

Introduction- Railway Track Components

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Railway Track/ Permanent Way

» The combination of rails, fitted on sleepers and resting on ballast and subgrade is called the railway track or permanent Way

» Consists of

- i. Rails
2. Sleepers
3. Ballast
4. Subgrade

Requirements of an Ideal Permanent Way

- » Gauge should be uniform and correct
- » The rails should be in proper level
 - i. Straight track - two rails must be at the same level
 2. Curves- outer rail should have proper superelevation
- » Track should have enough lateral strength
- » The radii and superelevation on curves should be properly designed and maintained

Requirements of an Ideal Permanent Way

- Track should be resilient and elastic in order to absorb shocks and vibrations of running track.
- Joints, including points and crossings which are regarded to be weakest points of the railway track, should be properly designed and maintained
- There should be adequate provision for easy renewals and replacements
- Drainage system must be perfect
- The track structure should be strong, low in initial cost as well as maintenance cost

Typical Cross-Section of a Railway Track

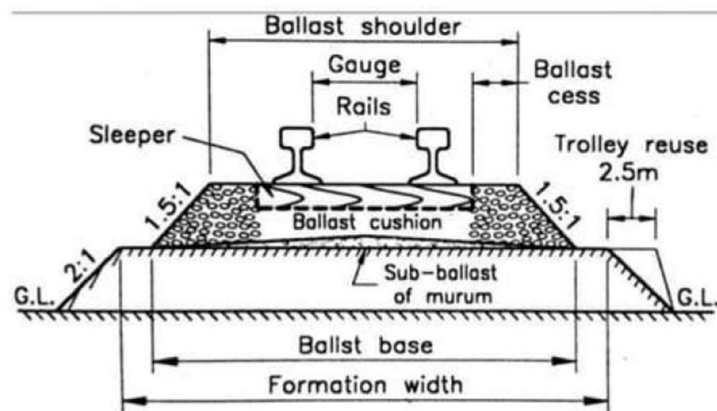


Fig. 3.1 Typical Cross-section of a Permanent Way on Embankment.

Component Parts of a Railway

Track

1. Rails

- » Unsymmetrical | sections made up of steel Functions
- » Provide a hard, smooth and unchanging surface for passage of heavy moving loads with a minimum friction between the steel rails and steel wheels
- » Bear the stresses developed due to heavy vertical loads, lateral and braking forces and thermal stresses
- » Transmit the loads to sleepers and consequently reduce pressure on ballast and formation below

Component Parts of a Railway

Track

RAILS - REQUIREMENTS

- Should be of proper composition
 - Vertical stiffness should be high enough to transmit th
 - Capable of withstanding lateral forces
 - Head must be sufficiently deep to allow for an adequate margin of vertical wear
 - Web should be sufficiently thick to bear the load & provide adequate flexural rigidity in horizontal plane
- Foot should be wide enough so that they are stable a overturning,

Component Parts of a Railway

Track

Sleepers

» provide transverse ties on which rails are laid

Functions

» Hold rails at proper gauge

» Support and fix the rails in proper position

» Transfer load uniformly from rails to ballast

» Provide longitudinal & lateral stability to track

» Provide elastic medium between rail and ballast

Component Parts of a Railway

Track

Sleepers-Requirements

- » Sufficiently strong to act as a beam under loads
- » Provide sufficient bearing area for the rail
- » Should have sufficient weight for stability
- » Facilitate easy fixing & taking out of rails without disturbing them
- » should facilitate easy removal and replacement of ballast —
- » Should be able to resist impact and vibrations of moving trains

Component Parts of a Railway

Track

Ballast

» granular and gritty material placed & packed below & around sleepers (stone ballast is widely used in India)

Functions

- » To hold sleepers in position, prevents lateral & longitudinal movement
- » Distribute load from sleepers to subgrade
- » Impart elasticity and resilience for comfortable ride
- » Provide effective drainage
- » Act as a medium for provision of super elevation

Component Parts of a Railway

Track

Ballast-Requirements

- sufficient strength to resist crushing under heavy load moving trains
- durable enough to resist abrasion and weathering action
rough and angular surface so as to provide good lateral and longitudinal stability to the sleepers
- good workability so that it can be easily spread and formation should not make the track dusty or muddy due to its crushing :
to powder under wheel loads
- should not have any chemical action on metal sleepers rails

Component Parts of a Railway

Track

Subgrade/ Formation

- » naturally occurring soil, prepared to support track.
- » They could be in embankments, levels or cuttings

Functions

- » Support railway track from beneath

Requirements

- » Uniform transmission of load over large area
- » Effective drainage of water
- » No variation in volume and moisture under adverse weather conditions



RAILS



TYPES OF RAILS

- The rails used in the construction of railway track are of following types:
- 1. Double headed rails(D.H. Rails)
- 2. Bull headed rails(B.H.Rails)
- 3. Flat footed rails(F.F.Rails)

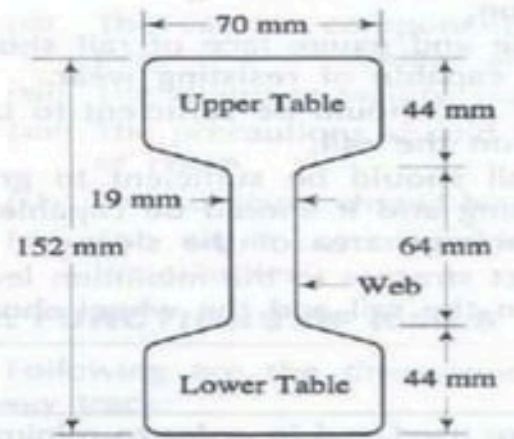
DOUBLE HEADED RAILS

- The rail sections, whose foot and head are of same dimensions, are called Double headed or Dumb-bell rails.
- In the beginning, these rails were widely used in the railway track.
- The idea behind using these rails was that when the head had worn out due to rubbing action of wheels, the rails could be inverted and reused.

- But by experience it was found that their foot could not be used as running surface because it also got corrugated under the impact of wheel loads.
- This type of rail is not in use in Indian Railways now-a days.



Fig. 1 Double headed rail



Double headed rail

BULL HEADED RAILS

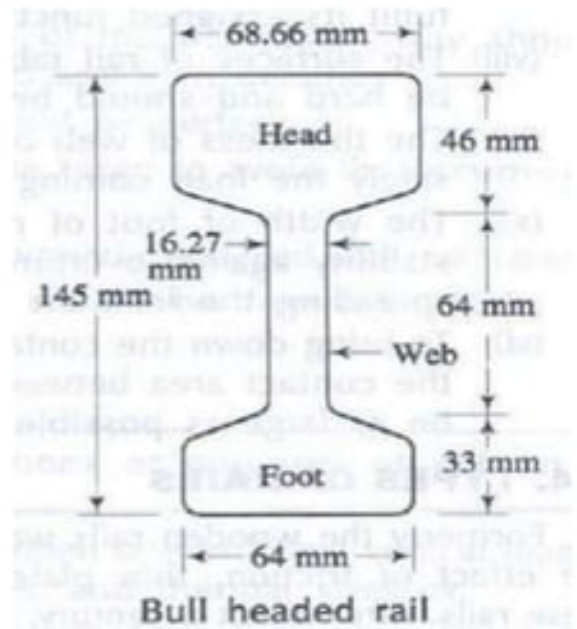
- The rail section whose head dimensions are more than that of their foot are called bull headed rails. In this type of rail the head is made little thicker and stronger than the lower part by adding more metal to it. These rails also require chairs for holding them in position.

Bull headed rails are especially used for making points and crossings.

Bull Headed Rail



Bull Headed



MERITS

- (i) B.H. Rails keep better alignment and provide more smoother and stronger track.
- (ii) These rails provide longer life to wooden sleepers and greater stability to the track.
- (iii) These rails are easily removed from sleepers and hence renewal of track is easy.

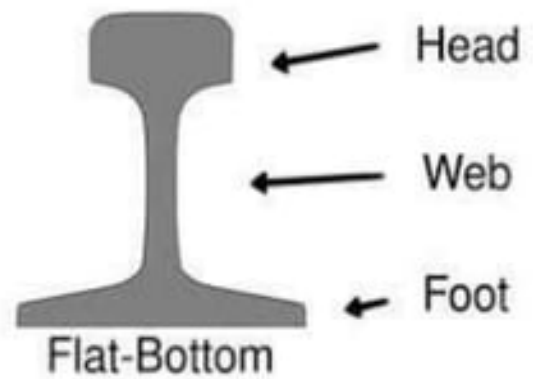
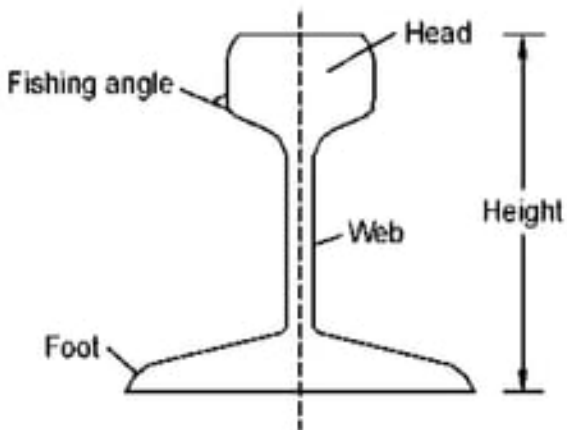
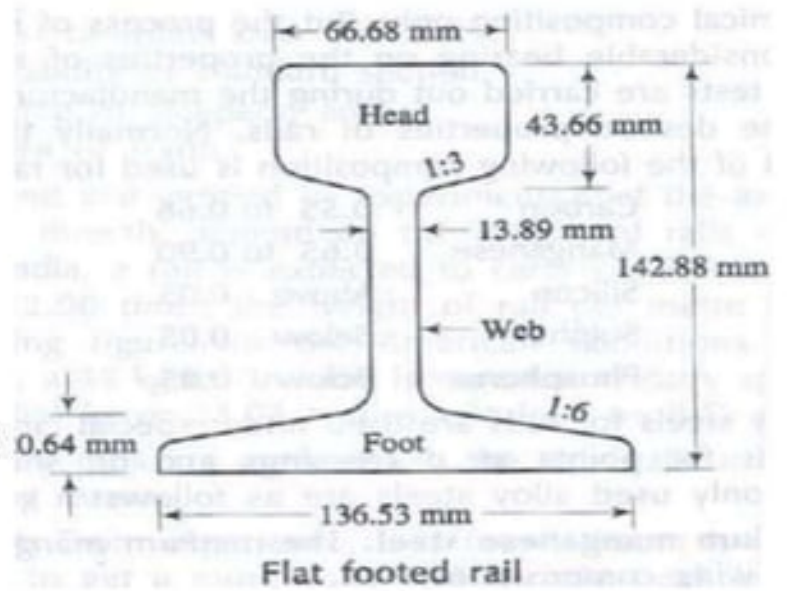
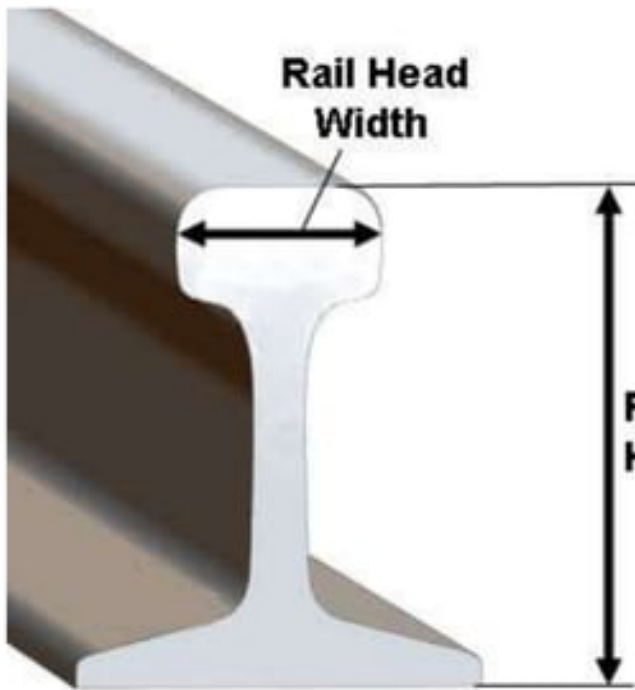
DEMERITS

- (i) B.H. rails require additional cost of iron chairs.
- (ii) These rails require heavy maintenance cost.
- (iii) B.H. rails are of less strength and stiffness.

FLAT FOOTED RAILS

- The rail sections having their foot rolled to flat are called flat footed or vignole's rails.
- This type of rail was invented by Charles Vignole in 1836.
- It was initially thought that the flat footed rails could be fixed directly to wooden sleepers and would eliminate chairs and keys required for the B.H. rails.

- But later on, it was observed that heavy train loads caused the foot of the rail to sink into the sleepers and making the spikes loose.
- To remove this defect, steel bearing plates were used in between flat footed rails and the wooden sleeper.
- These rails are most commonly used in India.



MERITS

- (i) F.F. rails have more strength and stiffness.
- (ii) No chairs are required for holding them in position.
- (iii) These rails require less number of fastenings.
- (iv) The maintenance cost of track formed with F.F. rails is less.

DEMERITS

- (i) The fittings get loosened more frequently.
- (ii) These rails are not easily removed and hence renewal of track becomes difficult.
- (iii) It is difficult to manufacture points and crossings by using these rails.

Rail Fastening System

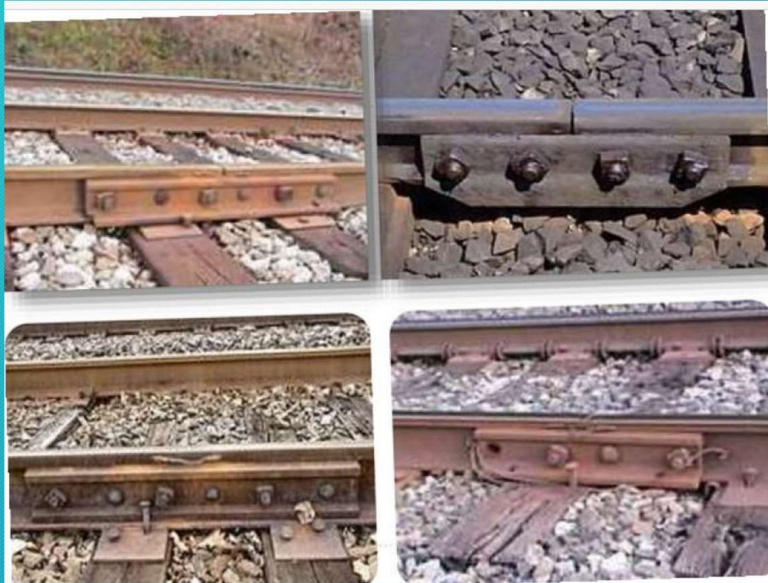
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FASTENING SYSTEM

- Rail fastening system is a means of fixing rails to sleepers
- Used to keep rails in proper position
- Important fittings are:
 - > FISH PLATES
 - > SPIKES
 - > BOLTS
 - > CHAIRS
 - > BLOCKS
 - > KEYS
 - > PLATES

FISH PLATES

- Fishplate, splice bar or joint bar is a metal bar that is bolted to the ends of two rails to join them together in a track
- Maintain the continuity of rails & to allow for expansion and contraction of rail due to temperature difference.
- Maintain correct alignment of line both horizontally & vertically.
- Fishplate is a small copper or nickel silver plate that slips onto both rails

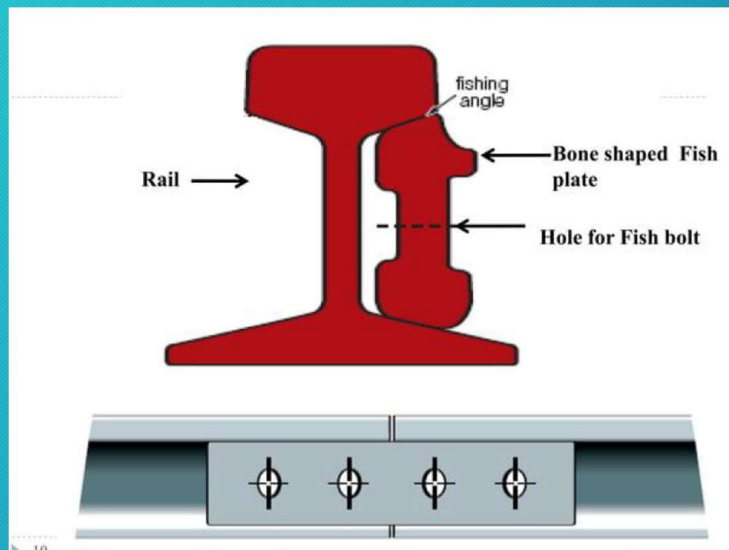


REQUIREMENTS OF FISH PLATES

- They must support the rail and top of the foot
 - They should allow free movement of rails for expansion & contraction,
 - They should bear stresses due to lateral & vertical bending moments
 - They should hold ends of rail both laterally in line and vertically in level
 - They should not wear due to impact, expansion & contraction
- Length of fish plate should not exceed 457mm in India.

FISH BOLTS

- Holes are drilled through plates and web of rails and then fish bolts and nuts are provided in these holes.
- Alternate holes are made elongated and oval shaped so that bolts in the rails will not be turned by vibrations.
- Holes are made of larger diameter generally 5mm- 6mm to allow for expansion & contraction.



SPIKES

- To hold rails to wooden sleepers.
- A rail spike is a large nail with an offset head that is used to secure rails and base plates to sleepers

SPIKES



REQUIREMENTS

The spike should be

- Strong enough to hold rail in position & enough resistance

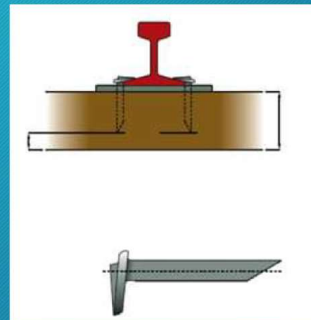
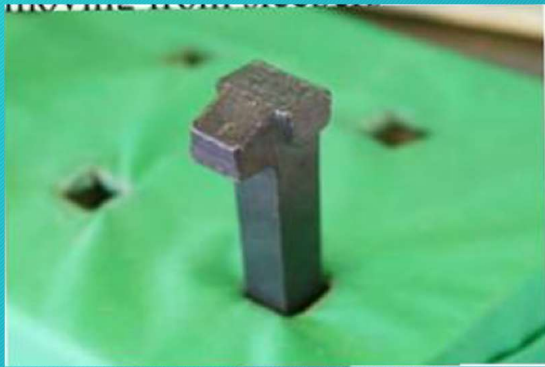
to motion to retain its position

- Cheap in cost
- Deep as possible for better holding power
- Easy in fixing and removal from sleepers
- Capable of maintaining the gauge

DOG SPIKES

- Commonly used
- Hold rail flanges with timber sleepers
- Shape of head of spike resembles ear of dog hence called dog Spike
- Section of spike is square – shape & bottom part is either pointed or chisel shaped
- Cheapest, easy in fixing and re
- Maintain better gauges

DOG SPIKES



SCREW SPIKES

- Tapered screws with V- threads used to fasten rails with timber sleepers.
- Head is circular with square projection

SCREW SPIKES



SCREW SPIKES

- Holding power is double that of dog- spike
 - Resist lateral thrust in better way
 - More costly
 - Gauge maintenance is more difficult
 - Driving operations are similar to dog -spikes
 - Tapered screws with V- threads used to fasten rails with timber sleepers.
- Head is circular with square projection

SCREW SPIKES



BEARING PLATES

- Rectangular plates of Mild steel or cast iron
- Used below flat footed rails to distribute the load on a larger area of timber sleepers
- Placed below rails carrying heavy vehicles at high speed



BEARING PLATES

Advantages:-

- Distribute load to sleepers over a large area and prevent sinking of rail in soft wooden sleepers
- Prevent destruction of sleepers due to rubbing action of rail, increase life of sleeper
- Help in firm and perfect holding of spikes to sleepers which prevent shifting of rails
- Better maintenance of gauge

Ballast

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Ballast

It is a layer of broken stone, gravel, moorum or any other gritty (sand) material placed & packed below & around sleepers for distributing the load from the sleepers to the formation & for providing drainage as well as giving longitudinal & lateral stability to the track.

Ballast - Functions

- Provide level & hard bed for sleepers.
- Hold Sleepers in position.
- Transfer & distribute load to wide area.
- Provide elasticity & resilience to track.
- Provide longitudinal & lateral stability.
- Provide effective drainage.
- Maintain level & alignment of track.

Ballast - Requirements

It should be tough and should not crumble under heavy loads.

It should be cubical shape & angular shape with sharp edges.

It should be able to non-porous & non-water absorbent particles of ballast are usually more durable due to better resistance .

It should not make the track dusty or muddy.

It should offer resistance to abrasion and weathering.

It should not produce any chemical reaction with rails and sleepers.

Ballast - Requirements

It should provide good drainage system.

The size of stone ballast should be 5cm for wooden sleepers, 4cm for metal sleepers & 2.5 cm for turnouts & crossovers.

It should be cheap & economical or the ballast should be available in nearest quarries.

In short, the ballast should be such which fulfils the characteristics of strength, clean ability, durability, economy & stability.

Ballast - Types.....

Broken Stone

Sand

Blast furnace slag or cinders

Soft aggregate like moorum & gravel

Kankar (lime agglomerate which is common in certain clayey soils and is dug out of the ground)

Brick ballast

Ballast - Types-----Broken Stone

- Mostly used in Indian stones like granite, qua railways.
- Procured from hard rtzite, hard trap etc.



Ballast — Types...Sand

- " It is cheap and provides good drainage.
- " The best sand consist of a good quantity of fine gravel & sand which is used on narrow gauge (N.G) tracks.
- " Its blowing effect due to vibration.
- " The sand gets into the moving parts and on the track and causes heavy wear.
- " hence the sand laid is covered with stones, bricks to avoid blowing about too much.

Blast Furnace Slag

- " It is used in yards, sidings etc,
- "It is used as initial ballast in new construction.
- " Cheap & easily available.
- " But its corrosive, harmful for steel.

Moorum

It is the soft aggregate & is the result of decomposition of laterite & has a red & sometimes a yellow colour.

Also as blanketing material on black cotton soil.

Cheap & easily available.

But its corrosive, harmful for steel sleepers & fittings.

Ballast - Size.....

The size of ballast used varies from 1.9 cm to 5.1 cm. The best ballast is that which contains stones varying in size from 1.9 cm to 5.1 cm with reasonable proportion of intermediate sizes.

The exact size of the ballast depends upon the type of sleeper used and location of the track as below.

- * Ballast size for wooden sleeper tracks = 5.1 cm
- * Ballast size for steel sleepers tracks = 3.8 cm
- ° Ballast size for under switches & crossings = 2.54cm

Sleepers

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Sleepers

Sleepers are members generally laid transverse to the rails, on which the rails are supported & fixed, to transfer the loads from the rails to the ballast and the sub grade.

Sleepers - Functions

- " Holding rails to correct gauge and alignment.
- " Firm and even support to rails.
- " Transferring the load evenly from rails to wider area of ballast.
- " Elastic medium between rails and ballast.
- " Providing longitudinal and lateral stability

Sleepers - Requirements

- " The sleepers to be used should be economical, i.e they should have minimum possible initial & maintenance cost.
- " Moderate weight — easy to handle.
- " Fixing & removing of fastenings should be easy.
- " Sufficient bearing area.
- " Easy maintenance & gauge adjustment.
- " Track circuiting (electric insulation) must be possible.
- " Able to resist shocks & vibrations.

Sleepers - Types

= Timber or Wooden Sleepers

" Metal Sleepers

Cast iron sleepers

" Steel sleepers

" Concrete sleepers

Reinforced concrete sleepers

Pre - stressed concrete sleepers

Sleepers - Types

Timber or Wooden Sleepers

Advantages

- Easy to manufacture and handling.
- Suitable for track circuited area.
- Can be used with or without ballast.
- Suitable for all types of ballast.
- Fittings are few & simple in design.
- Alignment can be easily corrected.
- Easily available in all part of India.

Sleepers - Types

Timber or Wooden Sleepers

Disadvantages

Lesser life (12-15 years)

Liable to damage by better packing.

Difficult to maintain the gauge.

Susceptible to fire hazards.



Sleepers - Types

Cast Iron Sleepers

Advantages

- Uniform in strength & durability
- Easy to manufacture and handling.
- Gauge can be easily adjusted & maintained.
- It should be economical, as life is longer.
- Alignment can be easily corrected.
- Not susceptible to fire-hazards.
- Frequent renewal is not required.

Sleepers - Types

Cast Iron Sleepers

Disadvantages

- More ballast required.
- Not suitable for high speed route.
- Lesser lateral stability.
- Not fit for track circuited area.
- Tie bars weakened by corrosion.
- Fittings required are greater in number & difficult to maintain and inspection.

Sleepers - Types

Steel sleepers

Advantages

- " Longer life (30 to 40 years).
- " Better Stability.
 - = Lesser damage during handling / Transport.
 - = Easy to maintain Gauge.
- " Simple Manufacturing Process.
- " High Scrap value.
- " They are not attacked by vermin's.
- " They are not susceptible to fire hazards.

Sleepers - Types

Steel sleepers

Disadvantages

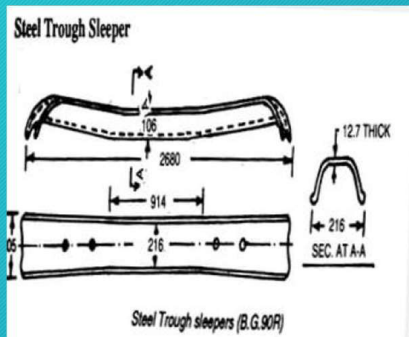
" Liable for corrosion.

" Not fit for track circuited area.

= Develops cracks at rail seat during service.

" The overall cost of steel sleepers is more than that of timber sleepers.

= Fittings required are greater in number & difficult to maintain and inspection.



▪ Steel sleepers

Sleepers - Types

Concrete sleepers

"Advantages

- " Longer life (40 to 60 years).
- " Better Stability.
- " Lesser damage during handling / Transport.
- " Easy to maintain Gauge.
- " No chances of damage by fire/ corrosion
- " No possibility of theft.
- " No chances of gauge widening.
- " They are not attacked by vermin and natural decay.
- " There is no difficulty in the track — circuiting.

Sleepers - Types

Concrete sleepers

Disadvantages

- " Handling and laying is difficult being heavy.
- " Damage is very heavy in case of derailment.
- " No scrap value.
- " Not suitable for manual packing.
- " They damage the bottom edge during the packing.

