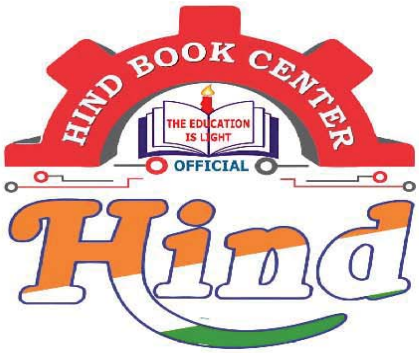

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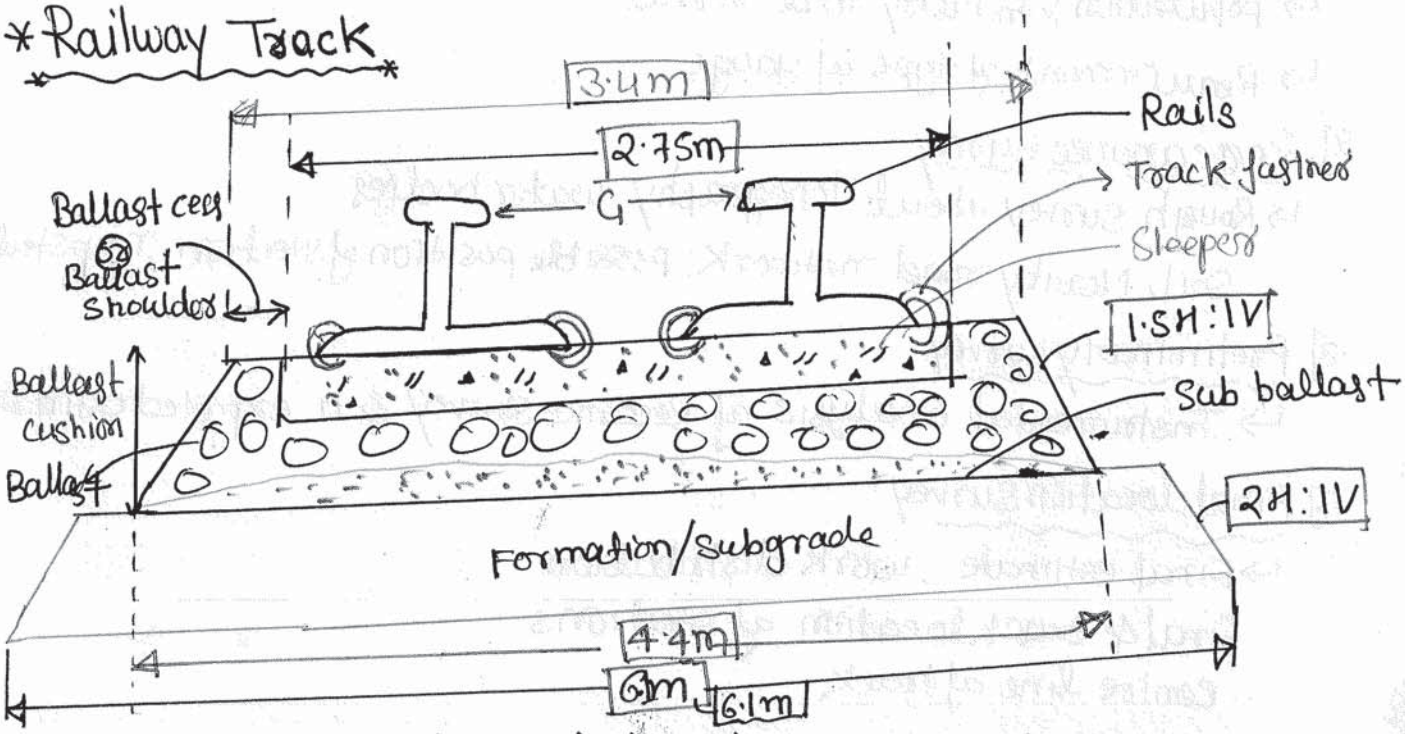
Leeture-1 ★ Railway Engineering ★ 22 October 21

↳ Railway is very huge, rapid and reliable transporation system all over the world.

*Railway Track



Rails ⇒ Allows movement of Train

Sleeper ⇒ hold rail in position & take load from rails

Ballast ⇒ hold Sleeper & Rail in position & distribute load coming from sleeper.

Track fastner ⇒ Attach rail & sleeper together

Formation/subgrade ⇒ working as a formation of track.

Sub ballast ⇒ → made from murrom soil (Fine grained soil)
↳ less permeable soil ↳ Decomposition of laterite

Survey Required Before Railway track construction

1] Traffic Survey
- ↳ Number & type of train
- ↳ population & Industry to be served
- ↳ Requirement of type of gauge

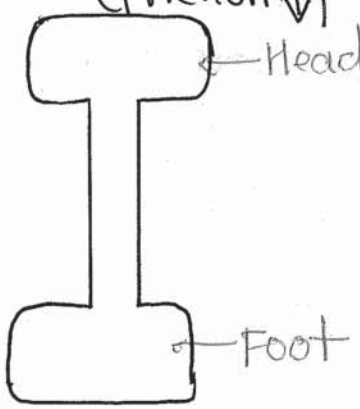
2] Reccanance survey
- ↳ Rough survey about topography, water bodies Soil, Nearby road network, possible position of station., map study

3] Preliminary survey
- ↳ Instrumental analysis of Reccance survey & a expected estimate

4] Final location survey
- ↳ Final estimate, work distribution
  Final & exact location of stations
  centre line of track

☆ Chapter 1 ☆ Rails

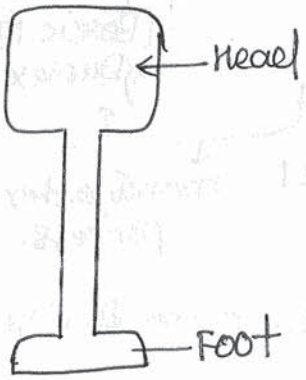
→ Strong, smooth, Frictionless
→ parallel, levelled, & continuous
→ it is a continuous girder as it allows movement of train ie moving load.
→ ∵ Contact Area of wheel is very less with compare to perimeter, so moving load considered as point load (Friction ↓)



→ equal thickness of Head & Foot
→ Purpose to use from both side but found lot of wear & Indentation mark at bottom due to movement of train.

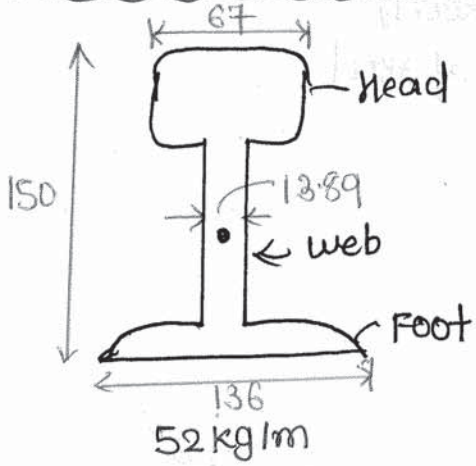
1] Double Headed

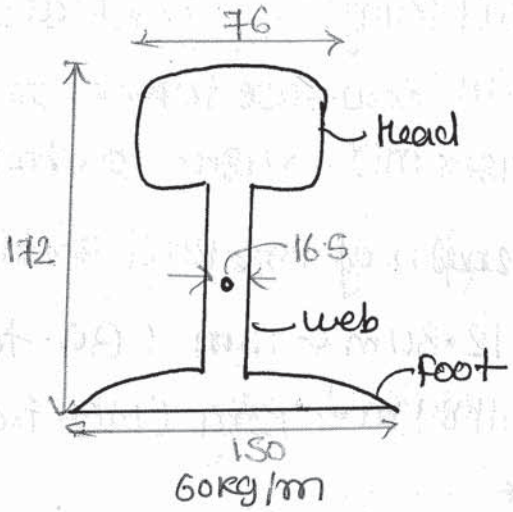
2] Bull headed Rail



→ Top head thickness increased

3] Flat Footed Rail





→ Carbon > Magnese > Silica > Phasporous > Sulphur.

→ Equal distributed of material

→ CG must be in centre to reduce chances of development of bending stress

→ Head ⇒ Should be enough thick to provide vertical Stiffness

→ web ⇒ Should be enough thick to provide flexural Rigidity in horizontal plane

→ foot → Should be flat, to resist overturn & start distribution of load.

	Speed	UTS(Mpa)	A(mm²) ☆	GMT (Gross million Tonn per year per km)
52 kg/m	130 kmph	710	6615	20-25
60 kg/m	160 kmph	880	7686 ☆	35

Note① Identification of Rail

Roman (11)

IRS-52-710-SALT-XI-17-OB

- IRS-52 → Rail Section (weight)
- 710 → UTS
- SALT → Manufacture (company)
- XI → month
- 17 → year (like 2017)
- OB → manufacturing process (1) open breath 2) Basic Bessmer 3) Duplex)

Note② Falling weight test & Tup test to be done on Rail section.

Note③ Rail tongs – to hold rail

Jim (Row – use to bend or break Rail)

Visex mix → used to check level of rail

Note④ Length of one Rail section

= 12.80 m ≃ 13m (BG-track)

= 11.89 m ≃ 12m (MG-track)

Important

Defects in Rail

1] Corrugation in Rail / Roaring Rails (Rail pe dhul jaisi jamna)

↳ Minute depression over top of rail surface (spreading in nature)

↳ when train moves from it makes roaring sound (Train becomes चीता)

↳ it can also occur due to accumulation of dust over rail surface

↳ generally cause behind depression is break application, accelaration etc.

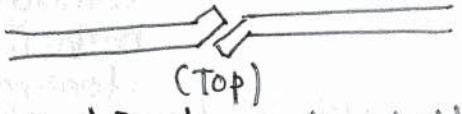
2] Hogging in Rail

↳ due to loose fish plate & bolt

③ Kinking in Rail (Ye bolt loose hone ke vajah se)

↳ Placing of ballast becomes loose alongwith fish plate and fish bolt.

↳ Rails misalignment (out of tract)

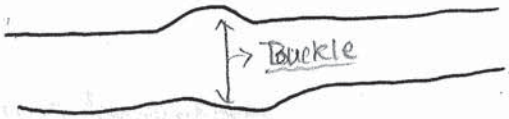


4] Buckling of Rail (Ye bolt tight hone ke vajah se)

→ Due to tights bolts & close packing of rails, if further temprature increase rail buckles in letral Direction

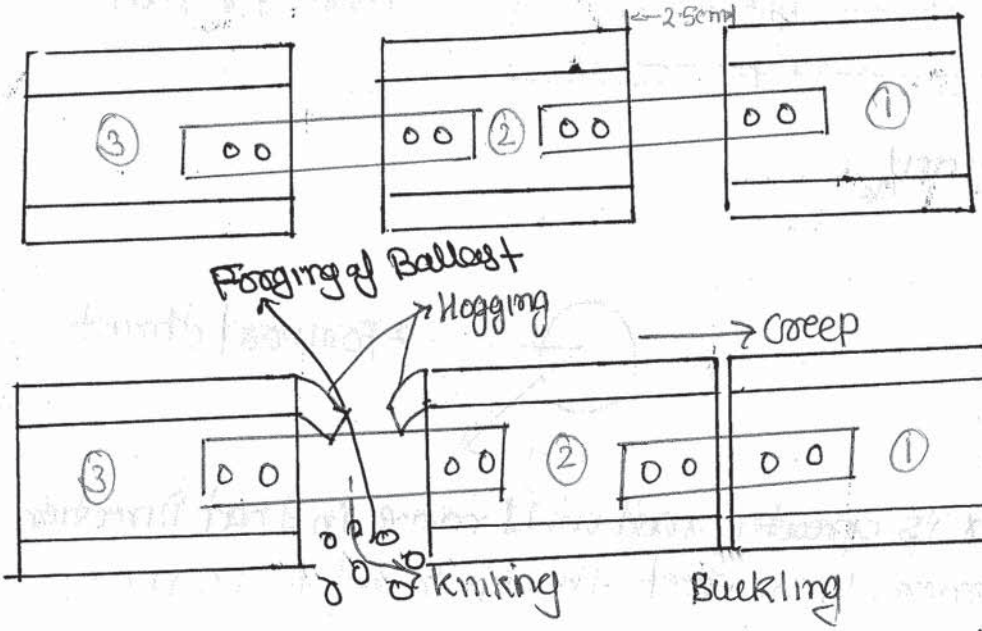
→ Misaliangment → widening of gauge.

→ downword deflection will not occur due to continuous support.



VVImp

5] Creep in Rail (Natural)



⇒ The movement of rail w.r.t sleepers in the direction of traffic known as creep of track

⇒ ≯150mm or 6 continuous rail should not be subjected to creep.

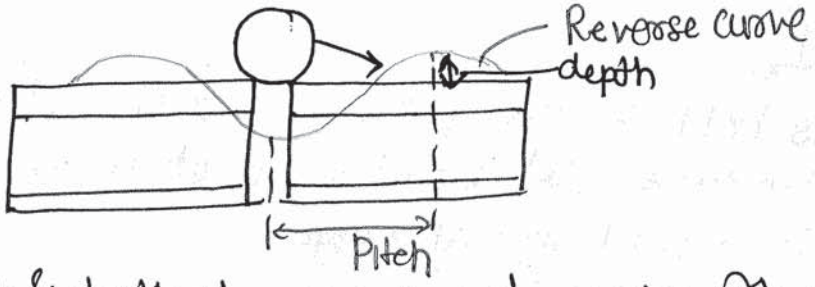
⇒ Atleast with in 3 months

⇒ Creep indicator.

⇒ If joint is close from one side & open from other side signifies creep

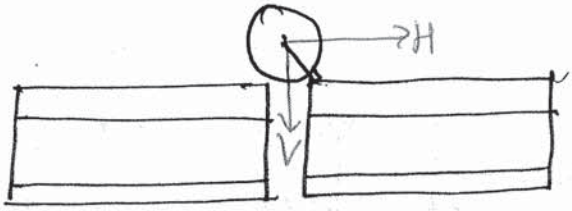
⇒ Closing of Joint ⇒ Buckling
Opening of Joint ⇒ Hogging, Kinking, Forging of Ballast.
↳ coming out of ballast due to loosing of packing

① Wave Theory



↳ Pitch & depth of wave depend on Strength, Stability & Track modulus.

② Percushion Theory



Horizontal component of Impact force will move the rail.

③ Drag Theory *

→ whichever is greater, rail will move in that Direction
(Generally Forword thrust found to be more)

6] Wear in Rail

↳ Due to abnormal loading, high speed of train when stress on the rails becomes more than the yield stress metal will flow know as wear of the rails

↳ It can occur

At Top
- → Corrugation
- → Skidding & Slipping of wheel
- → Vertical loading
- → Corrosion & humidity

At Side ⇒ Due to Shrinkage of wheel Flane

At Ends ⇒ Due to Creep, Hogging, Kinking etc

Total wear ≯ 5%
Top wear ≯ 25%

Rail Joint

↳ Rail joint are suppose to be weakest portion in a railway track

↳ Ideally Rail joint should be elastic

↳ As the Number of joint Increases the chances of Creep, hogging Kinking and also increases lots of cost because of the Number of fish plate and bolts

↳ So to make it economic and more stronger welding of rail is done.

↳ welding provides such a restrained at the ends of rail So that fastners can do the work propely (Resisting the Buckling)

↳ Sucess of welded rail depends upon strength of fastners

↳ welding of rail reduces no. of joint, chances of failure, make it economical also reduces the maintainee

Type of welded Rail

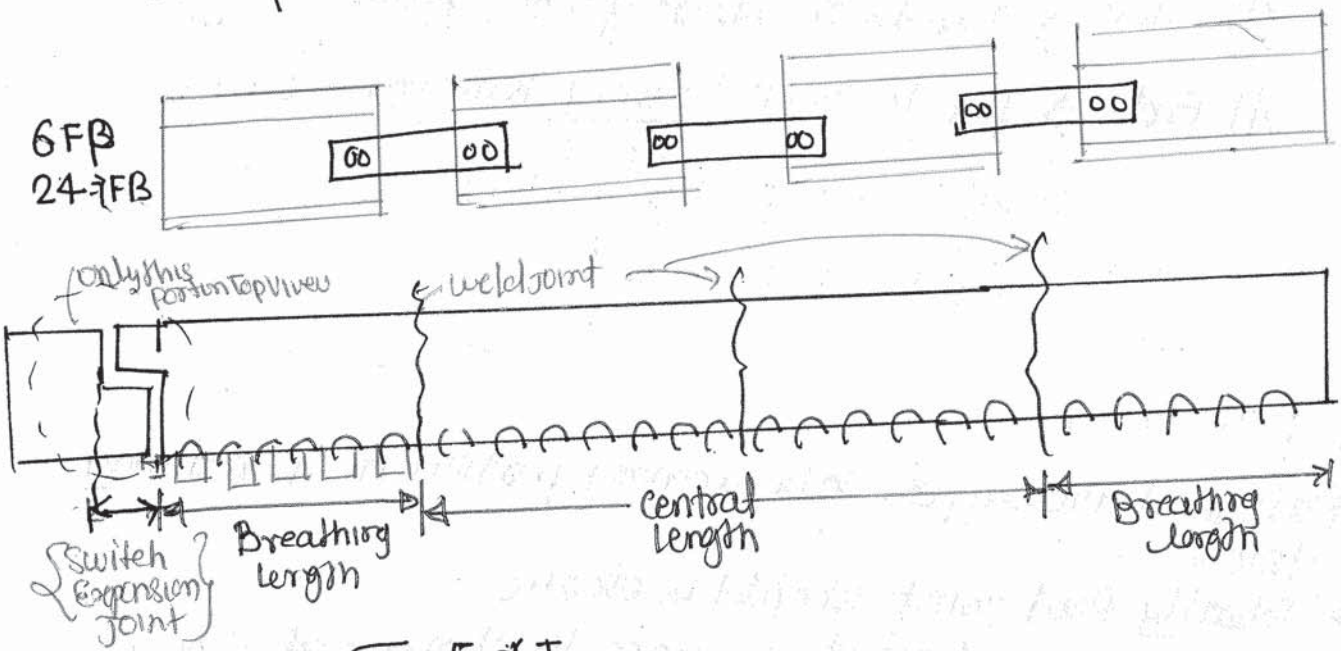
① Short welded Rail ⇒ 3, 5 or upto 10 rail

↳ As a entire length of short welded rail is subjected to temprature. so not suggested that.

② Long welded Rail (LWR) ⇒ 200–300m upto 1000m

↳ In Long welded rails the centre portion of is not allow to expand because of fastners.

↳ The end length of either sides of LWR is allow to expand is known as breathing length.



$\sigma = E\alpha T$

$\therefore F = AE\alpha T$ (Force to be resisted due to Temprature Increment)

R = Resisting capacity of sleeper

$$\text{No. of sleeper} = (n) = \frac{F}{R}$$

$$\text{Breathing length } (L) = (n-1)S$$

③ Continuous welded Rail (CWR) S ⇒ Spacing between sleeper.

– welding > 1km (Station to Station)

→ Not suggestable.

Question: A 60kg/m rail is subjected to temprature increment 30°C the rail section is provided above the concrete sleeper having the resisting capacity of 300kg and placed at spacing 50cm c/c calculate the Breathing length required $E = 2.1 \times 10^5 N/mm^2$, $\alpha = 11.3 \times 10^{-4}/°C$

Solution

$$F = AE\alpha\Delta T = 7686 \times 2.1 \times 10^5 \times 11.5 \times 10^{-4} \times 30$$

$$F = 5568507N$$

$$R = 300kg$$

$$n = \frac{F}{R} = \frac{5568507}{300} = 189.9 \simeq 190$$

$$L = (n-1)S$$

$$= (190-1) \times 0.5$$

$$L = 94.5m$$

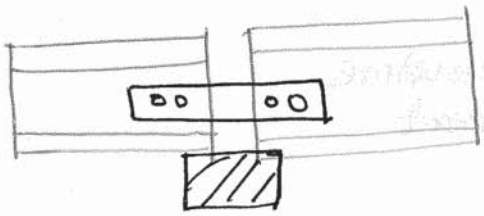
Total Breathing length $= 2 \times 94.5$

$= 189m$

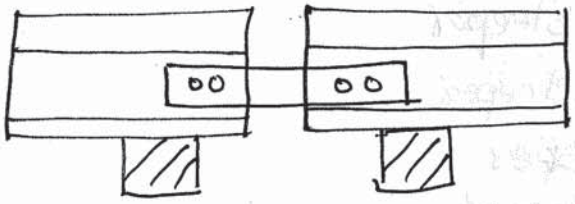
$$\frac{\Delta}{2} = L\alpha T$$

* Types of Joint *

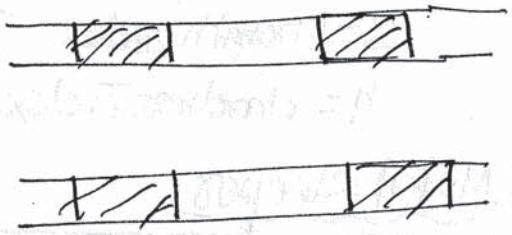
1] Support Joint



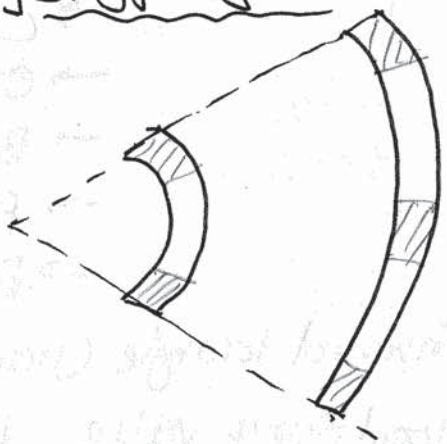
2] Susperdered Joint



3] Squar Joint



4] Staggerd Joint

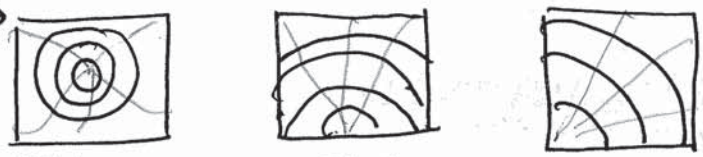


#2 Sleeper (Ballast also prove but last than sleeper)

↳ Sleepers are provided to hold the rail in correct position, to provide the elasticity, to distribute the load coming from rails, to ballast.

① Wooden sleeper

↳ Sal, teak, Chir, deodar
Hard soft

→ 

Ekka or Box headed | Slab | Quater

↳ It fails due to Natural decay

→ Life 10-15 years

→ Composite Sleeper Index → 1) Point crossing > 1352
2) Bridge > 1455

$$CSI = \frac{S + 10H}{20} > 783$$

S = Strength Index
H = Hardness Index
} At 12% moisture content

② Metal Sleeper

Steel Sleeper

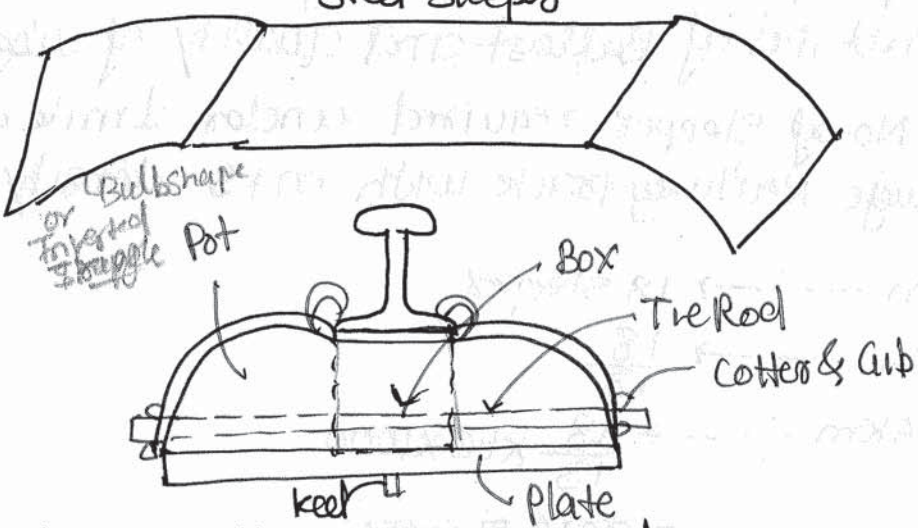
Cast Iron Sleeper
→ CST-9 Sleeper
→ CI-PoT Sleeper
→ Box Sleeper
→ Plate Sleeper
→ Duplex Sleeper

Same Idharbhi ⇐

→ Inverted triangle (bulb shape) (trough) provide extra grip over ballast.

→ good Scrap value, Design life 35-40 years

Steel Sleeper



→ does not allow tracking circuiting
→ lots of joints are needed
→ less lateral stability
→ corrosion (steel)

③ Concrete & prestressed sleeper → M55 – M60 concrete

→ High shock absorber
→ High Track modulus
→ design life 50-60 years
→ allow Track circuiting
→ easy to manufacture

Disadvantages
→ heavy in weight
→ Not good for beater packing
→ Less scarap value

Note Size of Sleeper
↳ 275cm x 25cm x 13cm (Im General)
↳ 275cm x 25cm x 15cm } Bridges
x 18cm }

Sleeper Density
↳ The No. of sleeper per rail is known as sleeper Density
↳ It varies from M+3 to M+7

m = length of one rail
= 12.8m ≃ 13m (B.G)
= 11.89 ≃ 12m (MG)

→ Density of sleep depends on strength of rail, material of sleeper, material of Ballast and quality of subgrade

Q.1] calculate No. of sleeper required under 1mile of Board Gauge Railway track with m+s density.

$$13m \longrightarrow 18 \text{ sleeper}$$

$$1m \longrightarrow \frac{18}{13}$$

$$1.6Km \longrightarrow \frac{18}{13} \times 1.6 \times 1000$$

$$= 2216 \text{ sleeper}$$

Q.2] If 4800 sleeper are provided under 3km of metr gauge track calculate sleep density

$$3km \longrightarrow 4800 \text{ sleeper}$$

$$3000m \longrightarrow 4800 \text{ sleeper}$$

$$1m \longrightarrow \frac{4800}{3000}$$

$$12m \longrightarrow \frac{4800}{3000} \times 12 = 18 \text{ sleeper}$$

$$= (m+6)$$

Note: Adjustment of ballast

to make the sleeper parallel to each other known as squaring of sleeper.

#3] Ballast

↳ Ballast is provided under the sleepers to hold the sleepers and rail in the correct position
↳ It provides drainage (1.9cm – 5.1cm size of ballast)
↳ provides some extent of elasticity (Bahut kam)
↳ Distribute the load uniformly which is coming from Sleeper
↳ provides letral stability to tracks
↳ ~~It provides~~ super elevation provided by ballast at curve

Type of ballast

① Stone Ballast ⇒ broken pieces of Igneous Rock

② Brick Ballast ⇒ overburnt Brick
→ provide good drainage

③ River pabbles ⇒ used for soft formation
→ broken piece can only gives roughness.

④ Ashes & cinders ⇒ can't be used under busy track
→ Can be used in yards
→ convert into dust when load comes over it.
→ promote corrosion of rail

⑤ Sand Ballast
↳ can blow off when Train comes
→ Sleeper packed under sand ballast are Silent Sleeper
→ Also induce corrogation.

Ballast Shoulder

↳ Ballast shoulder is provided beyond the sleeper length for providing letral stability upto 38cm – 43cm
↳ Ballast shoulder can be increased by 15cm at outer rail of curve for provide additional letral stability