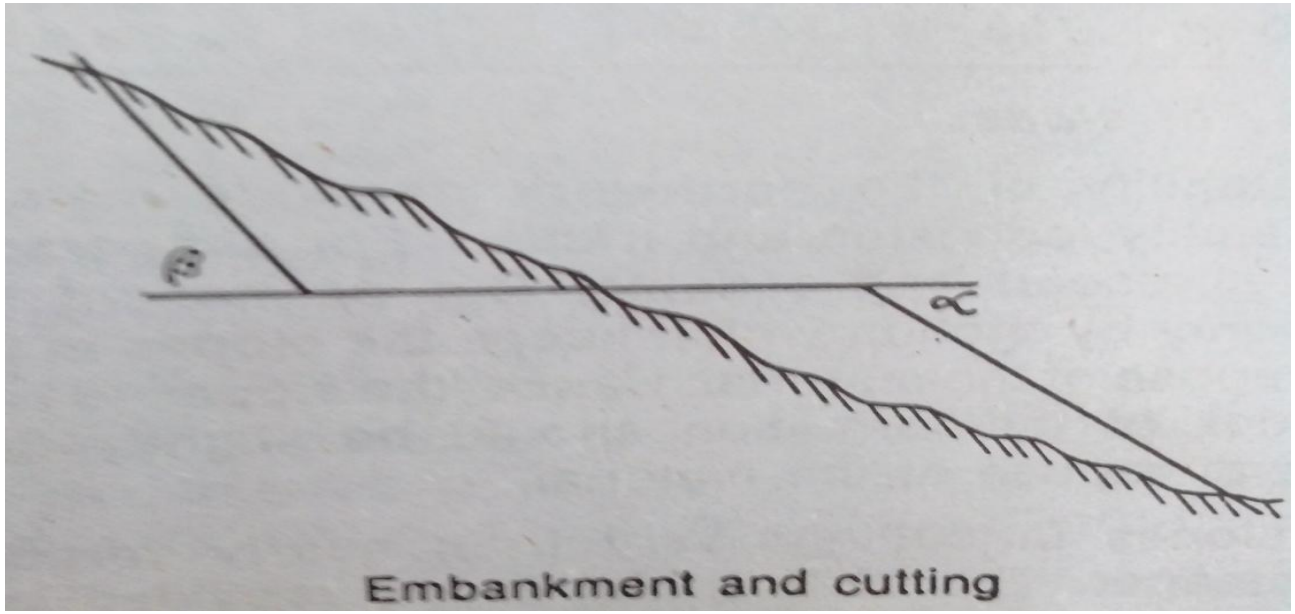
EARTHWORK

- *When it is made after cutting the ground below ground level, it is called in **cutting**.*
- *In case of cutting, the line is laid below ground level and hence, the required portion is to be excavated.*



EARTHWORK

- *A railway line may be constructed either in embankment or in cutting or in a **combined section.***
- *It should be noted that angles **α** and **β** are not necessarily the same.*



Embankment and cutting

EARTHWORK

Features of railroad bed level:

When the formation is to be made on embankment or cutting, various features should be carefully considered.

1. ***Width of formation:***
   - ✓ *The width of formation will depend on:*
     - *the number of tracks,*
     - *gauge of tracks,*
     - *centre to centre distance between the tracks,*
   - ✓ *Width of ballast layer*
   - ✓ *Width of trenches to drain off water, if necessary.*

- **Minimum width of embankment**

	Single	Double
For B.G :	610cm	1082cm
For M.G :	488cm	884cm
For N.G :	370cm	732cm

- **Minimum width of cutting**

	Single	Double
For B.G :	549cm	1021cm
For M.G :	427cm	827cm
For N.G :	335cm	701cm

EARTHWORK

2. *Slopes of sides:*

- *The stability of the earthwork depends mainly on two factors, namely,* ***cohesion*** *and* ***friction****.*
- *For* ***temporary stability****,* ***cohesion*** *is useful and reliable,*
- *But* ***permanent stability*** *is achieved only by* ***friction*** *which keeps the slopes at the natural angle of repose of the material.*
- *The slopes to be provided to the sides of the formation should be slightly flatter than the angle of repose of the material.*

EARTHWORK

- *The slopes in cuttings vary from nearly vertical to **1.5 to 1** or steeper.*

3. ***Drains:***

- *The accumulation of water reduces the friction in all sorts of soils.*
- *In case of embankments, the rain water is easily drained off. But in case of cuttings, drains are to be provided.*
- *The side drains are constructed along the track at a depth of about 1200 mm from the rail level.*

Stabilization of track on poor soil:

Following are four usual methods of stabilization of track on poor soil:

i. ***Layer of moorum***

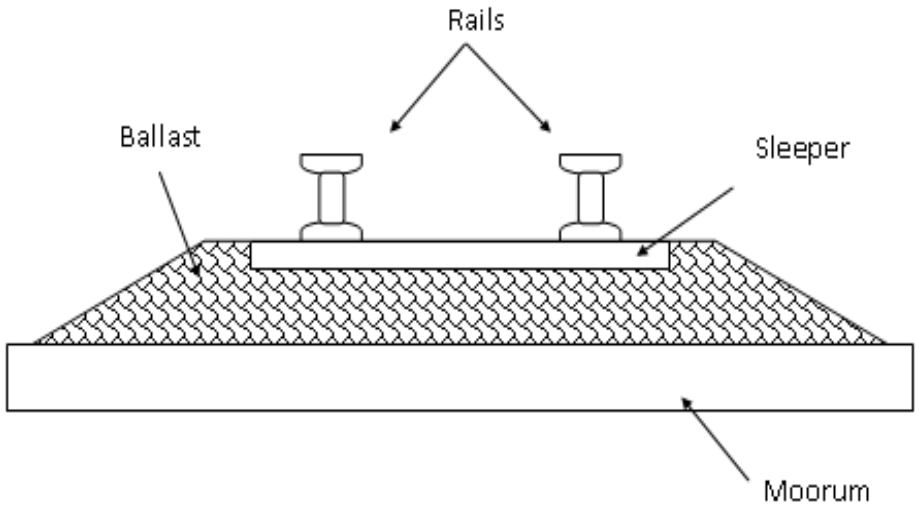
ii. ***Cement grouting***

iii. ***Sand piles***

iv. ***Use of chemicals***

Layer Of Moorum:

- *In very poor soil such as black cotton soil which swells and shrinks considerably by contact with moisture and by the loss of moisture to the extent of 20% to 30% of its volume, a layer of moorum is provided under the ballast, as shown:*

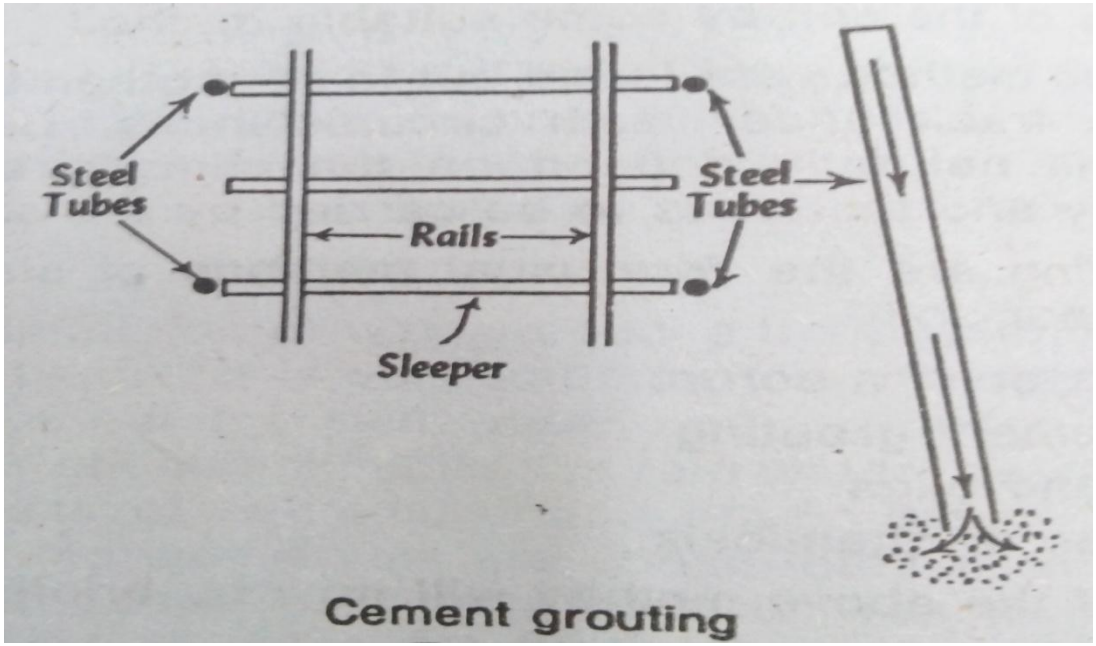


Layer Of Moorum:

- *The thickness of this layer varies from 300 mm to 600 mm.*
- *This layer distributes the pressure and it also prevents the ballast from being lost in the cracks of the soil.*
- *Instead of moorum, ashes, rubble, slabs of concrete, unserviceable sleepers, etc. are also used and they are found to be quite satisfactory.*

ii. Cement Grouting:

- *In this method, the steel tubes about 30 mm diameter are driven into the formation at every alternate sleeper.*
- *They are driven near the ends of the sleepers as shown:*



Cement Grouting:

- *The steel tubes are generally 150 cm long and driven at an angle so that the end of the tube is nearly under the rail.*
- *Then the cement grout is forced under a pressure of about 0.7 N/mm2 through these tubes.*
- *The cement grout spreads through the poor soil and consolidates it.*
- *The steel tubes are then gradually taken out.*

Cement Stabilization Cont.

(1)Normal Soil-Cement

- It consists of 5 to 14% of cement by volume.
- Cement is sufficient to produce a hard and durable material.
- Sufficient water be used for hydration requirement & workability
- It is weather resistant and strong and used for stabilizing sandy and other low plasticity soils.

(2) Plastic Soil-Cement

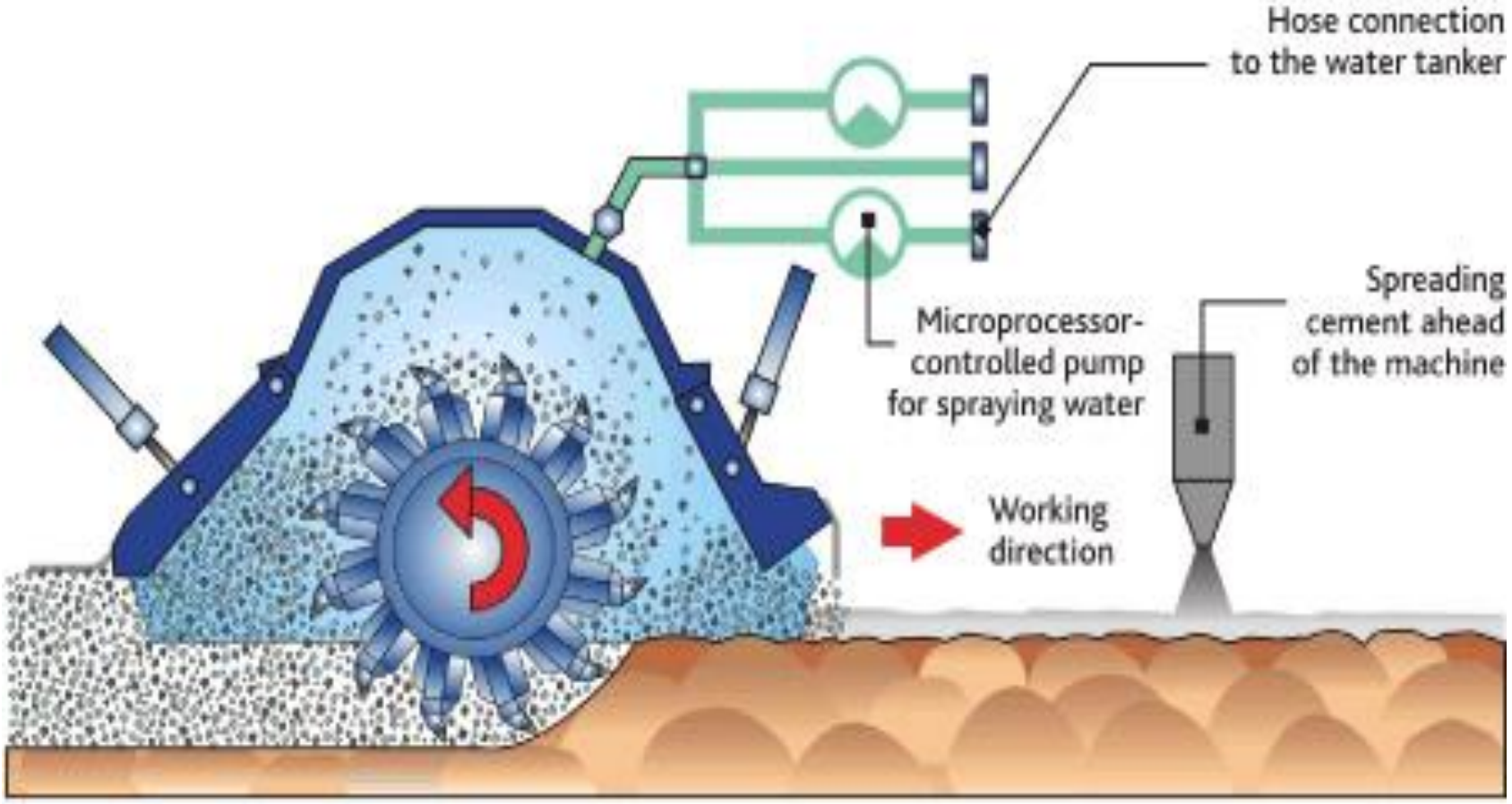
★It consists of 5 to 14% of cement by volume,

★It has more water to have wet consistency similar to that of plastering mortar at the time of placement.

★Used for water proof lining of canals and reservoirs

★Used for protection of steep slopes against water erosion.

Spreading cement ahead of the machine and metered injection of water

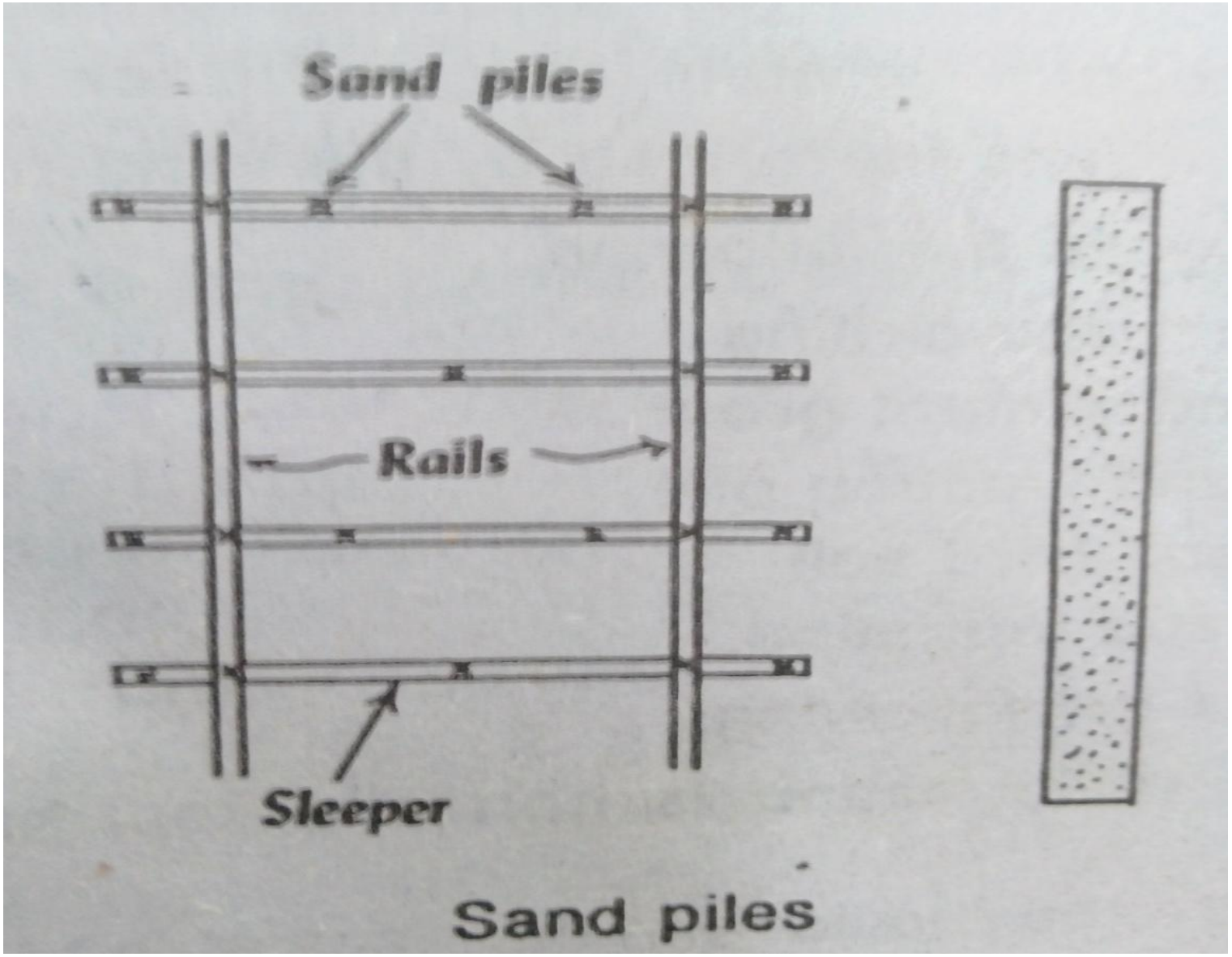



Soil stabilisation cement-GLORIT Step 2


25
D. OUTZWILLER
Soil stabilisation cement-GLORIT Step 3

iii. Sand Piles:

- *In this method, a vertical bore of about 300 mm diameter is made in the ground by driving wooden pile;*
- *The wooden pile is then withdrawn and the space is filled with sand and is well-rammed;*
- *The functions performed by the sand piles are as follows:*
  a. *They can function as timber piles.*
  b. *They provide an arrangement of vertical drainage.*
  c. *They provide good mechanical support.*


Sand piles
Rails
Sleeper
Sand piles

iv. Use Of Chemicals:

- *In this method, the chemicals are used in place of cement grout to consolidate the soil;*
- *The silicate of soda followed by calcium chloride is effective for sandy soils containing less than 25% clay and silt.*

Lime stabilization

- Lime stabilization is done by adding lime to soil. It is useful for the stabilization of clayey soil.
- When lime reacts with soil there is exchange of cations in the absorbed water layer and a decrease in the plasticity of the soil occurs.
- The resulting material is more friable than the original clay, and is, therefore more suitable as sub-grade

Track Drainage:-

Drainage of a track, Station Yards and platforms are the three places Where Drainage arrangements are needed. Track Drainage Comprises of Interception, Collection and disposal of from the track. This is done by adopting proper Surface and Subsurface Drainage System

Types of track Drainage

Surface Drainage

Surface Water due to rain or Snow or Flow From Adjacent areas have to be Disposed of Through Surface Drainage. Surface Drainage has to be attended to in three locations. Drainage in mid- Section Between railway Stations

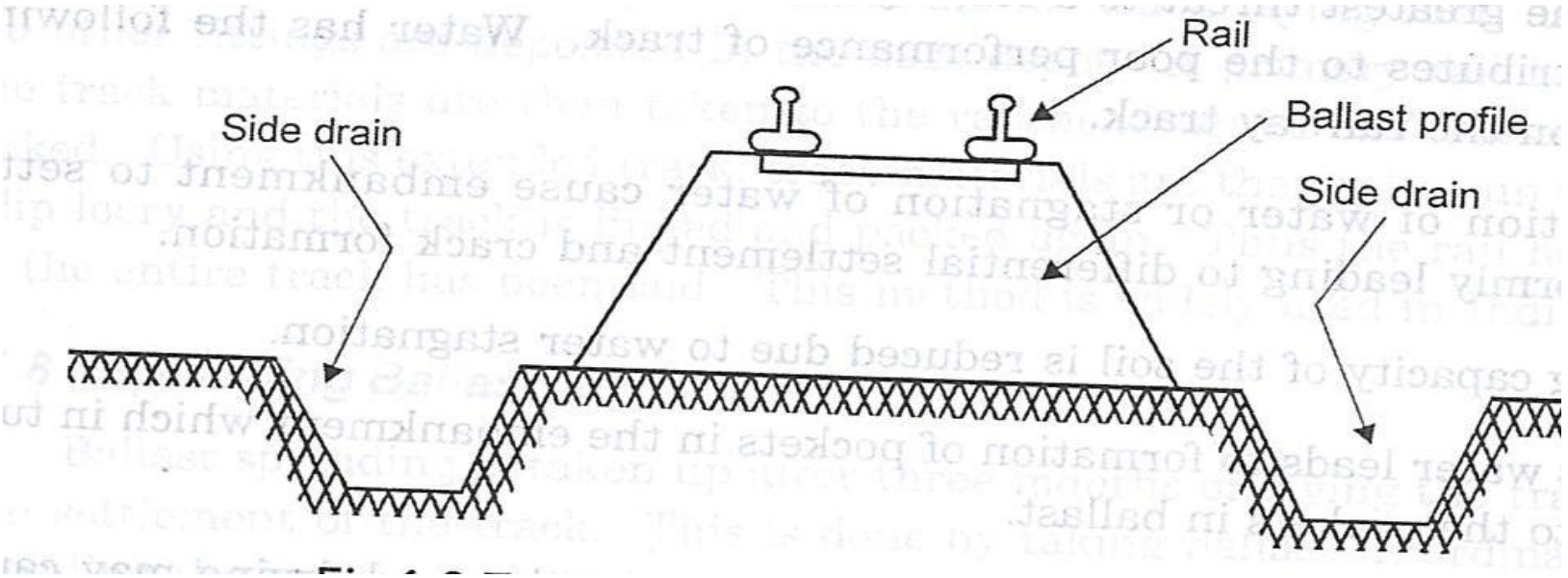
1.Drainage in mid-section

2.Drainage in Station Yards

3.Drainage at Station Platforms

1.Drainage in mid-section

- A typical arrangement of cross Section of a mid-section. Side Drains may be unlined or lined. At a level Crossing all water should flow to the side Drains. In cutting catch water Drains Have Been Provided Wherever Necessary. All Extra Ballast on the Side Should be Recovered Which Encourage Growth of the vegetation.



2.Drainage in Station Yards

❖Open Surface Drains-Shaped Drains, Longitudinal Drains and Open Drainage are Provided to Free Station Yard From Water .

❖A typical surface drainage system with open Drains for a Station Yard .Every Station Yard is Provided with a network of Cross and Longitudinal Drains.

❖In Station Yard the vulnerable points are water columns and carriage watering points with washing Hydrants.

3.Drainage at Station Platforms

For Drainage of Station Platforms the following Points Should be Taken into account

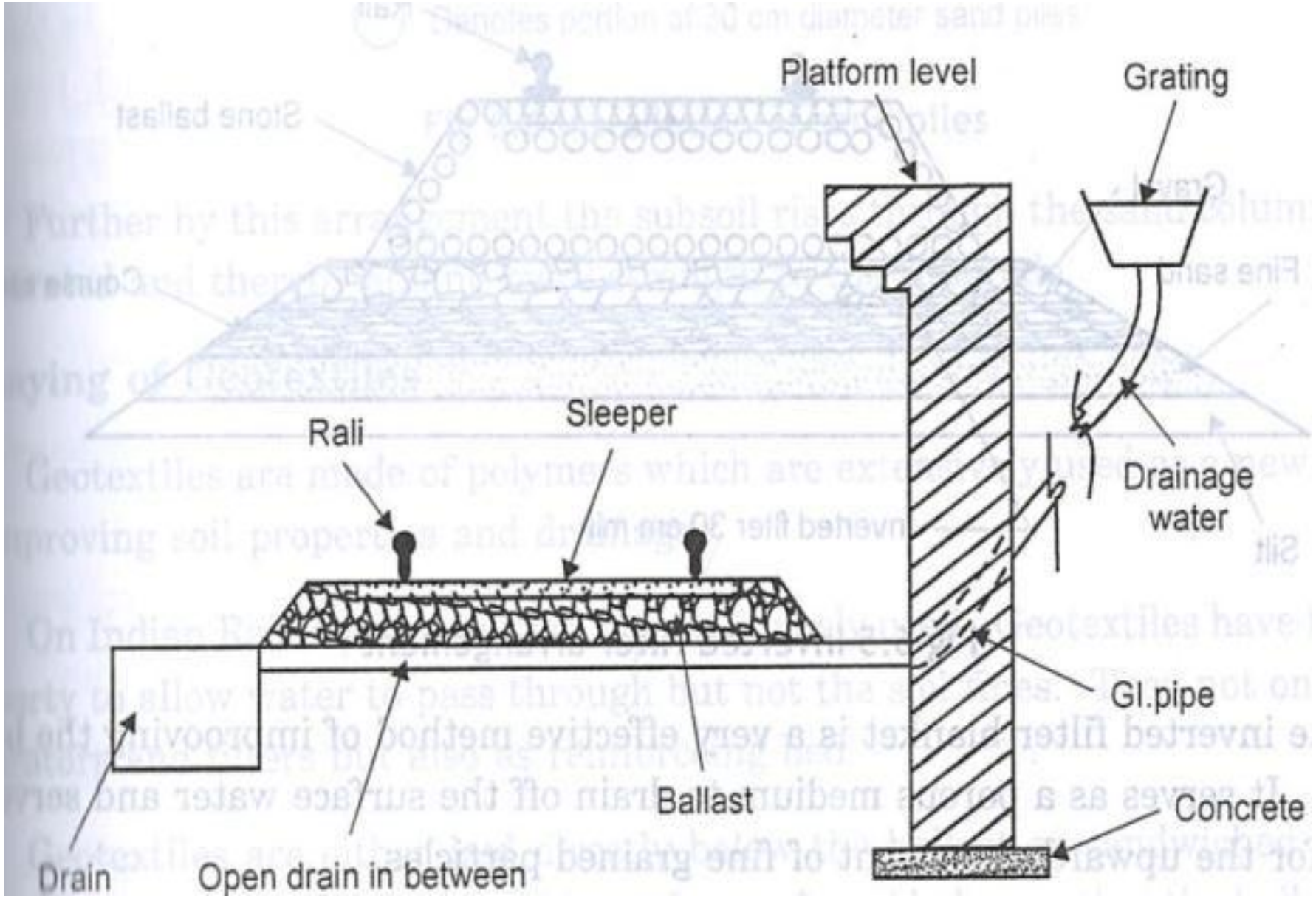
1.Slopes away From the track

2. Discharge on non-Track Side

3. Discharge not towards Ruin-through lines

•In general all end of platforms should be sloped away From the Track. all other Discharges Form tea Stalls, Toilets, Water taps. If there is need be , covered longitudinal Drains Should Be Provided

•Incase of island platforms, all Drains Should discharge on the less important side of the track


Platform level
Grating
Rali
Sleeper
Drainage water
Gl.pipe
Ballast
Concrete
Drain
Open drain in between

2.Sub-Surface Drainage

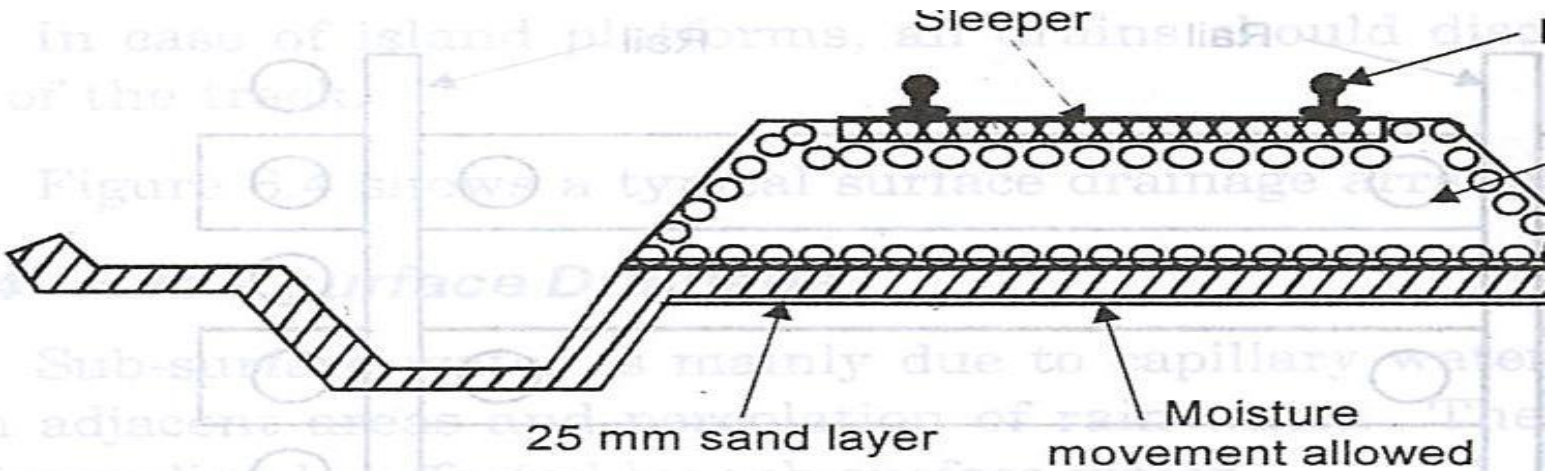
- Sub-surface water is due to the capillary water. Other sources are seepage from adjacent areas percolation of rain water. The sub grade and the formation are immediately affected by the Sub-Surface irrigation

- **1. Provision of an inverted fillers**
- **2. Sand piling**
- **3. Laying of Geotextiles**
- **4. Other Methods**

Provision of an inverted fillers

An inverted filter blanket of adequate thickness is provided between the ballast and the week formation. The Blanket is of non-Cohesive material with enough bearing capacity to sustain the load thereon

The inverted fillers Blanket is a very effective method of improving the bearing capacity. It serves as a porous medium to drain off the Surface Water and Serves as a barriers for the upward movement of fine Grained particles.



Laying of Geotextiles

- Geotextiles are made of polymers which are Extensively as a new Technique in improving the Soil Properties and Drainage
- On Indian railways Geotextiles are Extensively used. Geotextiles are having the unique property to allow water to pass through but not the soil fines. They not only Work as separate and filters But also as reinforcement bed
- Geotextiles are either laid directly below the ballast or sandwich between a 50mm layer of sand on top and a 25mm layer sand below so that the ballast directly does not rest on Geotextiles . and thereby preventing tear and puncture of textiles

4. Other Methods

- All other methods Which are used to for Soil Stabilization may be used to arrest Sub-Soil water. Cement Grouting , Chemical Grouting

Tunnelling Methods

TUNNEL DESCRIPTION

- A tunnel can be defined as an underground passage for the transport of passengers, goods, water, sewage, oil, gas, etc. The construction of a tunnel is normally carried out without causing much disturbance to the ground surface. Made into natural material (rocks)

1. Empty inside
2. Carry the loads itself
3. Both ends are open to atmosphere
4. Generally horizontal
5. Thick walled structure looks like cylinder

The choice of tunnelling method may be dictated by:

- geological and hydrological conditions,
- cross-section and length of continuous tunnel,
- local experience and time/cost considerations (what is the value of time in the project),
- limits of surface disturbance, and many others factors.

TUNNEL CONSTRUCTION METHODS:

- Classical methods
- Mechanical drilling/cutting
- Cut-and-cover
- Drill and blast.

Methods of Tunneling

The selection of a method depends upon the size of the bore, the condition of the ground, the equipment available, and the extent to which timbering is required.

Tunneling may be basically divided into two main groups.

(a) Tunneling in hard rocks

(b) Tunneling in soft rocks

The following methods are generally employed for tunneling in hard rocks:

Full face method:

- The full face method is normally selected for small tunnels whose dimensions do not exceed 3 m. In this method, the full face or the entire facade of the tunnel is tackled at the same time.

- Vertical columns are erected at the face of the tunnel and a large number of drills mounted or fixed on these columns at a suitable height.

- A series of holes measuring 10 mm to 40 mm in diameter with about 1200 mm centre-to-centre distance are then drilled into the rock, preferably in two rows. These holes are charged with explosives and ignited.

Full face method

Full face method

Heading and bench method

• In this method, the heading (top or upper half) of the tunnel is bored first and then the bench (bottom or lower half) follows. The heading portion lies about 3.70 m to 4.60 m ahead of the bench portion.

• In hard rock, the drill holes for the bench are driven at the same time as the removal of the muck. The hard rock permits the roof to stay in place without supports.

Advantages

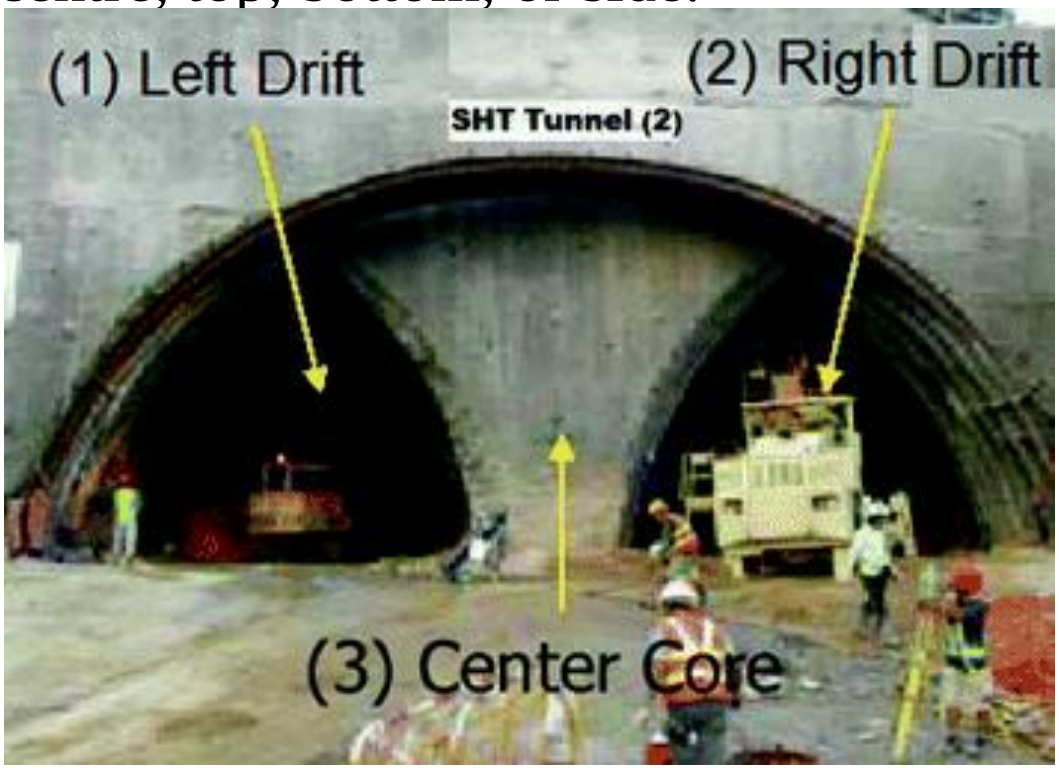
The work of drilling of holes for the explosives and the removal of muck can progress simultaneously.

Heading and bench method

Drift method

•A drift is a small tunnel measuring 3 m × 3 m, which is driven into the rock and whole section is widened in subsequent processes till it equates that of the tunnel.

•The position of the drift depends upon local conditions; it may be in the centre, top, bottom, or side.

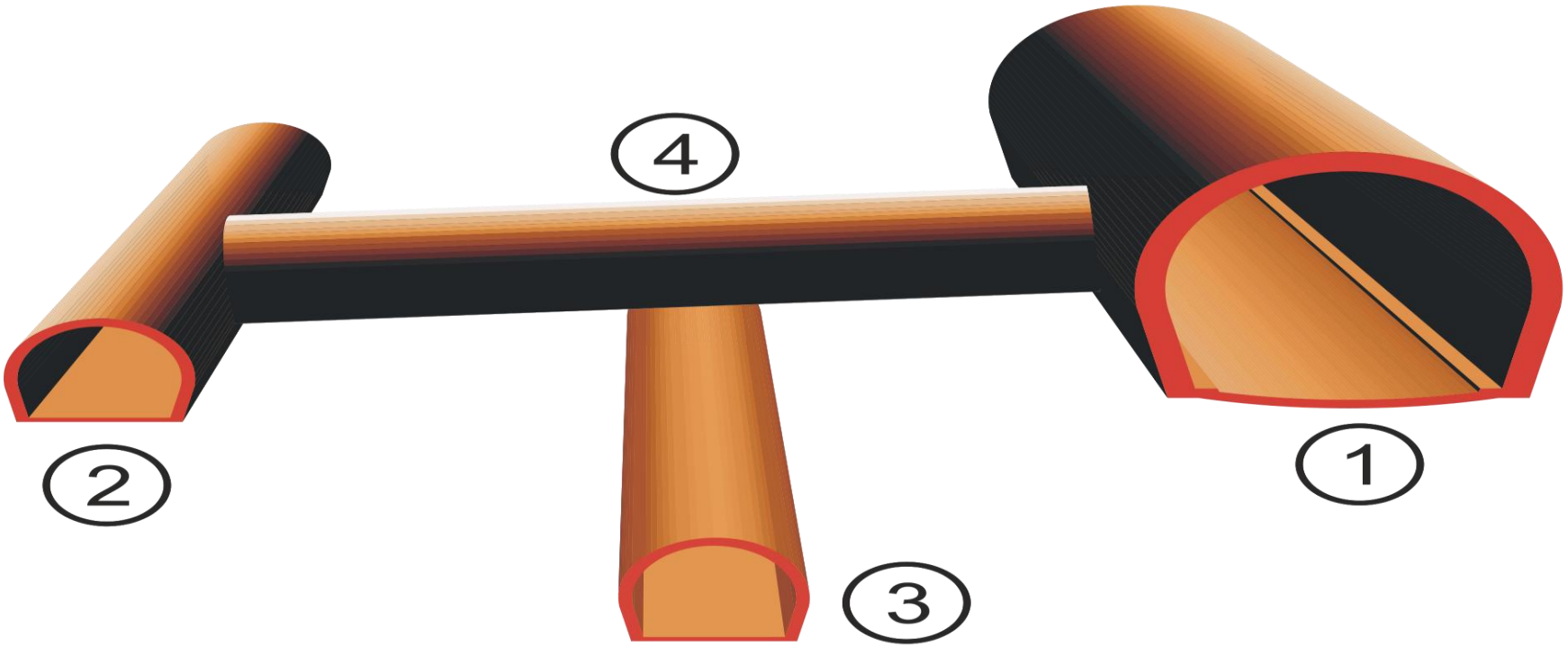


Pilot tunnel method

- The pilot tunnel is driven parallel to the main tunnel and connected to the centre line of the main tunnel with cross cuts at many points. The main tunnel is then excavated from a number of points.
- The cross section of the pilot tunnel usually measures about 2.4 m × 2.4 m.
- The pilot tunnel offers the following advantages.

(a) It helps in removing the muck from the main tunnel quickly.

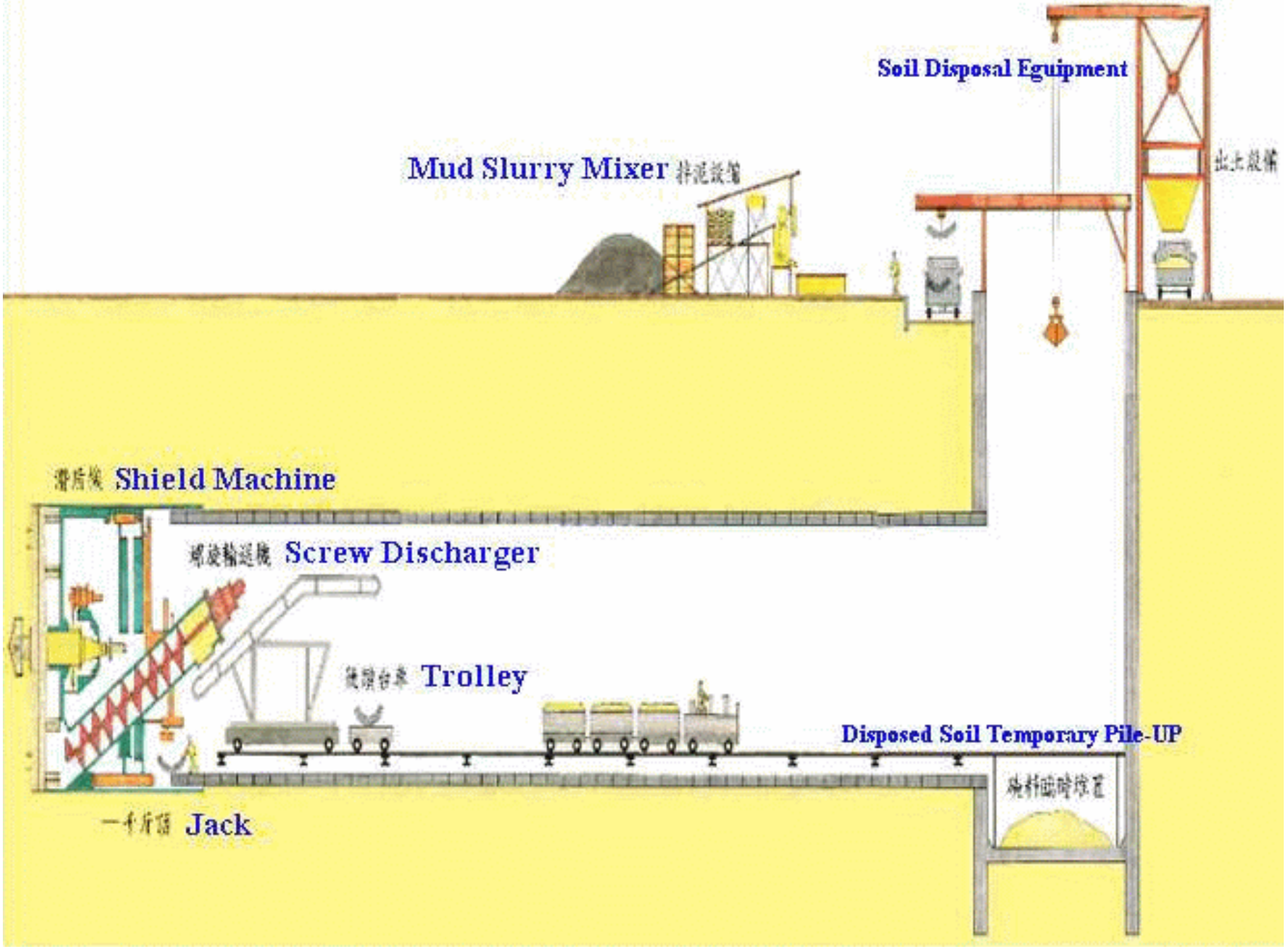
(b) It helps in providing proper ventilation and lighting in the main tunnel.

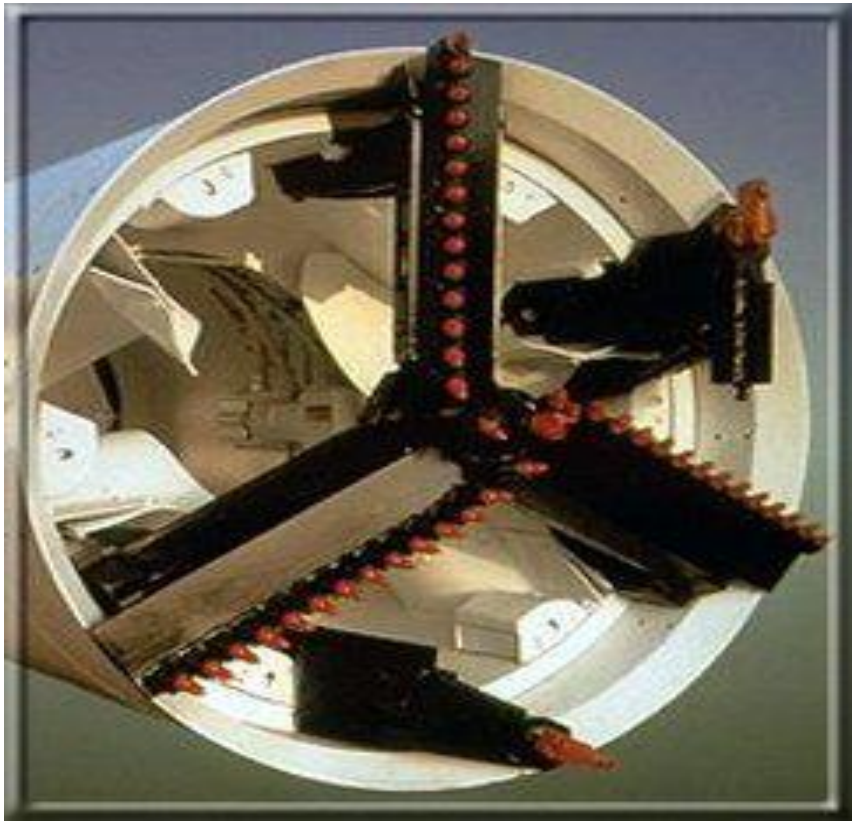


Pilot tunnel method

SHIELD TUNNELING METHOD

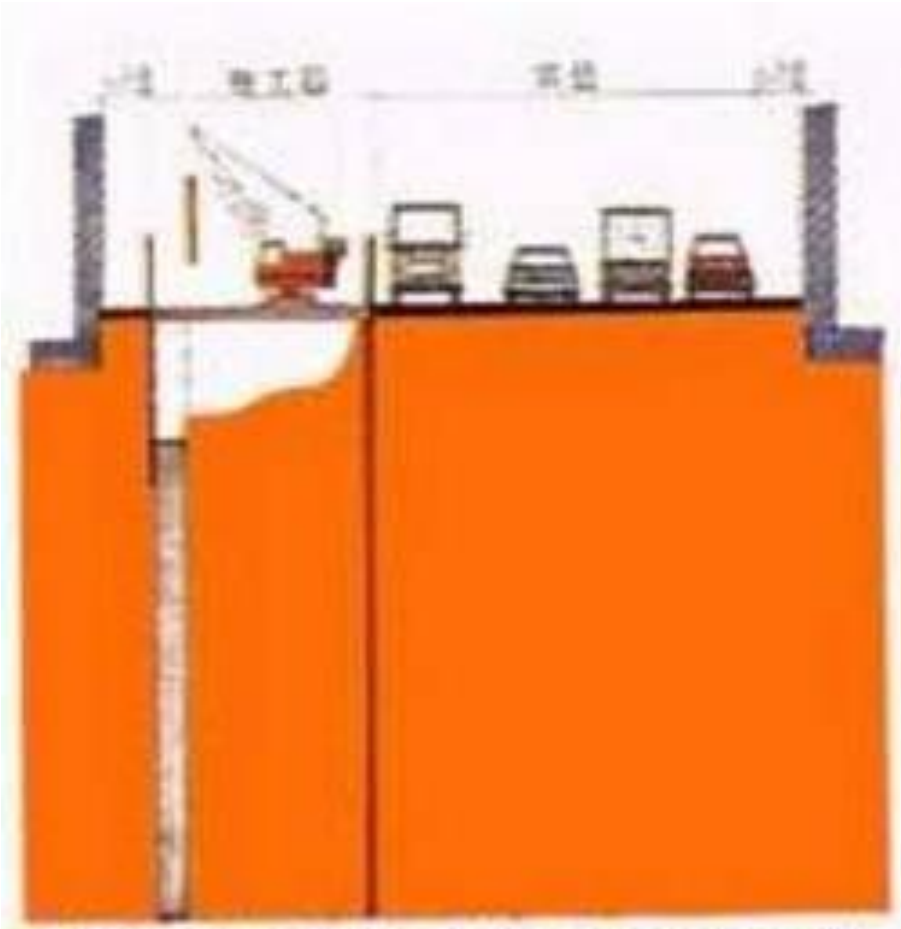
- This method involves the use of shield machine to drive the tunnels below the ground.
- After completion of a work shaft, the shield machine is lowered into the shaft and assembled there before excavation and construction of the tunnels using precast concrete lining segments of about 1.2 meter width.
- This construction method causes minimal disruption to traffic and the environment because all the work takes place below ground and the ground level environment is unaffected.


Soil Disposal Eguipment
Mud Slurry Mixer
Shield Machine
Screw Discharger
Trolley
Disposed Soil Temporary Pile-UP
Jack

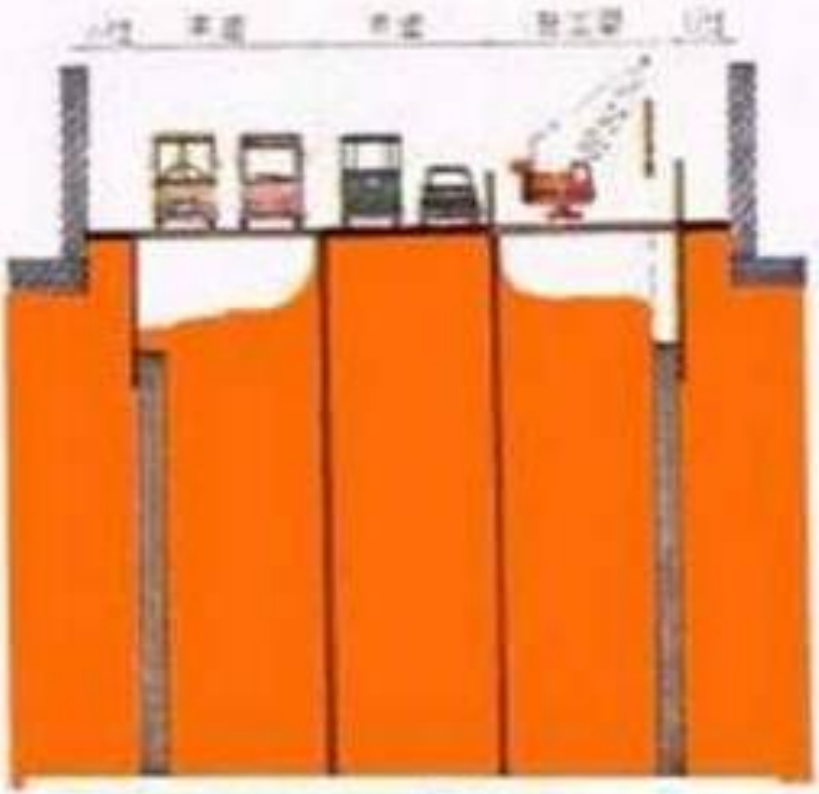


CUT and COVER TUNNELLING METHOD

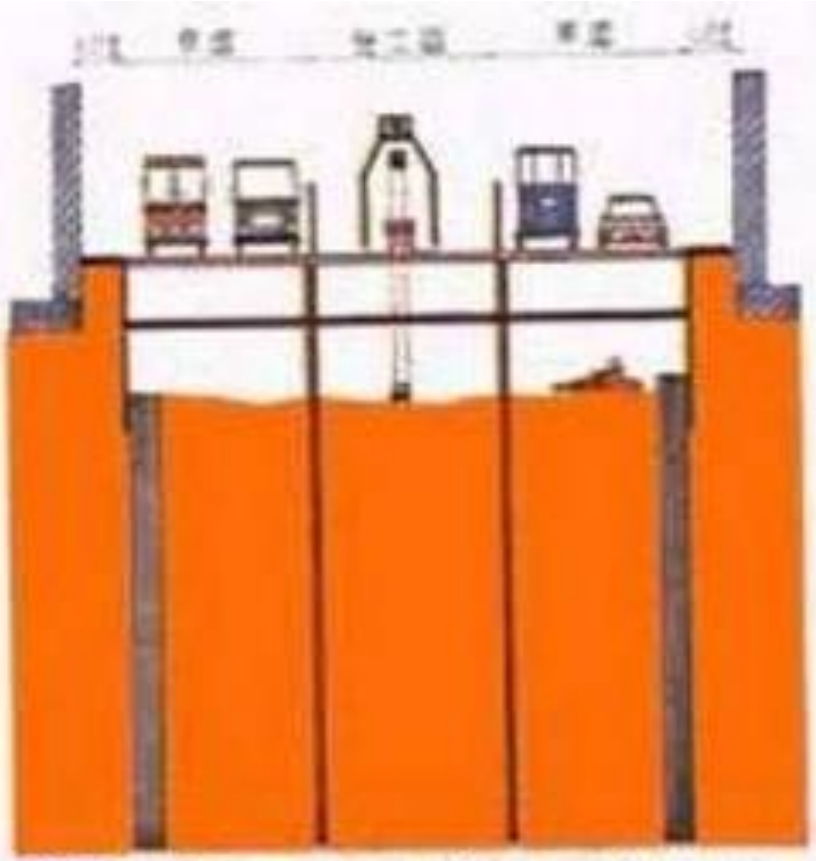
- This construction method, whereby the site is fully excavated, the structure built and then covered over, uses diaphragm walls as temporary retaining walls within the site area.
- *Step one :*Construction of diaphragm walls, pin piles, and decking.
- *Step two :*Excavation within the diaphragm walls, installing struts as work progresses.
- *Step three :*Construction of permanent floor slabs and walls.
- *Step four :* Fitting out the internal structures, backfilling, and reinstating the surface structures.



1.Construction of diaphragm wall decking,and pin piles at left area



2.Construction of diaphragm wall decking,and pin piles at right area.



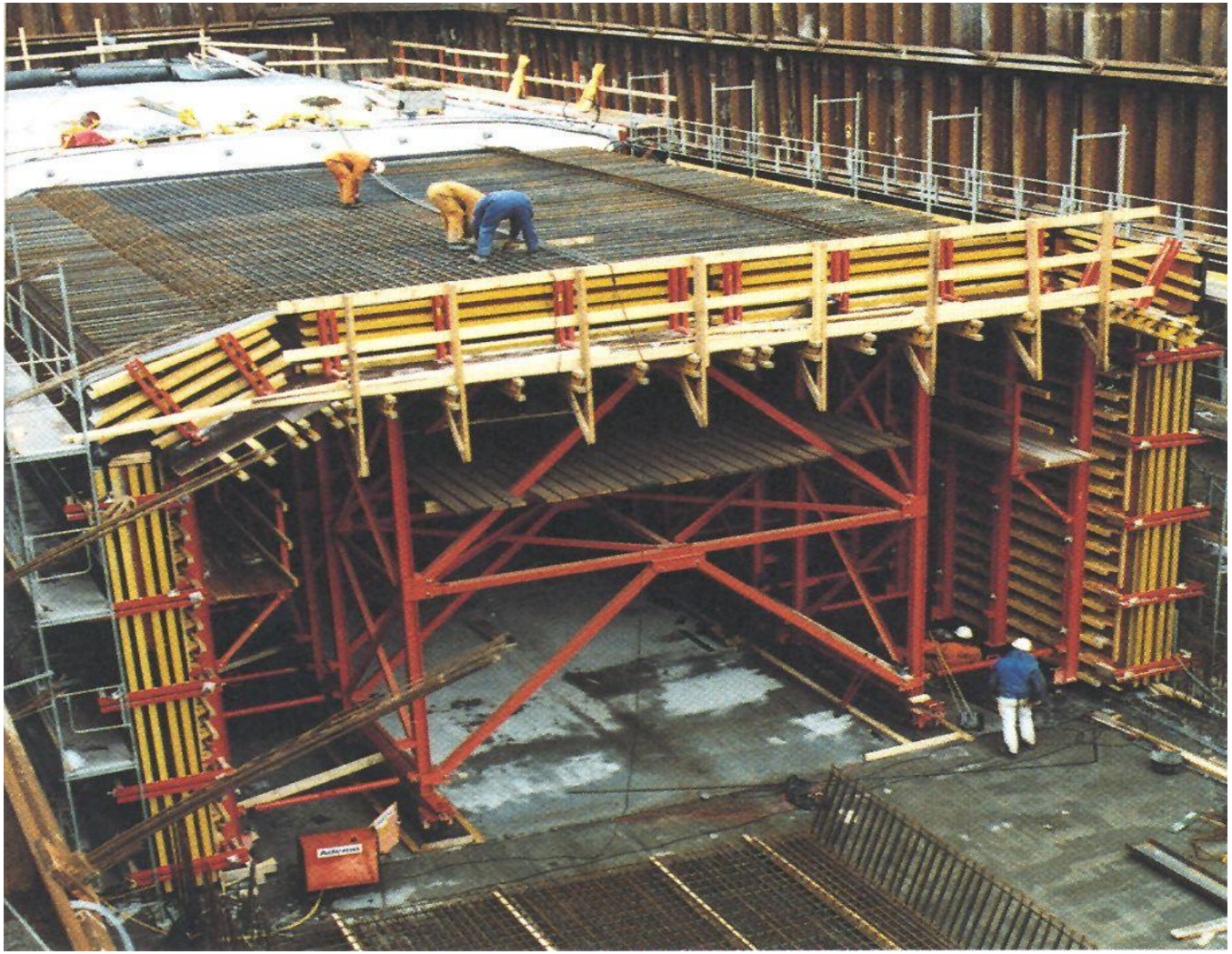
3.Decking,excavation,and strut installation at central area

4.Construction of main structure (down - up)

5.Pavement restoration in section

6.Completion of underground station

Cut and Cover Method



METHODS OF TUNNELING IN SOFT SOILS

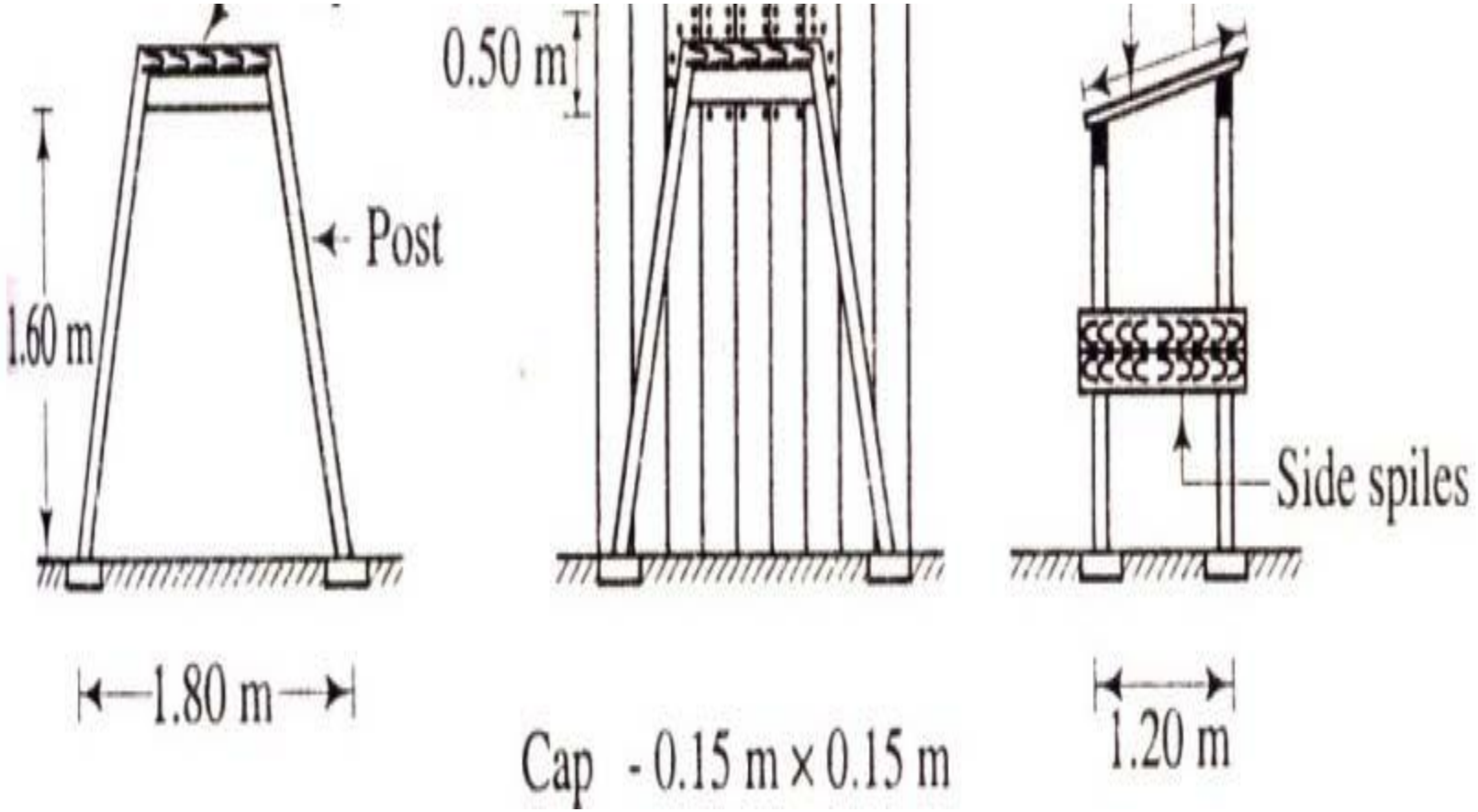
- Forepoling Method
- Needle Beam Method
- American Method
- English method
- Belgian Method
- German Method
- Austrian Method

Forepoling method

- Forepoling is an old method of tunnelling through soft ground. In this method, a frame is prepared in the shape of the letter A, placed near the face of the tunnel, and covered with suitable planks.

- Poles are then inserted at the top of the frame up to a viable depth. The excavation is carried out below these poles, which are supported by vertical posts.

- The excavation is carried out on the sides and the excavated portion is suitably supported by timber. The entire section of the tunnel is covered thus. The process is repeated as the work progresses.


0.50 m
Post
1.60 m
Side spiles
1.80 m
1.20 m
Cap - 0.15 m x 0.15 m

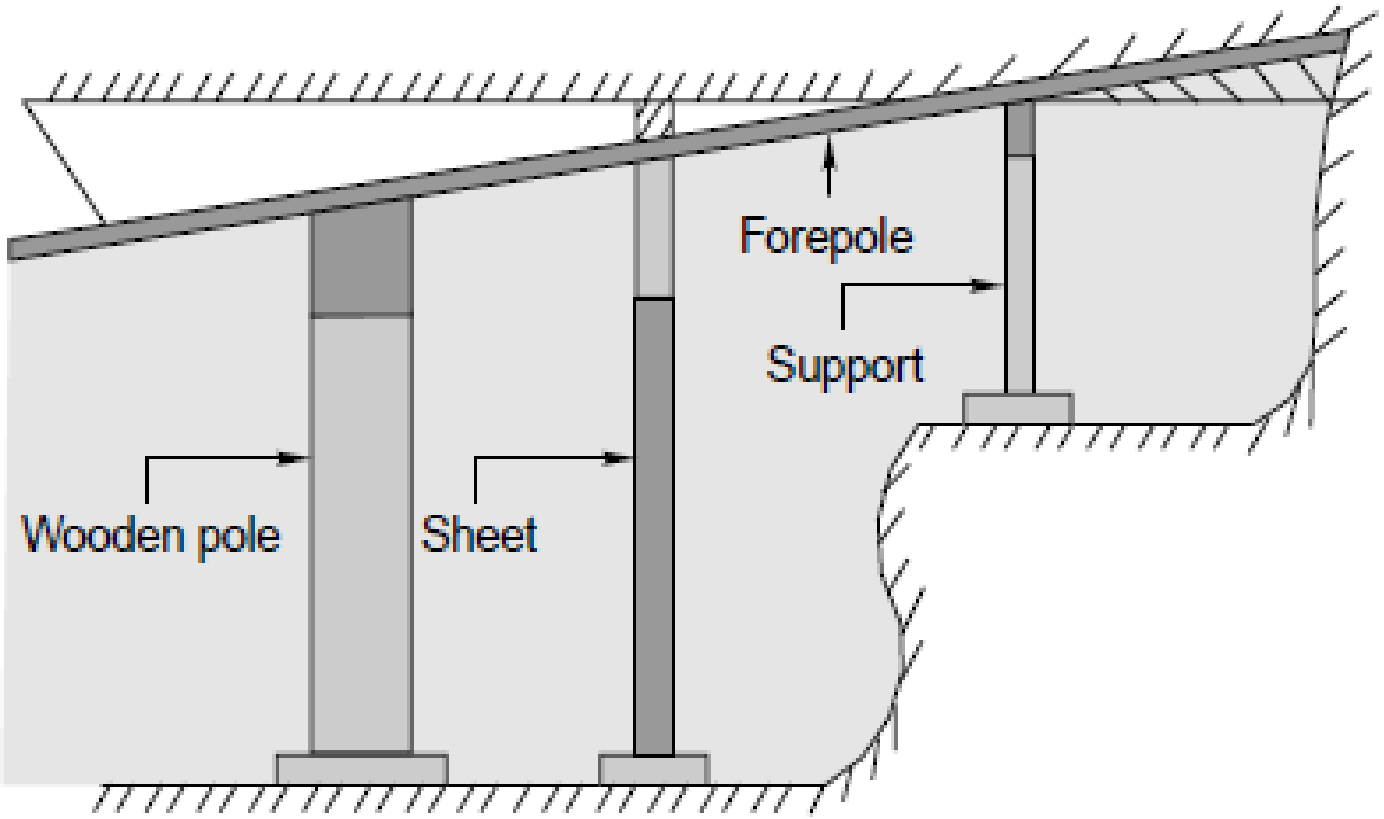


Fig. 30.6 Forepoling method

Linear plate method

In the linear plate method timber is replaced by standard size pressed steel plates. The use of pressed steel plates is a recent development.

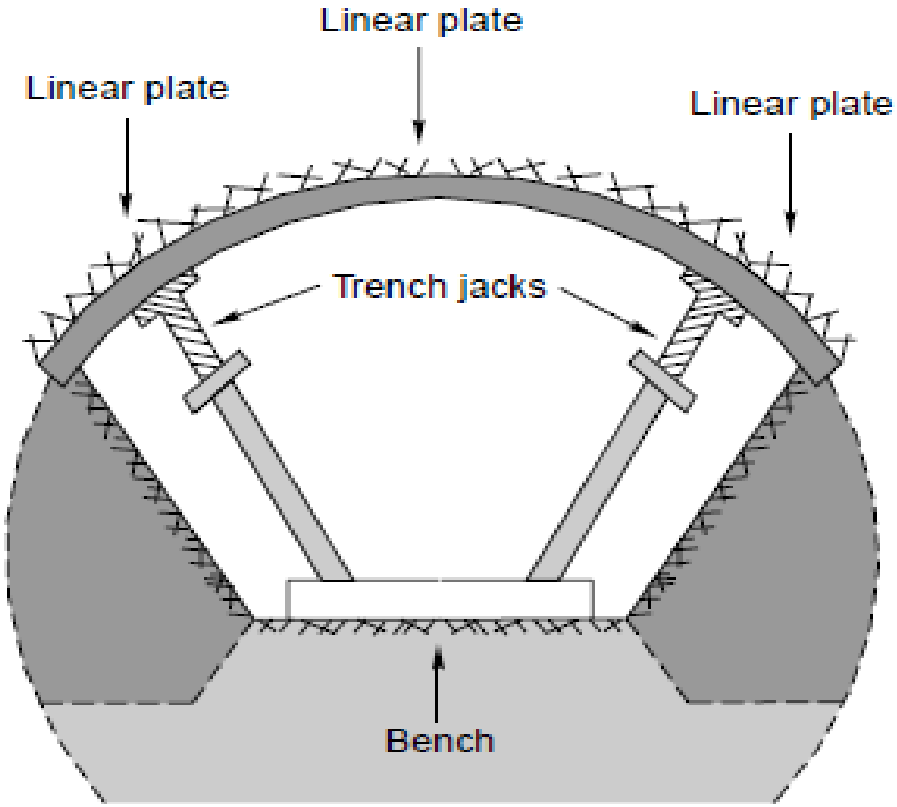


Fig. 30.7 Linear plate method

Needle beam method

- The needle beam method is adopted in terrains where the soil permits the roof of the tunnel section to stand without support for a few minutes.

- In this method, a small drift is prepared for inserting a needle beam consisting of two rail steel (RS) joists or I sections and is bolted together with a wooden block in the centre. The roof is supported on laggings carried on the wooden beam.

- The needle beam is placed horizontally with its front end supported on the drift and the rear end supported on a vertical post resting on the lining of the tunnel. This method of tunnelling is more economical compared to other methods.

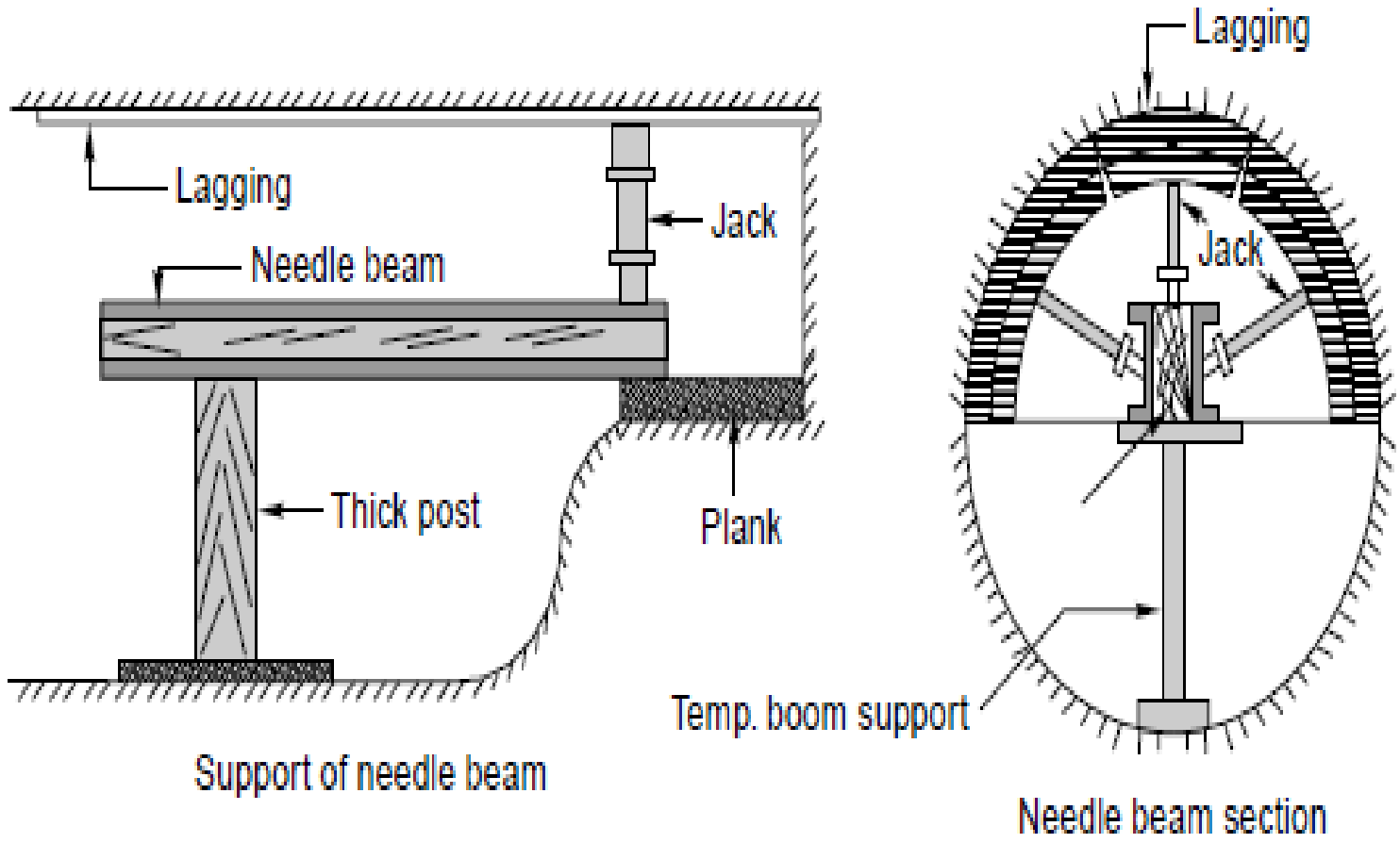


Fig. 30.8 Needle beam method

American method

➢In this method a drift is driven into the top of the tunnel. The drift is supported by laggings, caps, and two vertical posts. The sides of the drift are then widened and additional support is provided using timber planks and struts.

➢The process of widening is continued till it reaches the springing level. Wall plates are fixed at the springing level, which in turn are supported by vertical posts.

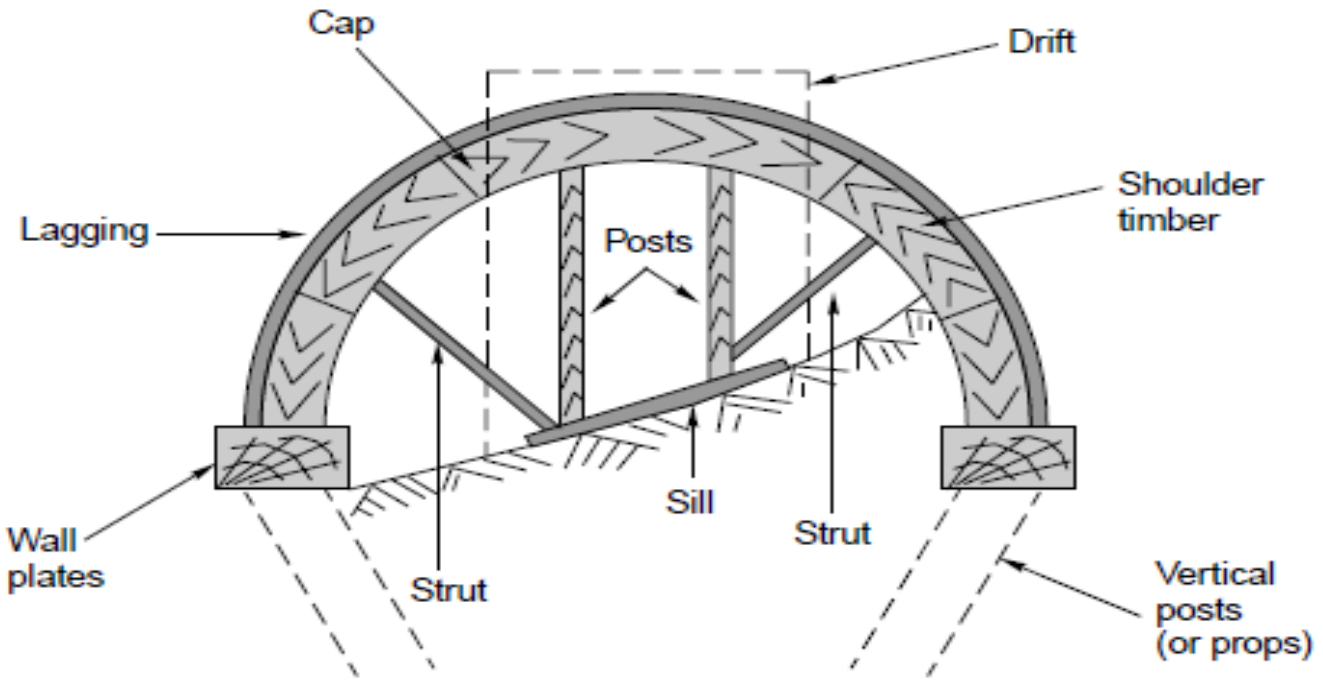
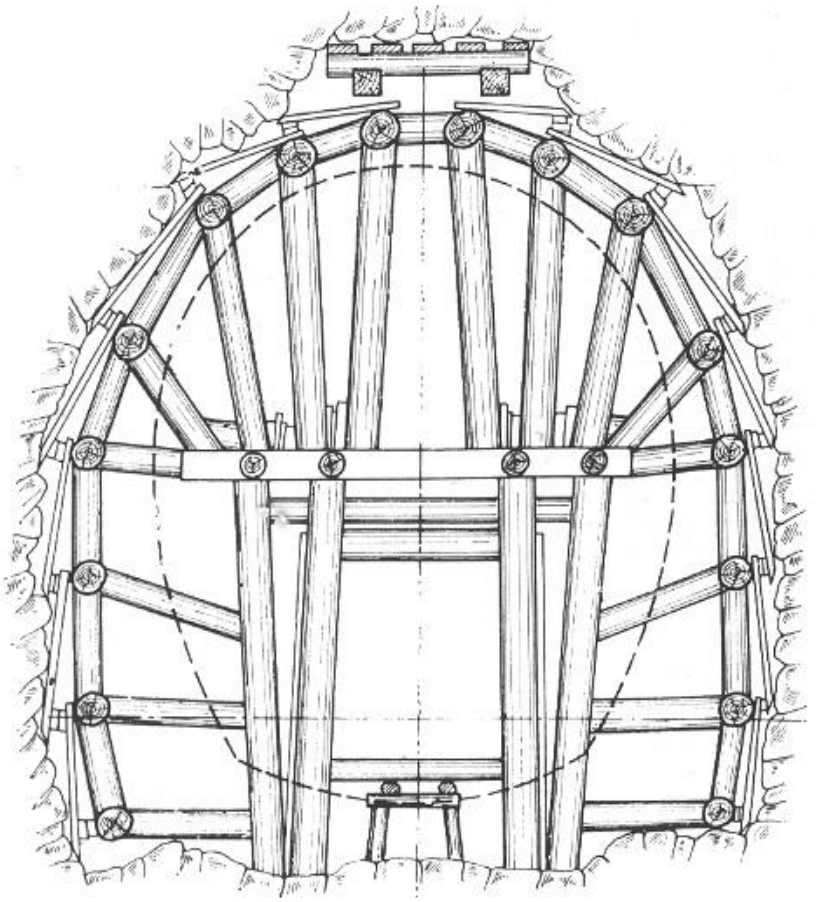


Fig. 30.9 American method

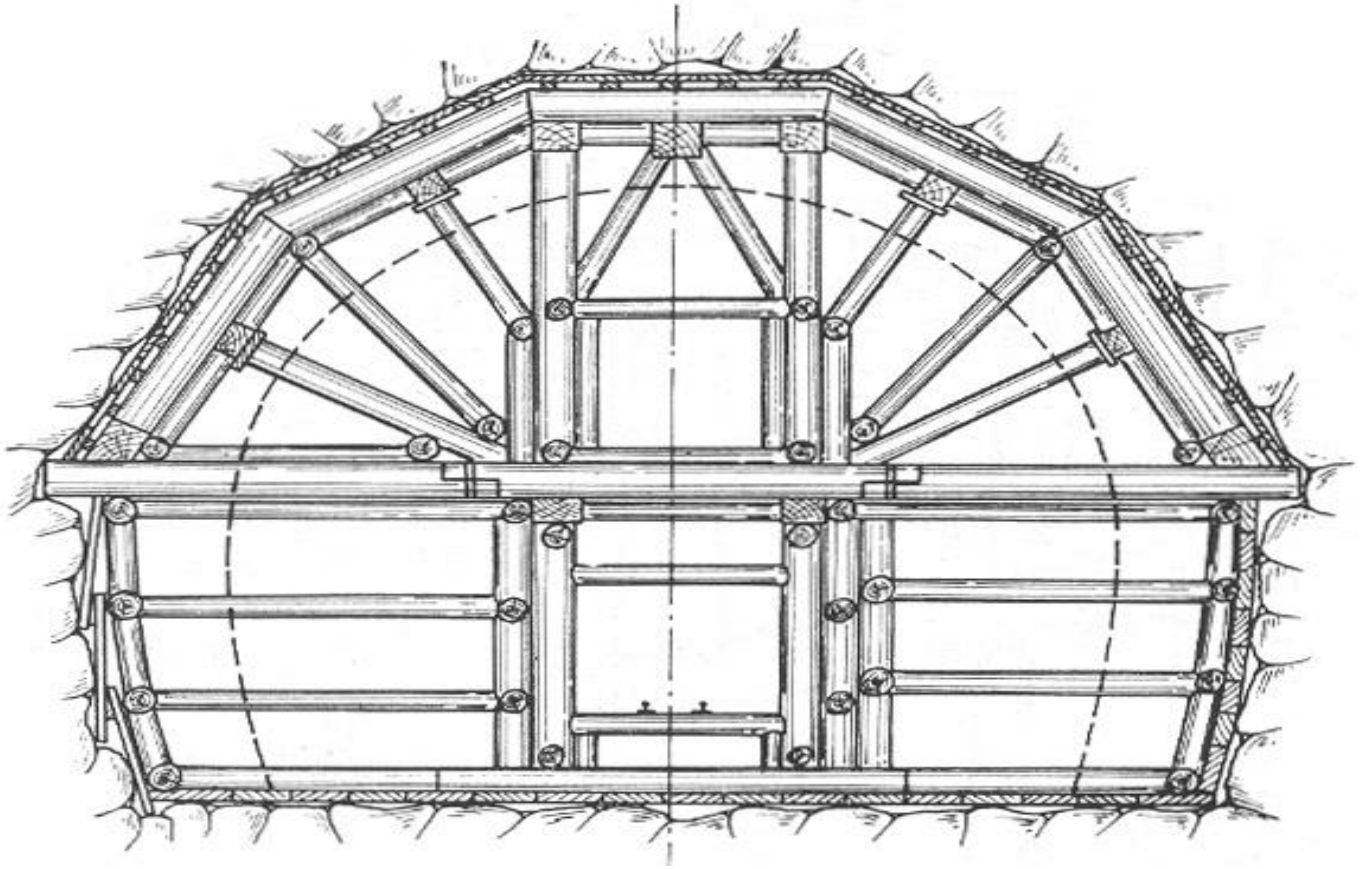
The English method

- **(crown-bar method, figure left)** started from a central top heading which allowed two timber crown bars to be hoisted into place, the rear ends supported on a completed length of lining, the forward ends propped within the central heading.
- Development of the heading then allowed additional bars to be erected around the perimeter of the face with boards between each pair to exclude the ground.



The Austrian (cross-bar) method

- Required a strongly constructed central bottom heading upon which a crown heading was constructed.
- The timbering for full-face excavation was then heavily braced against the central headings, with longitudinal poling boards built on timber bars carried on each frame of timbering.



Ventilation of Tunnels

A tunnel should be properly ventilated during as well as after the construction for the reasons.

(a) To provide fresh air to the workers during construction.

(b) To remove the dust created by drilling, blasting, and other tunnelling operations.

(c) To remove dynamite fumes and other objectionable gases produced by the use of dynamites and explosives.

Methods of Ventilation

- Natural method of ventilation
- Mechanical ventilation by blow-in method
- Mechanical ventilation by exhaust method
- Combination of blow-in and blow-out methods

Drainage of Tunnels

- The sources of water for this purpose include ground water and water collected from the washing of bore holes.

- Water seeping in up through the ground as well as from the washing of bore holes is collected in sump wells and pumped out. If the tunnel is long, a number of sump wells are provided for the collection of water.

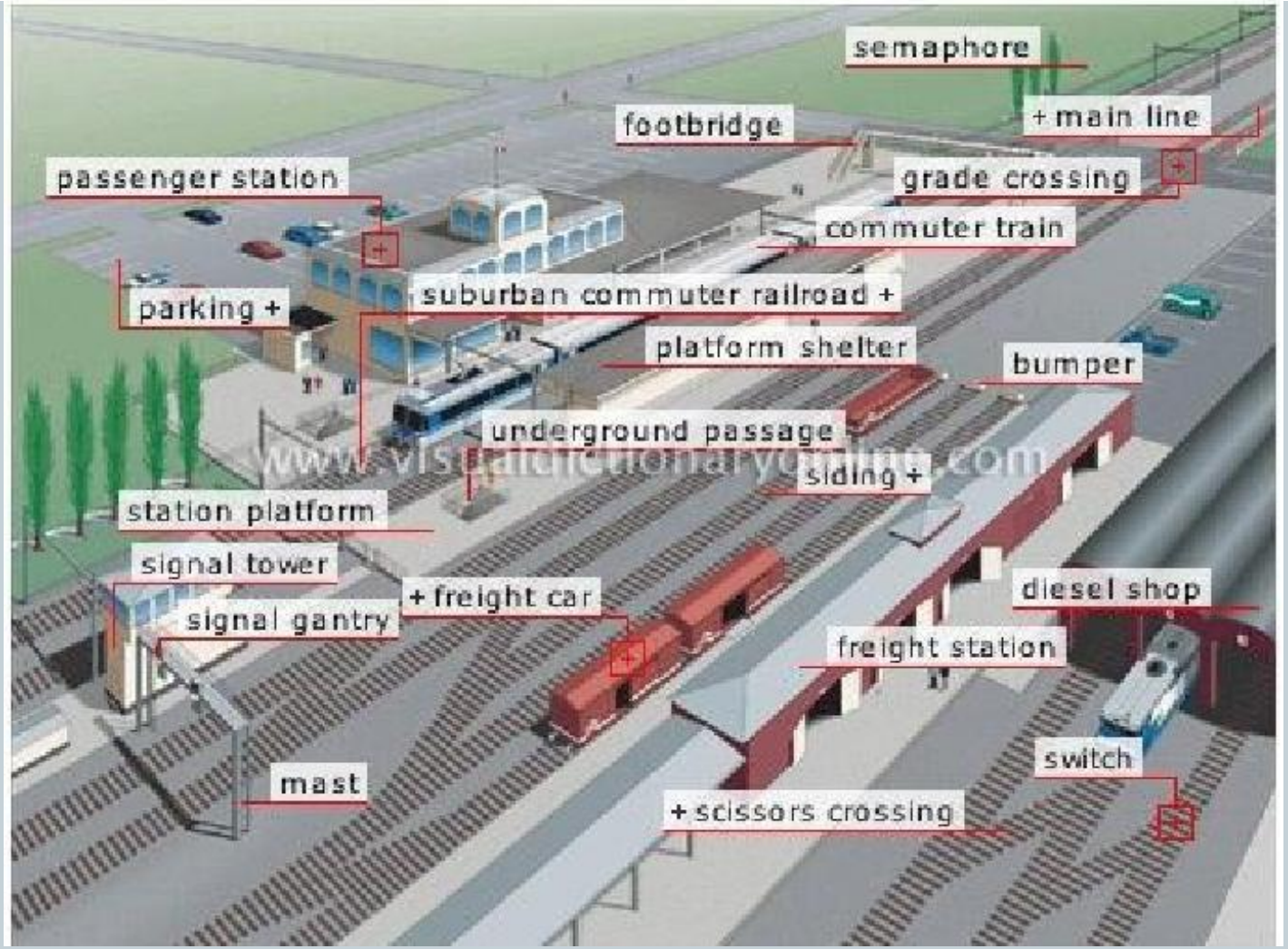
- After the construction is over, drainage ditches are provided along the length of the portion of the tunnel that slop from the portal towards the sump well and are used for pumping the water out.

Station and Yards

Definition of Station

- A railway station or a railroad station and often shortened to just station, is a railway facility where trains regularly stop to load or unload passengers and/or freight

Station and Yards



Purpose of Railway station

- For exchange of passengers and goods.
- For control of train movements
- To enable the trains on a single line track to cross from opposite directions.
- To enable the following express trains to overtake
- For taking diesel or coal and water for locomotives
- For detaching engines and running staff

Types of Stations

- Wayside Stations, Junction Stations, Terminal Stations

Wayside Stations

In this type arrangements are made for crossing or for overtaking trains.

Wayside stations are of the following types.

i.Halt stations,

ii.Flag Stations,

iii.Crossing stations

Halt Stations

- A **halt**, is a small station, usually unstaffed and with few or no facilities. In some cases, trains stop only on request, when passengers on the platform indicate that they wish to board, or passengers on the train inform the crew that they wish to alight.

Halt Stations

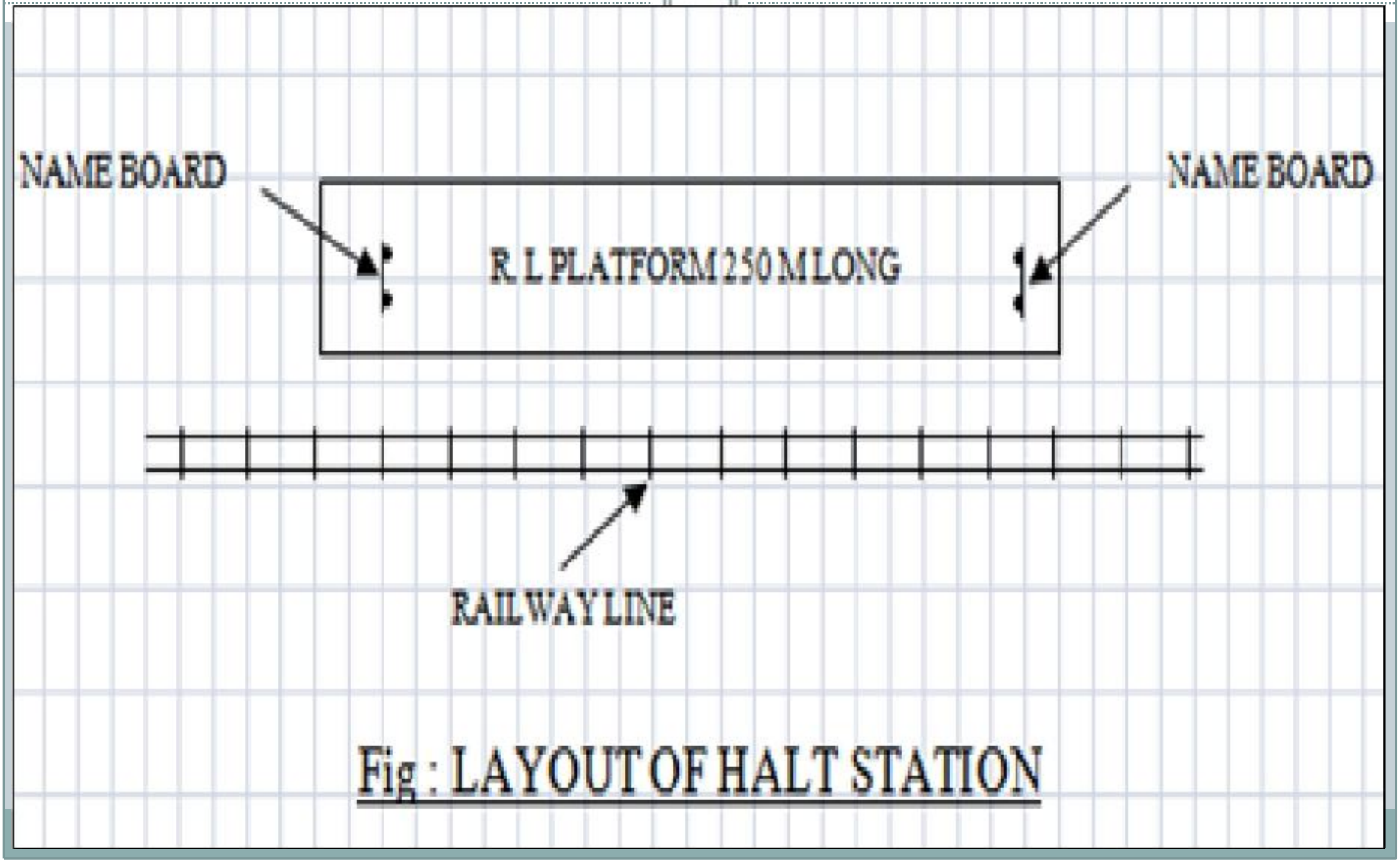


Fig : LAYOUT OF HALT STATION

Flag Stations

- **Flag stations** describes a stopping point at which trains stop only on an as-need or request basis; that is, only if there are passengers to be picked up or dropped off.
- These stations have no overtaking or crossing facilities and arrangements to control the movement of trains. These stations have buildings, staff and telegraph facilities.
- Some of the flag stations have sidings also in the form of loops.

Flag Stations

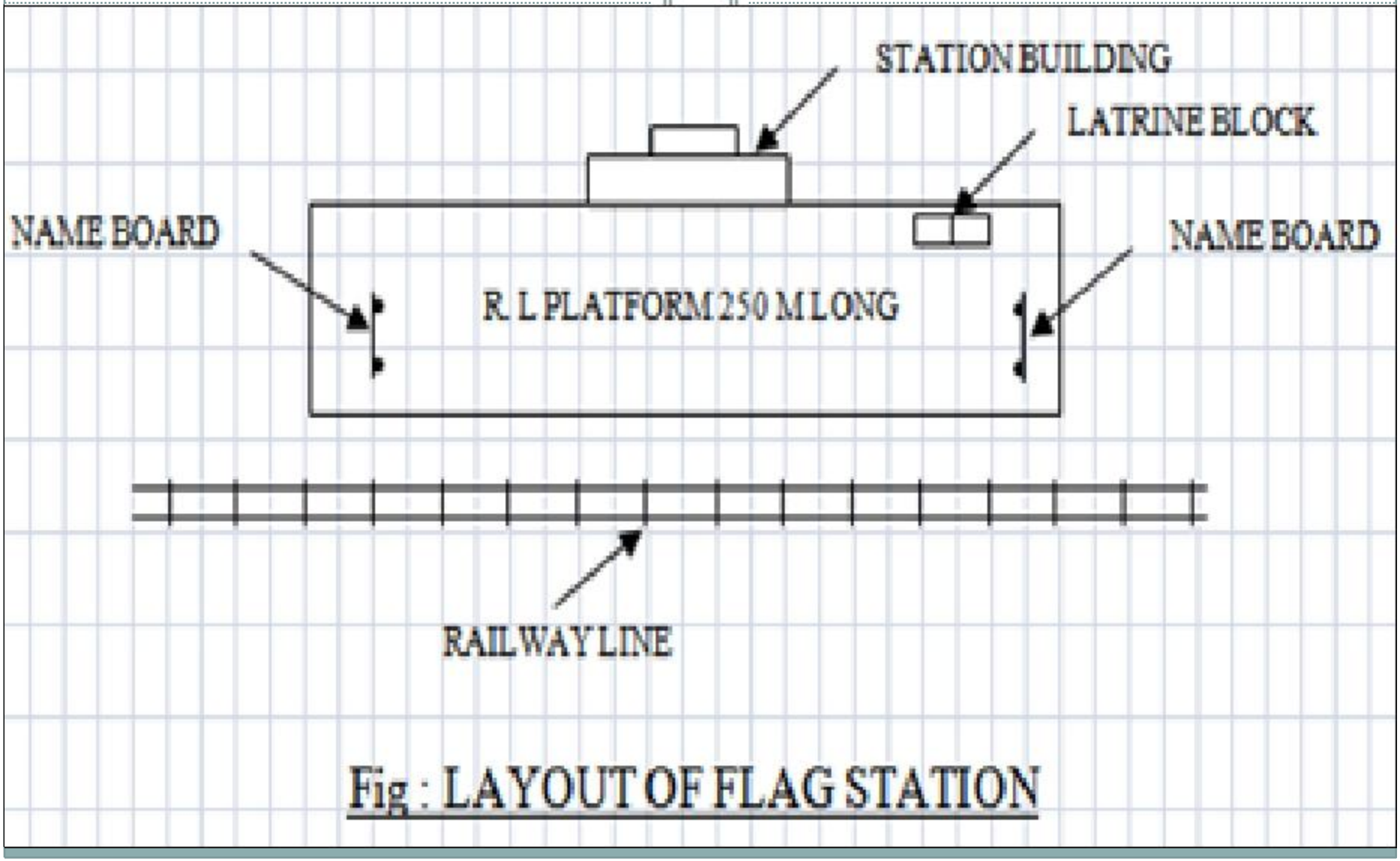


Fig : LAYOUT OF FLAG STATION

Crossing Stations

- Provided with facilities for crossing
- In this type at least one loop line is provided to allow another train if one track is already occupied by a waiting train
- Generally the train to be stopped is taken on the loop line and the through train is allowed to pass on the main line

Crossing Stations

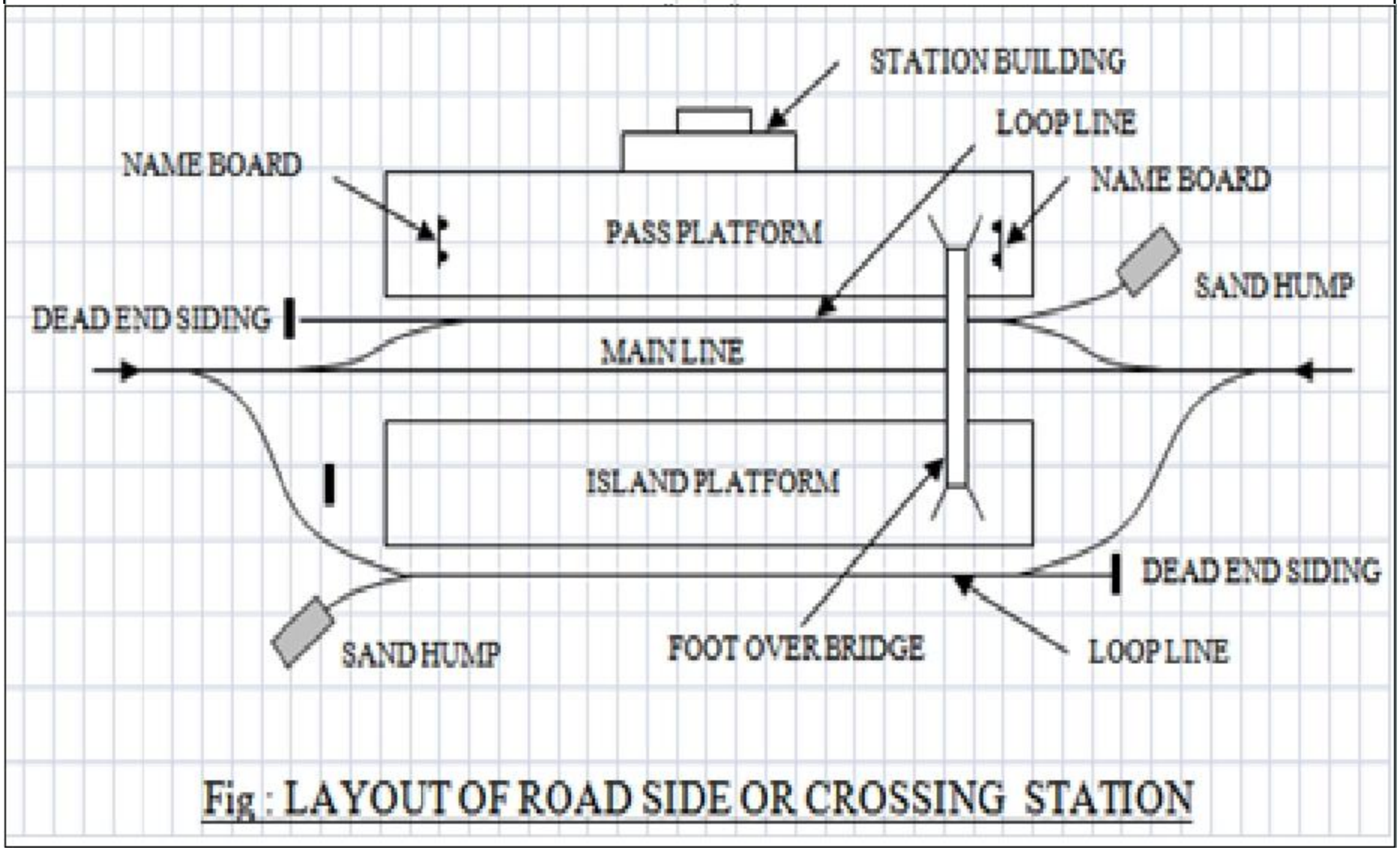


Fig : LAYOUT OF ROAD SIDE OR CROSSING STATION

Junction stations:

- At a junction stations, lines from three or more directions meet
- The stations where a branch line meets the main line are known as junctions.

Arrangements in junction stations

- Facilities for interchange of traffic between main and branch line
- Facilities to clean and repair the compartments of the trains
- Facilities for good sidings, engine sheds, turn table etc.

Junction stations:

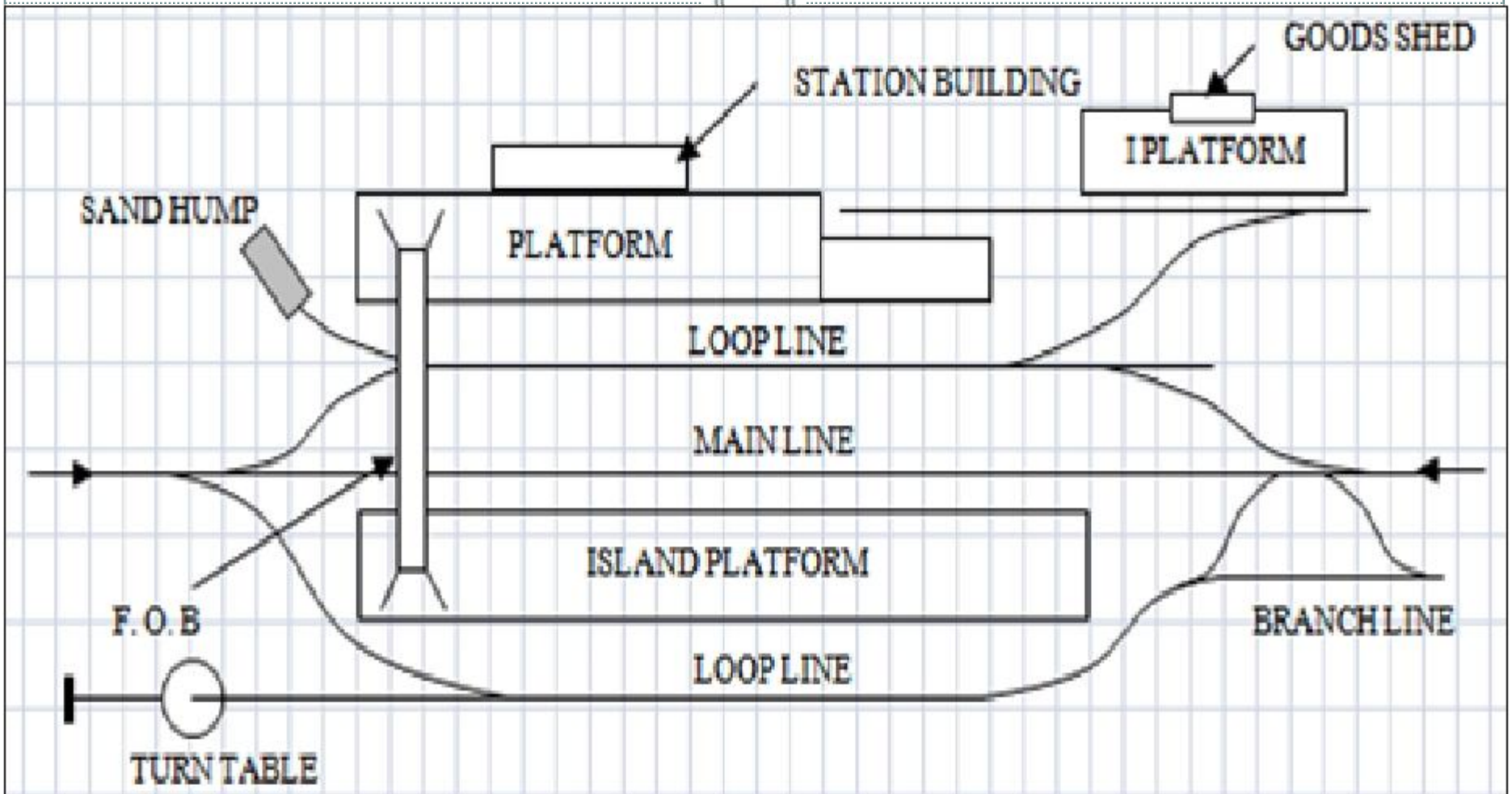


Fig : LAYOUT OF JUNCTION STATION

Terminal Stations:

- It is a station where a railway line or one of its branches terminates
- **Facilities required in terminal stations**
- Watering, coaling, cleaning, servicing the engine
- Turn table for the change of direction of the engine
- Facilities for dealing goods traffic. Such as marshalling yard, engine sheds, sidings etc.
- In circulating area, ticket office, restaurant etc are provided and it is directly connected to the road

Terminal Stations:

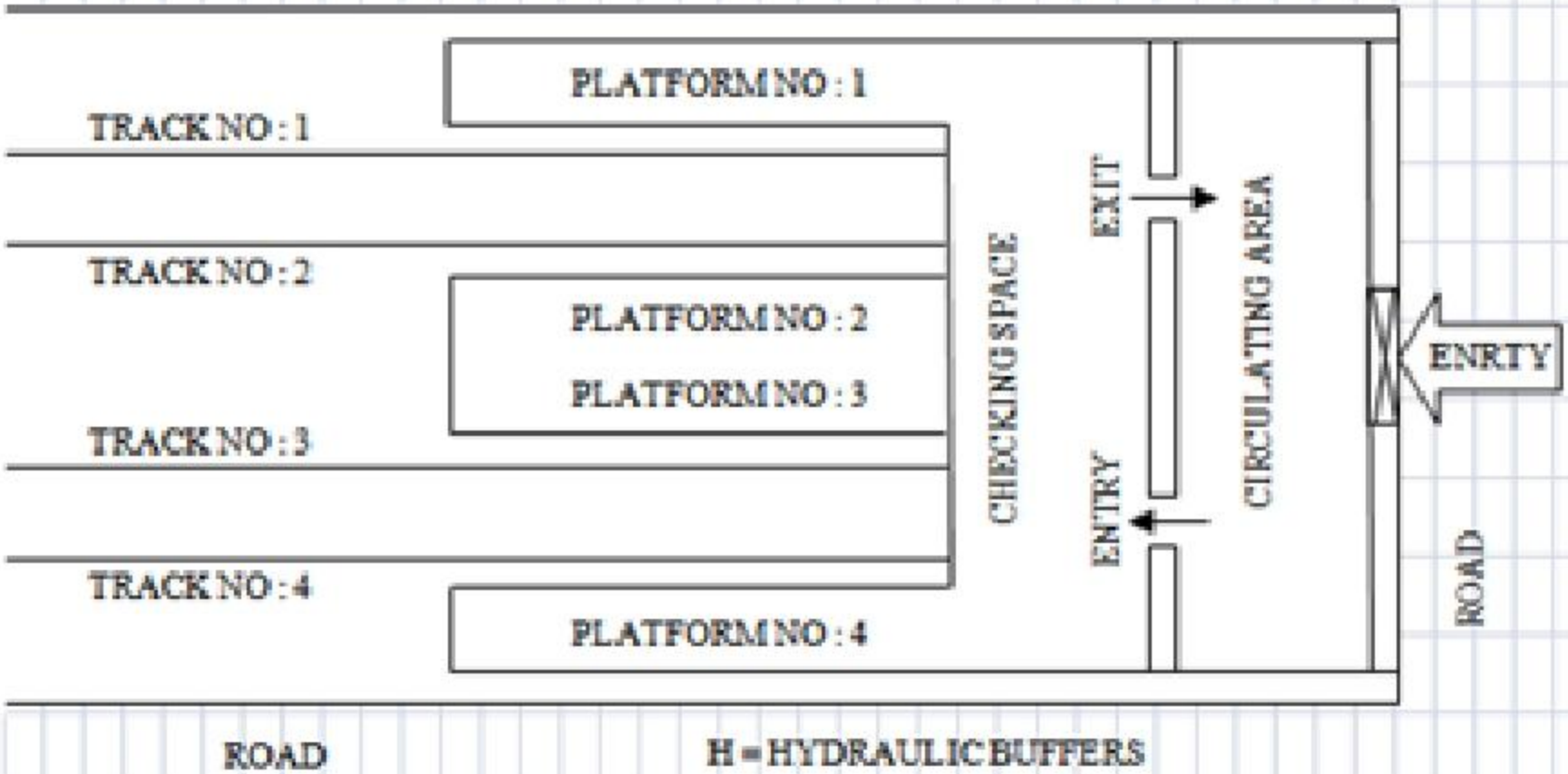


Fig : LAYOUT OF TERMINAL STATION

Classification of Stations

- Stations can be classified on the basis of their operation as
- 1.Block stations-Class A, Class B and Class C
- 2.Non Block Stations-Class D stations or Flag stations
- 3.Special class stations.

Block Stations:

- The stations at the end the block sections are called Block stations
- Authority to proceed is given in the shape of token at these stations.

Class A Station:

- On these stations the track is cleared up to 400m beyond the home signal for giving permission to approach a train

Class B Station:

- In such stations, the other signal is provided at about Within the station

Class C Station:

- On these stations passengers are not booked. It is simply a block meant for splitting a long block section and to reduce the interval between the successive trains.

Non Block Stations:

- Also known as Class D station or Flag station
- Situated between two consecutive block stations
- May not be telegraphically connected to the adjacent stations
- No equipment or staff is provided for controlling the movements of the trains.
- Trains are stopped by flag signals only

Definition of Yard:

- An area consisting of a network of railway tracks, sidings, and sheds for storing, maintaining, and joining engines and carriages.
- A yard is defined as a system of tracks laid within definite limits for various purposes such as receiving sorting and dispatch of vehicles.

Railway Yard

Types of Yards:

- Passenger yards,
- Goods yards,
- Marshalling yards,
- Locomotive yards

Goods yards

Requirements of a goods yard

- Approach road for movement of goods
- Sufficient number of platforms for loading and unloading
- Sufficient number of godowns
- Booking office
- Cart weighing machine
- Cranes for loading and unloading
- Vacuum testing machine

Marshalling yards:

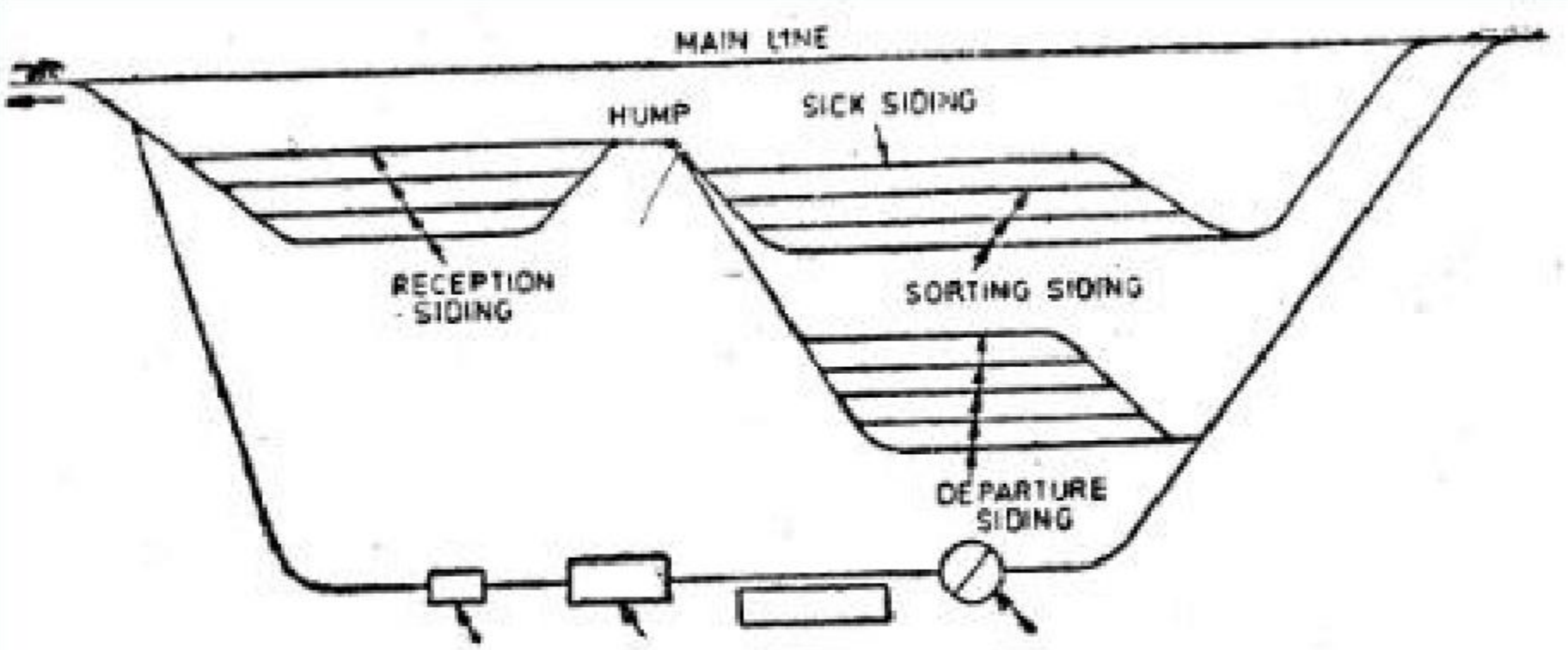
- **Marshalling yard** is a railroad yard

- It is the place where goods wagons received from different centres are sorted out and placed in order to detached at different stations

- The marshalling yards are distribution centre

- Empty wagons are also kept in marshalling yards

Marshalling yards:



Marshalling yard.

Types of marshalling yards:

(i)Flat yard

(ii)Gravity yard

(iii)Hump yard

Flat yard:

- Flat yards are constructed on flat ground, or on a gentle slope. Freight vehicles are pushed by a locomotive and coast to their required location.
- A **flat yard** has no hump, and relies on locomotives for all car movements

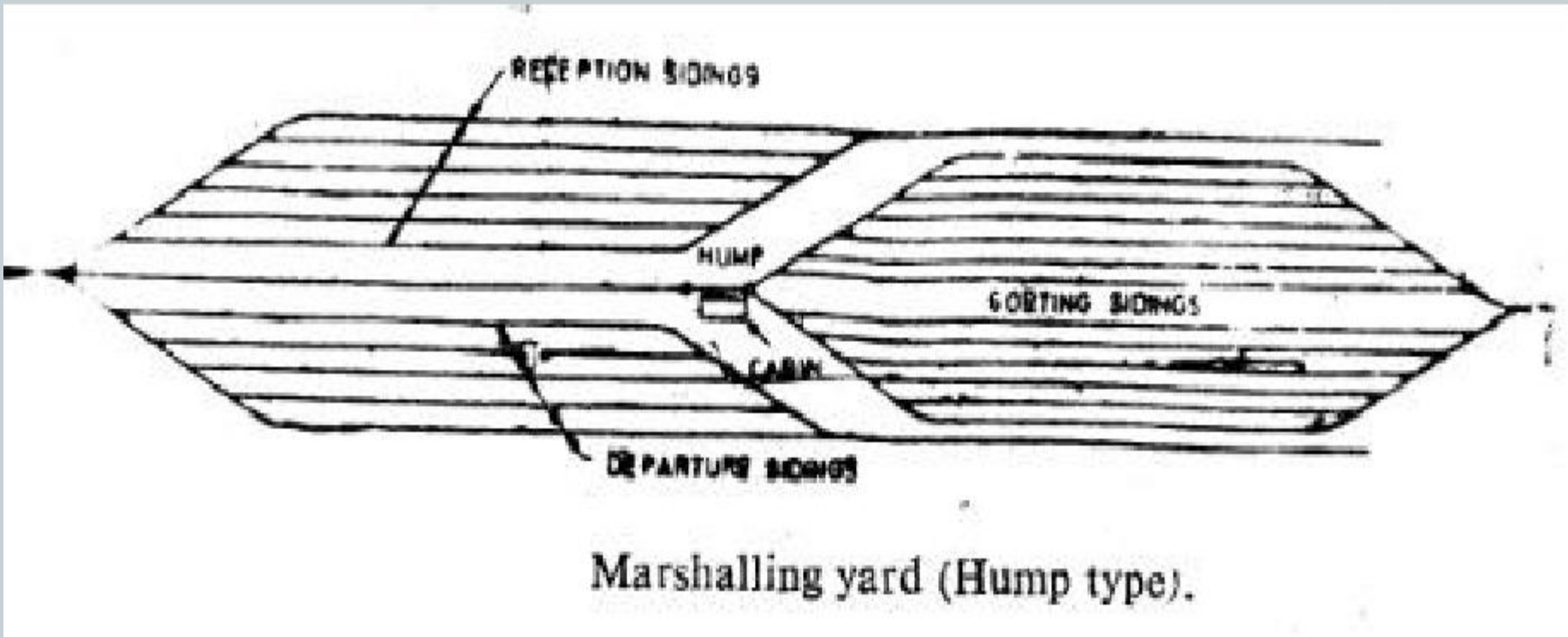
Gravity yard:

- The whole yard is set up on a continuous falling gradient and there is less use of shunting engines.
- Typical locations of gravity yards are places where it was difficult to build a hump yard due to the topography
- Gravity yards also have a very large capacity but they need more staff than hump yards and thus they are the most uneconomical classification yards.

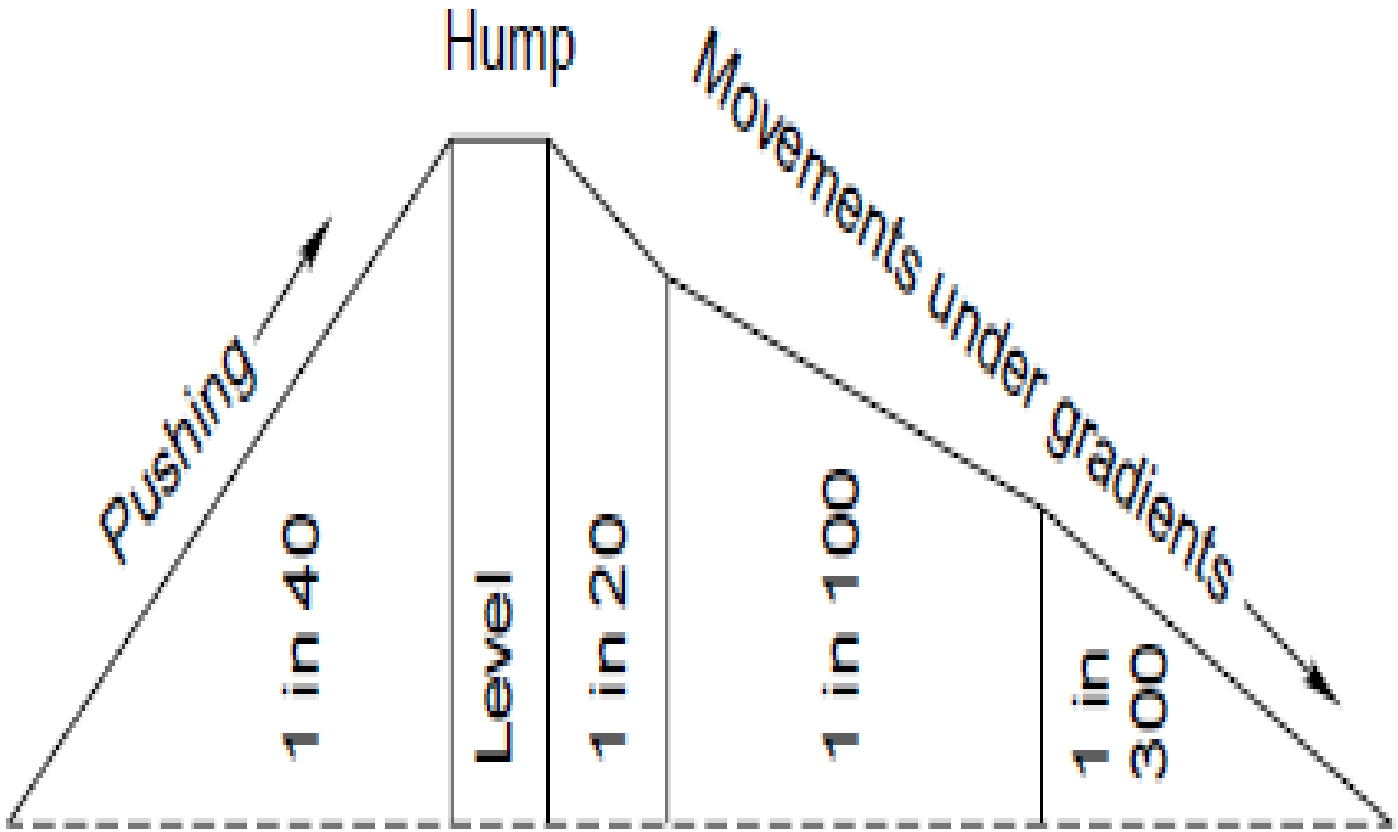
Hump-yard:

- These are the largest and most effective classification yards, with the largest shunting capacity—often several thousand cars a day.
- The heart of these yards is the hump: a lead track on a hill (hump) that an engine pushes the cars over.
- Single cars, or some coupled cars in a block, are uncoupled just before or at the crest of the hump, and roll by gravity onto their destination tracks
- A **hump yard** has a constructed hill, over which freight cars are shoved by yard locomotives, and then gravity is used to propel the cars to various sorting tracks

Hump-yard:



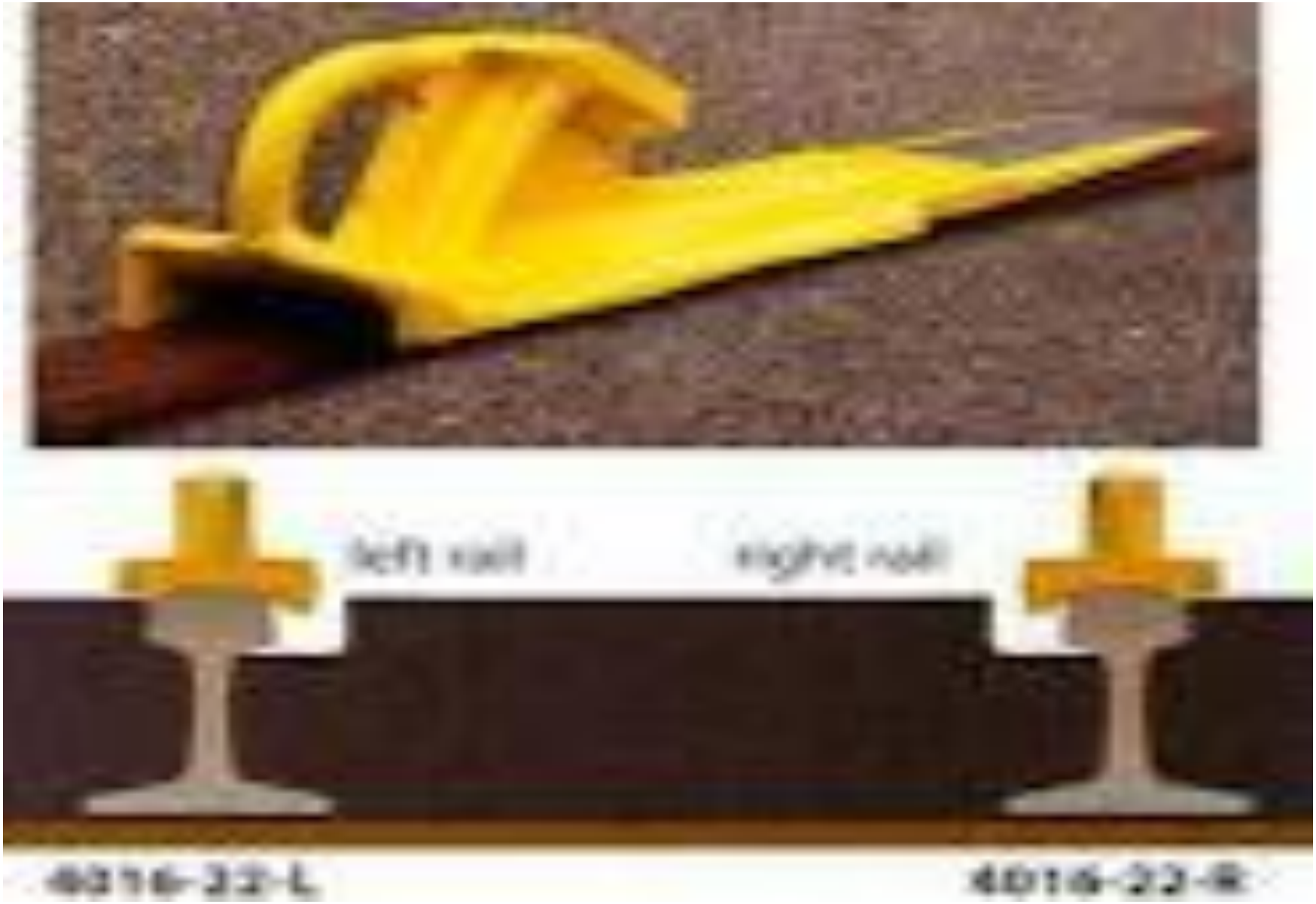
Marshalling yard (Hump type).



Typical gradients in mechanized hump yard

The stopping of individual wagons or group of wagons is carried out follows

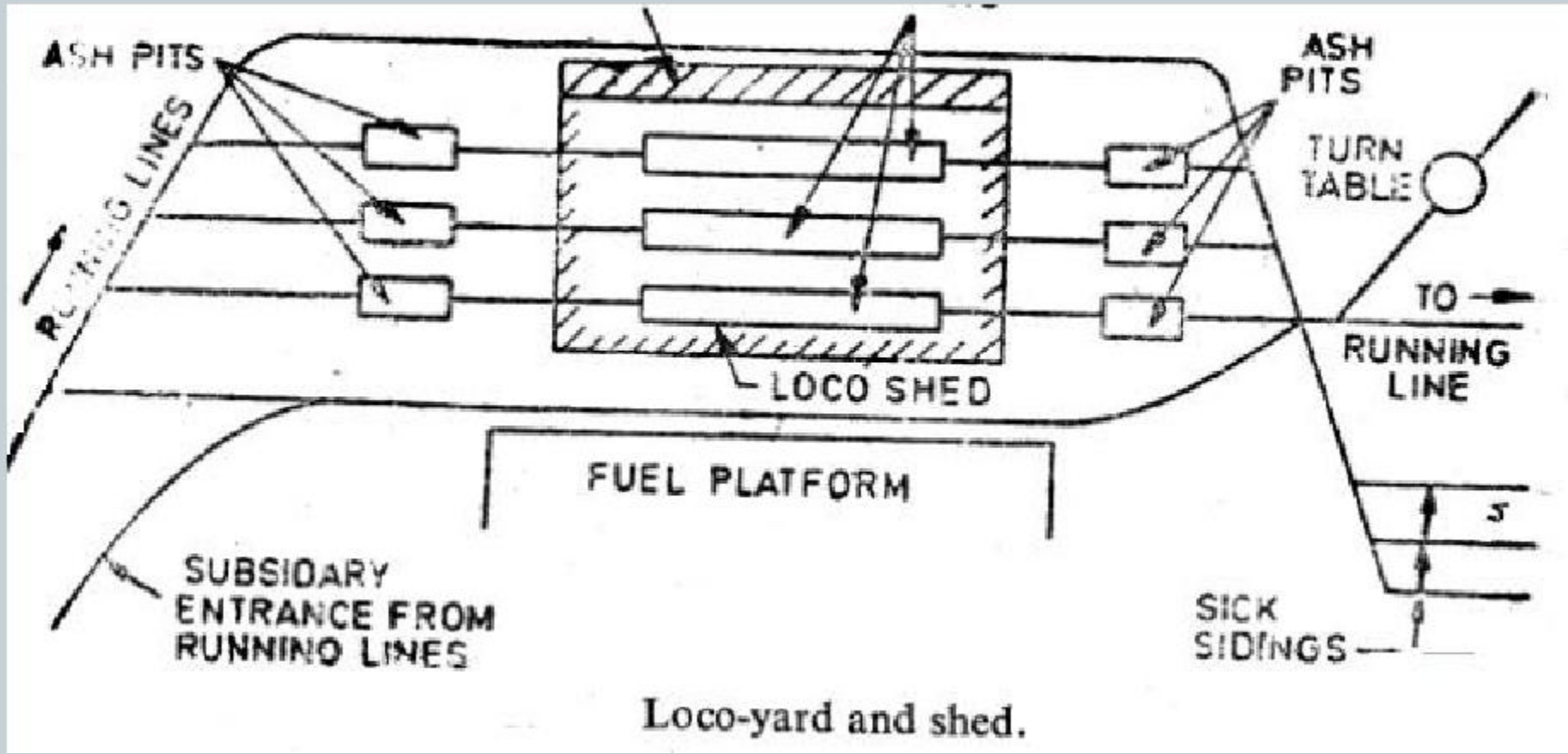
- Men run along the wagons and apply the wagon brakes at the desired point of stoppage.
- Retarders may be employed to stop the moving wagons. These are the blocks or bars which are fixed on either end of the rails.
- Skids may be placed on the rails.A moving wagon will drag the skid .will prevent the further movement of wagon.


left rail
right rail
4016-22-L
4016-22-R

Locomotive yards:

- This is the yard which houses the locomotives for various facilities such as watering, fueling, cleaning, repairing, servicing etc.

Locomotive yards:



Loco-yard and shed.

PLATFORMS

- Generally two types of platforms
  - Passenger Platforms
  - Goods platforms
- **Passenger Platforms**

➢ Minimum length = 61m

➢ Minimum width 3.6m

➢ Depends on longer train used the minimum length may be 183m

- **Distance from track:**
  - Sufficient clearence should be need between centerline of track and edge of paltform.

  It is about 1676mm for B.G

  It is about 1346mm for M.G

  It is about 1219mm for N.G

Height:

Elevation of platform from rail level

For B.G: 762mm to 838 mm.

For B.G: 305mm to 406 mm.

For B.G: 406mm to 229 mm.

Goods platform

- They are similar to passenger platform but they are higher in their elevation from rail level.

Minimum width of platform = 3m

Height

For B.G = 1067mm

For M.G = 686mm

For N.G = 610mm

Platform types include the

- **Bay Platform**,
- **Side Platform** (Also Called **Through Platform**),
- **Island Platform**.

➢A bay platform is one at which the track terminates, i.e. a dead-end or siding.
➢A side platform is the more usual type, alongside tracks where the train arrives from one end and leaves towards the other.
➢An island platform has through platforms on both sides; it may be indented on one or both ends, with bay platforms

Passenger Platform

Goods Platform

Track laying or plate laying

- Plate laying includes laying of rails, sleepers and fastenings. Normally three methods are adopted for plate laying.

Methods of plate laying

- Tram line method
- American method
- Telescopic method

Tram line method

- In this method, a temporary line known as a *tram line is laid by the side of the* proposed track for transporting track material to the site. This method can be useful in flat terrains.

- A modification of the above method, called *side method, is also in practice,* where track and bridge material such as steel girders and RCC slabs is carried to the site in trucks on a service road that runs parallel to the track. These materials are then unloaded near the work site. This method is used only in cases where the terrain is comparatively flat.

American method

- In this method, rails and sleepers are first assembled in the base depot, and the preassembled track panels are then conveyed to the site along with the necessary cranes, etc.

- The track panels are then unloaded at the site of work either manually or with the help of cranes and laid in their final position.

- This procedure is used in many developed countries, particularly where concrete sleepers are laid, which are quite heavy and not very easy to handle manually.

T-28 IN OPERATION

Telescopic Method

•This method is widely used on Indian Railways. In this method, the rails, sleepers, and other fittings are taken to the base depot and unloaded. The track material is then taken to the rail head and the track is linked and packed.

This method has three main operations

- **Unloading and preparation of materials**
- **Linking of track**
- **Packing of track**

Calculation of Materials required for track laying

Rails

The standard length of the rails is 13 m for BG and 12 m for MG lines.

$$\text{No. of rails per km for BG lines} = \frac{1000}{13} \times 2$$

$$= 77 \times 2 = 154$$

$$\text{Wt of 52-kg rails per km} = 52 \times 154$$

$$= 8008 \text{ kg}$$

Number of sleepers

The number of sleepers to be used depends upon the sleeper density. Assume sleeper density to be *M + 7, where M is the length of the rail in metres.*

Number of sleepers per rail = 13 + 7 = 20

Number of sleepers per km = 77 × 20 = 1540

Fittings and fastenings

(a) No. of fish plates per km length

= 2 × number of rails per km

= 2 × 154 = 308

(b) No. of fish bolts per km length

= 4 × number of rails per km

= 4 × 154 = 616

Fittings and fastenings

(c) No. of bearing plates

= number of sleepers × 2

= 1540 × 2 = 3080

(iv) Number of dog spikes

= number of sleepers × 4

= 1540 × 4 = 6160

Track maintenance

- **Necessity of track maintenance.**
- The railway track should be maintained properly in order to enable trains to run safely at the highest permissible speeds and to provide passengers a reasonable level of comfort during the ride. Track maintenance becomes a necessity due to following reasons.
    - Due to the constant movement of heavy and high-speed trains, the packing under the sleepers becomes loose and track geometry gets disturbed.
    - Due to the vibrations and impact of high-speed trains, the fittings of the track come heavy wear and tear of the track and its components.
    - The track and its components get worn out as a result of the weathering effect of rain, sun, and sand.

- Railway tracks can be maintained either conventionally by manual labour or by the application of modern methods of track maintenance such as mechanical tamping or measured shovel packing.

Conventional methods:

- As per the timetable or calendar, the 12-month cycle of maintenance consists of the following operations.
- (a) Through packing
- (b) Systematic overhauling
- (c) Picking up slacks

Through packing

Process in through packing

- Opening of road
- Examining of rails, sleepers and fastenings
- Examining Squaring of sleepers
- Check for alignment
- Check for the gauge of the track

Tolerance for gauge error was 6mm for straight tracks

Systematic Overhauling

- The systematic overhauling of the track should normally commence after the completion of one cycle of through packing. It involves the following operations in sequence.

- Shallow screening and making up of ballast section
- Replacement of damaged or broken fittings
- All items included in through packing
- Lubrication of rail jpints

Picking up Slacks

- Slacks are those points in the track where the running of trains is faulty or substandard.

(a) Stretches of yielding formation

(b) Poorly maintained sections that have loose packing, bad alignment, and

(c) Improperly aligned curves

(d) Approaches to level crossings, girder bridges, etc., particularly in sags

(e) Portions of track with poor drainage

(f) Sections with an inadequate or unclean ballast cushion

Modern methods

- Modern methods of track maintenance employ track machines and other modern track equipment for the maintenance of tracks as opposed to the traditional methods of manual packing. The methods used generally are the following.
- (a) Mechanized maintenance of track with the help of track machines
- (b) Measured shovel packing (MSP)
- (c) Directed track maintenance (DTM)

Rapid Transport System:

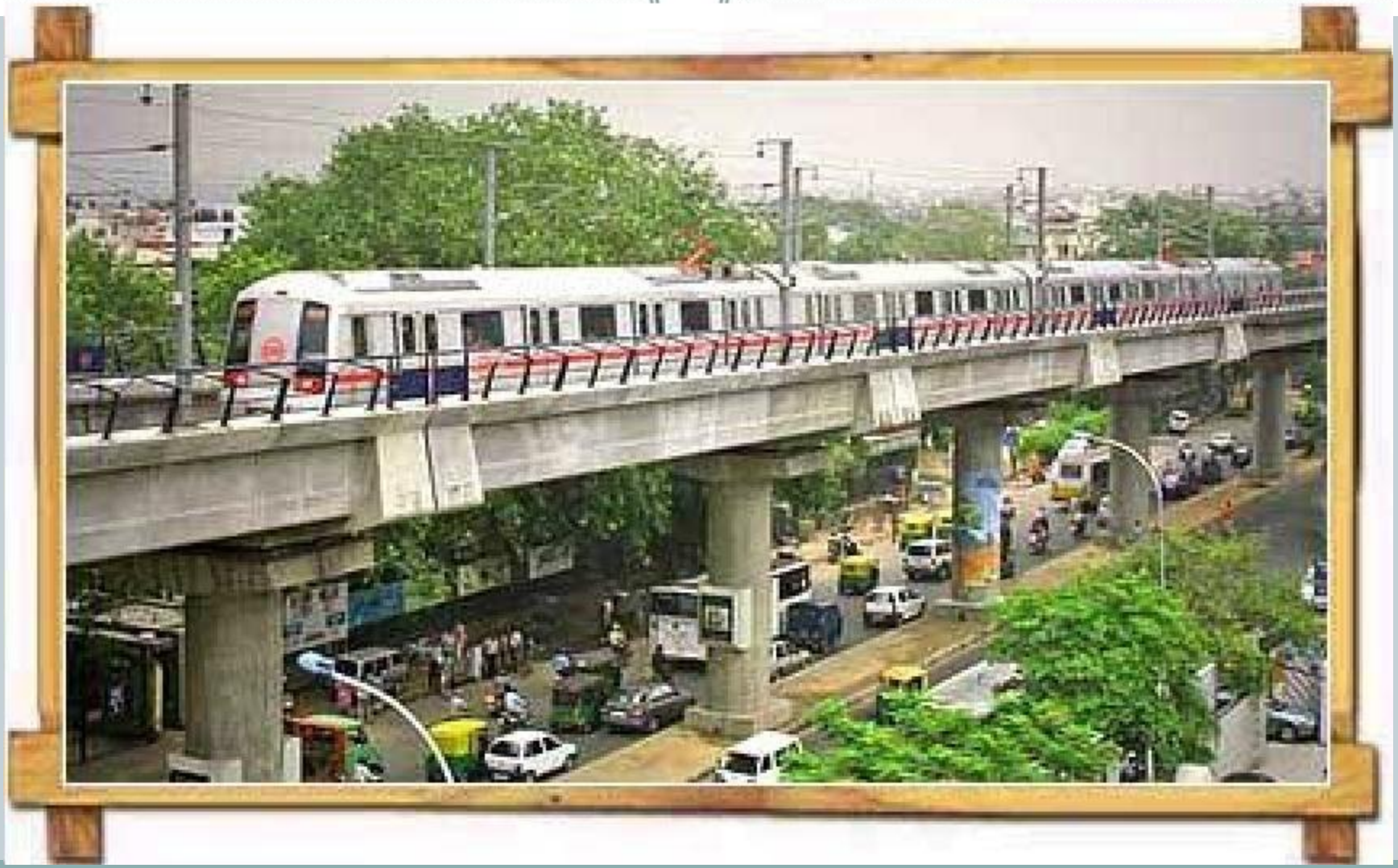
General

- **Rapid transport** is a type of high-capacity public transport generally found in urban areas.
- Unlike buses and trains, rapid transport systems operate on an exclusive right-of-way which is usually grade separated in tunnels or elevated railways.
- *Metro* is the most common term for underground rapid transport systems
- Rapid transport is used in cities, agglomerations, and metropolitan areas to transport large numbers of people often short distances at high frequency. The extent of the rapid transport system varies greatly between cities, with several transport strategies

Elevated railways

Mono Rail

Metro Rail in Chennai



Under ground railways:

- The railways provided just below ground level are called ―low level or underground railways‖.
- In this system of Railways, *tunnels* are constructed for carrying tracks through them and a over - bridge is necessary at every road crossing to carry the road traffic over the railway traffic.
- Due to ventilation problems in tunnels, *electricity* is the only source of power for traction in under ground railways.

Under ground railways:

Advantages :

- This system provides rapid and unobstructed transportation.
- This system helps in reducing traffic congestion problems.
- This system provides safety during aerial attack in war.

Suitability :

- Underground railways are suitable in the heavily congested urban areas where the traffic intensity on roads is heavy.

Under ground railways

Tube railways :

- The railway provided underground at a greater depth of about 18 m or more (up to 52 m) are called tube railways.
- This system of railways is so called as the section of the underground tunnels, carrying the track, is to avoid the interference of the tracks with *water* and *gas pipes, sewerage systems* and *oil* or *drainage pipes*, etc
- An electrically powered railroad with tracks running through a tunnel underground; a subway.

Some important features of the tube railways are given below :-

- The railways stations have to be of cylindrical form.
- Escalators or moving stair cases are to be constructed to reach the tube railways.
- Only electric traction to be used to avoid the smoke and ventilation problems.
- Automatic signaling system is to be used.
- Such a mechanism of the train is to be used that it cannot start until all the doors are closed, and it automatically stops, if the signal is at _STOP‘ position.
- This system of railways is used by the *London Post Office* in transporting mails through a small diameter tunnel with automatic control without any driver.

Tube railways :

TRACK CONSTRUCTION AND MAINTANENCE

METHODS OF LAYING

- **IN-SITU LAYING** – In openline, construction and Yard Remodelling (sometimes)

- **Assembly – Shifting – Laying**
  - Complete Renewal/Laying : Mechanised
  - Renewal/Laying by Parts : Either Manual or Mechanised
  - Prefabrication in Depot – Assembly can be done using road crane.

GENERAL PREPARATION FOR TURNOUT REPLACEMENT

- Field inspection to check site conditions, approach, presence of electrical & signalling gears, posts, boards etc. which may cause obstruction; availability of ballast etc.
- Arranging adequate space for assembly by necessary tools & plants and good quality artisan.
- Checking completeness of all components of P&C as per parts list. Checking of important dimensions.

MANUAL LAYING OF P&C ON PSC SLEEPERS

- Preliminary works
  - Survey : Measure & check existing layouts. Examine scope/need for improvement.
  - Mark proposed SRJ, ATS, crossing position & location of sleepers on lead and crossing portion.
  - Assemble the switch on staging.
  - Check housing of TR with SR and Throw.

MANUAL LAYING OF P&C ON PSC SLEEPERS

- Preblock works
  - On 1 in 12 T/O sleeper nos. 28 to 64 and 73 to 83 can be inserted one by one. Sleeper Nos. 21 to 27 should be kept ready with special bearing plates.
  - Shifting and adjustment of OHE alignment of required
  - OEHS should be issued on adjoining tracks.
- Alternate keys and 2 out of 4 bolts at joints should be removed. Ballast should be removed from top of the sleepers .
- Speed restriction of 20 kmph should be imposed.

MANUAL LAYING OF P & C ON PSC LAYOUT

- Block Works
  - One batch (40 men) dismantle switch and approach.
  - Second batch (20 men) remove sleepers and level the ballast bed.
  - Second batch then moves to dismantle crossing portion and take out sleepers from crossing.
  - Third batch (15 men) replaces sl. nos. 21 to 27.
  - The new assembled switch is dragged to proposed site and linked to approach track.(40 men)
  - Sleepers under crossing and behind HOS are inserted and rails linked.

MECHANISED LAYING OF PSC T/O

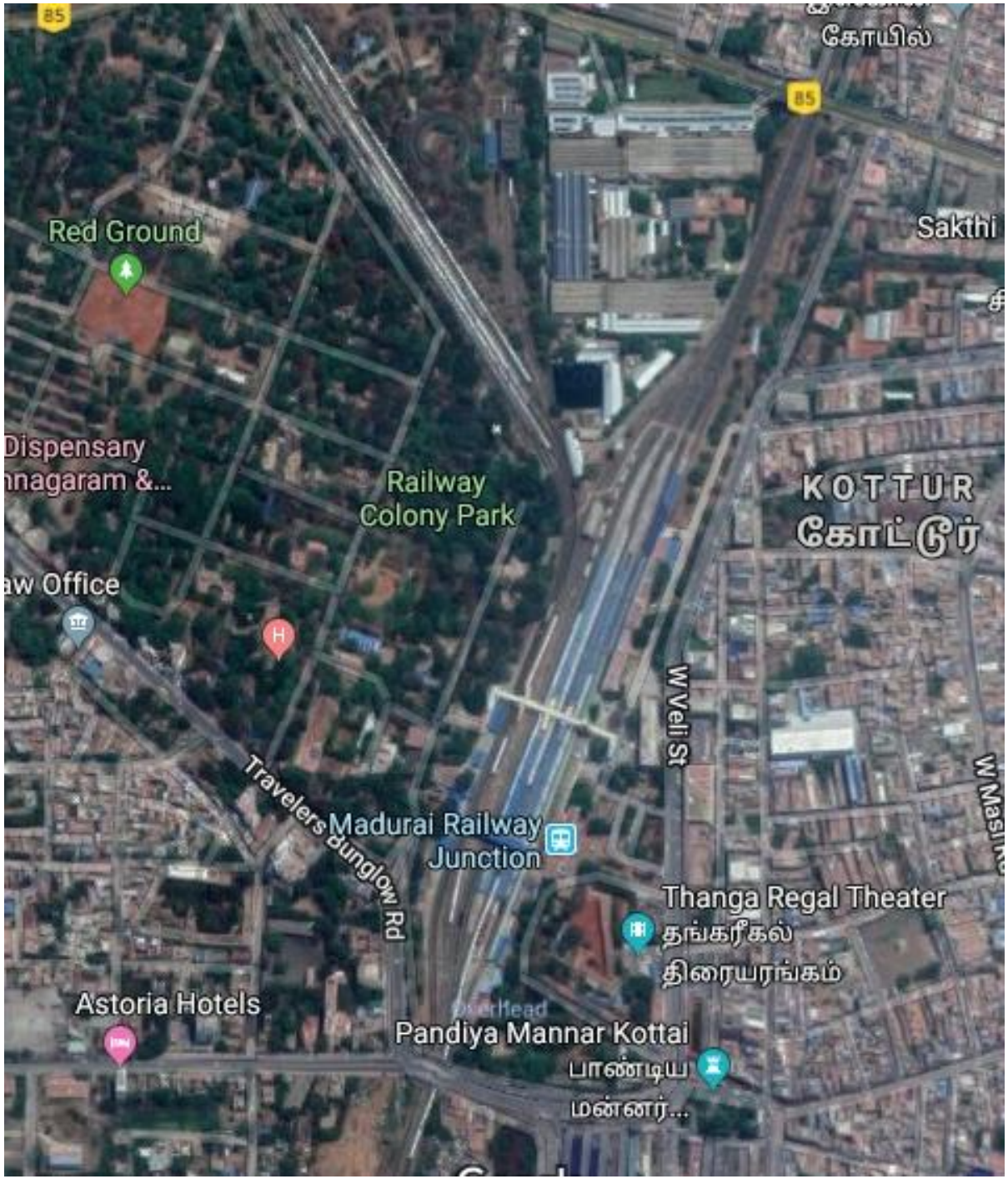
- By T-28 crawler cranes of M/s AMECA of Italy.
- One set consists of two self propelled portal cranes, one motorised rail trolley and two non-motorised rail trolley.
- CRS has permitted speed of 10 kmph when the crane runs on its own power.

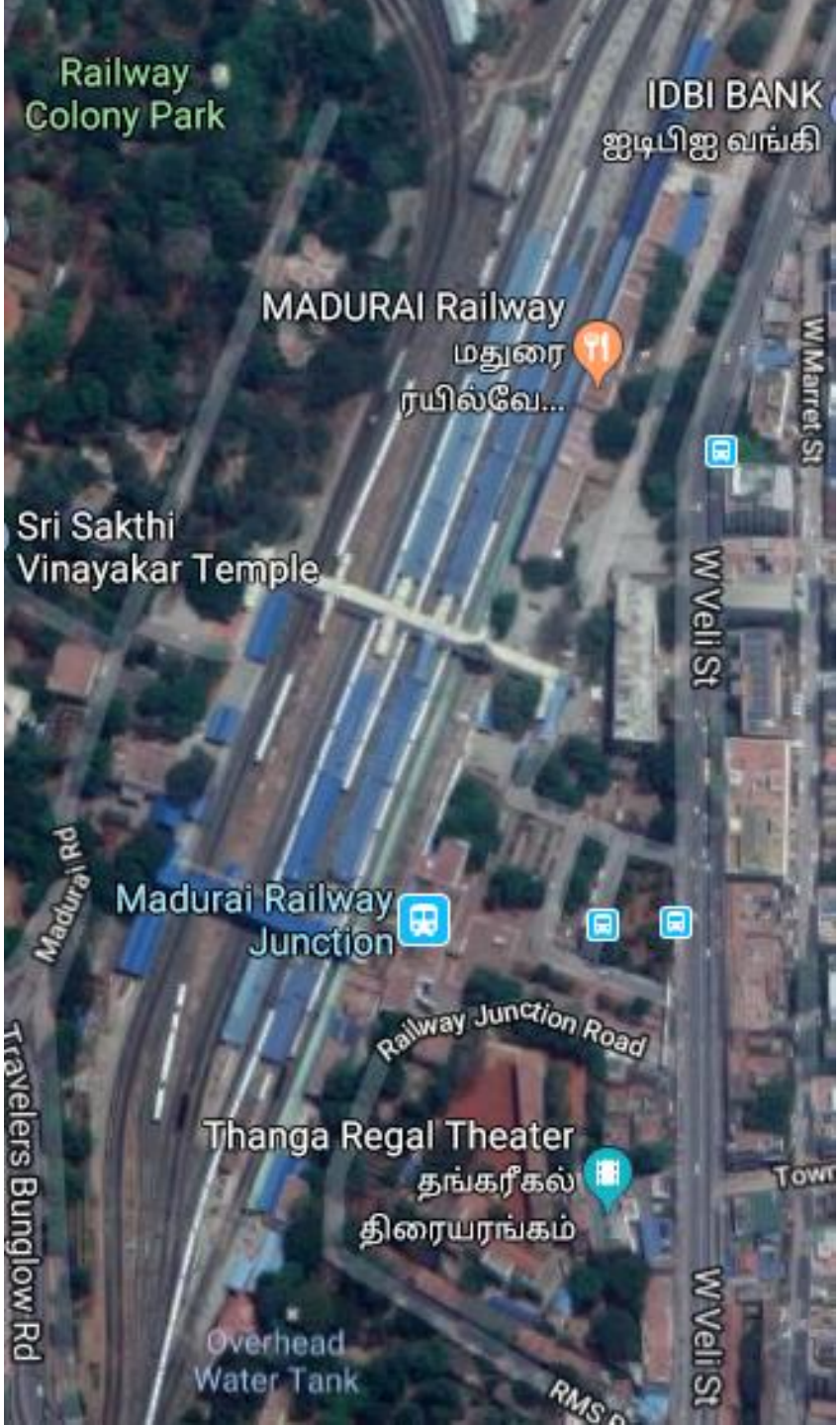
T-28 PORTAL CRANES

- Portal crane can run on rails (using rail wheels) as well as on road (using crawlers). The crawlers can be lifted up or opened laterally to accommodate the sleepers.

- The crane can be shifted laterally on the crawlers. These can also be rotated to take angular position. Crawler height can be adjusted individually.

T-28 IN OPERATION


85
கோயில்
85
Red Ground
Sakthi
Dispensary
nnagaram &...
Railway
Colony Park
KOTTUR
கோட்டூர்
aw Office
H
W Veli St
W Masi
Travelers Bunglow Rd
Madurai Railway
Junction
Thanga Regal Theater
தங்கரீகல்
திரையரங்கம்
Astoria Hotels
Pandiya Mannar Kottai
பாண்டிய
மன்னர்...


Railway
Colony Park
IDBI BANK
ஐடிபிஐ வங்கி
MADURAI Railway
மதுரை
ரயில்வே...
W Marret St
Sri Sakthi
Vinayakar Temple
W Veli St
Madurai Rd
Madurai Railway
Junction
Railway Junction Road
Travelers Bunglow Rd
Thanga Regal Theater
தங்கரீகல்
திரையரங்கம்
Overhead
Water Tank
W Veli St


Royal Enfield Showroom
Maha Engineering Works
Madura Coats Pvt. Ltd
Prabhakaran
Pookuzhi
akshmi...


தெற்கு
ரயில்வே...
Master Office
Egmore Railway
Police Station
எழும்பூர்
ரயில்...
IBH Books &
Magazines Distributors
Chennai Egmore
சென்னை
எழும்பூர்
Anjappar Chettinad
அஞ்சப்பர்...
Vasanta Bhavan Hotel
Hotel Chandra Park
Modern pick with a restaurant
2-star hotel
3.6
₹ 1,225
CHENNAI SORTING
DIVISION...
Gandhi Statue
காந்தி சிலை
Hotel Saravana Bhavan
Chennai, Egmore


Chennai andhra
rail cargo movers
Arcot Lutheran Church
Office of the
Chennai Corporation
VP Hall Compound Rd
Renuga Amman
Fedex
பெடெக்ஸ்
dal Revenue
e Purasawakkam
Jawaharlal
Nehru Stadium
ஜவஹர்லால்
நேரு...
Samudra Residency
Masjid E Ilahiya
Annai Velanganni
Chennai Central
Railway Station
Hotel City Tower
Periamet SS
Chief Magistrate Court
Allikulam Complex
New Central Hotel
Canara Bank ATM
கனரா வங்கி
ஏடிஎம்
Chennai Moore
Market Complex
மூர்
மார்க்கெட்
Periamet Police Station
tional
Chennai Central
Hotel Greens Gate
114


Srisakthivadivelan
Tours and Travels
Rameswaram
இராமேஸ்வரம்
Kalam Arcade
கலாம்
ஆர்கேட்
Shakti Mariamman
Temple