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B.Tech (CE)

Subject → Railway Engg

Date

21 Feb 2022

Topics ⇒ ① Rails, Rail Joints

② Sleepers, Fasteners

③ Ballast, subgrade

④ Stresses on Track & creep of Rail ⑤ Geometric design of Track

⑥ Points & crossing

⑦ Junctions (Tracks)

⑧ Equipments

⑨ Signalling & control system

⑩ Tractive Resistance

① Ralls

Ralls : \Rightarrow • These are steel girders or beam used for carrying the axle (train load) and transfer is to the subgrade through sleepers and ballast.

- obj. • Ralls converts the moving wheel load of train into point load, which acts on the sleepers.
- Since it has to resist high wear & tear it is made of high carbon steel.
 - In India, its manufacturing is done Open Hearth / Duplex process.
 \hookrightarrow (latest process)

Note : \Rightarrow Steel is manufactured by two process.

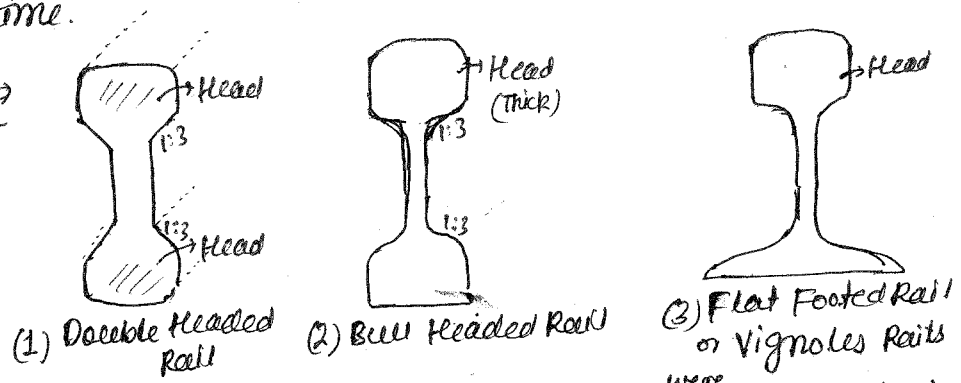
- (a) Triplex process : \Rightarrow It has three main production facilities
- (i) Acid Bessemer converter
 - (ii) Basic open hearth Furnace
 - (iii) Acid " " "

It is outdated hence not adopted.

(b) Duplex process : \Rightarrow • It consist of ~~now~~ blowing hot metal & scrap in the acid bessemer converter & finely refining them in Basic open hearth.

- Here scrap is also used or utilized.
- Used in today's time.

Types of Ralls : \Rightarrow



- (1) Double Headed Rail (DH Ralls) : \Rightarrow • These rails ~~are~~ used in beginning.
 • The idea behind providing two heads was, if one head will wear out the rail can be inverted & reused.
 • But in lower part due to indentation the smooth running surface is not obtained.

(2) Bull Headed Rails: \Rightarrow In these rails, head was made a little thicker and stronger than the lower part.

(3) Flat Footed Rail / Vignole rail: \Rightarrow Here bearing plate / flat plate is used at bottom.

• These rails are designated by weight of rail per unit length.

• ^{designation} 52 kg/m or 52 MR \longrightarrow V (speed): $V \leq 130$ kmph

• 60 kg/m or 60 MR \longrightarrow $V \leq 160$ kmph.

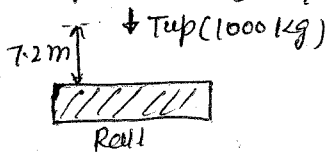
• Flat footed rails are more stronger, stiffer, easy to lay, cheaper and easy to maintain in comparison to double head / bull headed rails.

Requirement of Rails: \Rightarrow (i) These must be capable of with standing the lateral forces [hence width of head & foot is increased].

(ii) To allow for vertical wear of 10mm on its head. otherwise change the rail.

(iii) Minimum tensile strength is 72 kg/cm².

(iv) Must pass Weight / Tup test [Falling weight test] \rightarrow 1.5 m rail on length



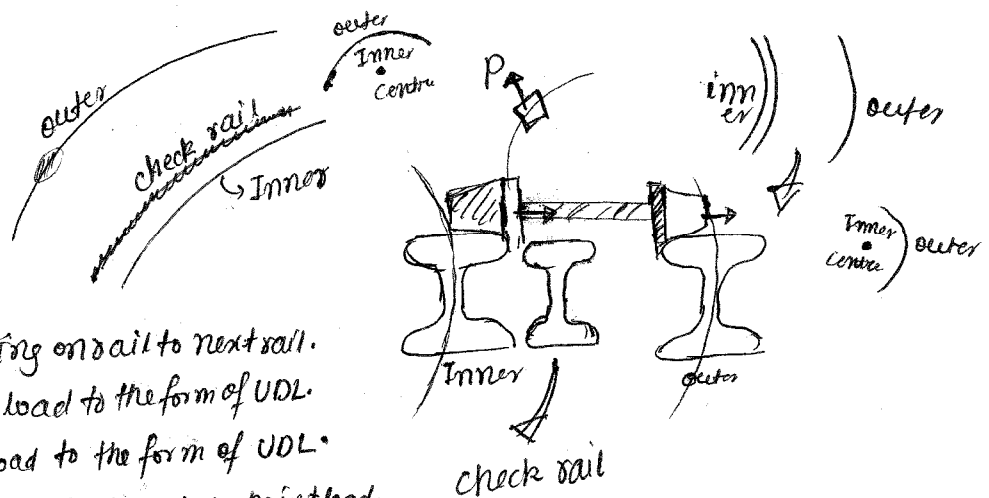
at site 1000 kg weight on steel feet on rail upto 7.2 m. It should not fall.

(v) Ratio of weight of rail to weight of locomotive (axle load) is 1:50.

(vi) When the wear of head exceeds 5% to total weight, it must be replaced.

(vii) On curves, check rail parallel to the inner rail is introduced to control wear and tear of outer rail and to avoid the derailment.

(viii) Check rail is used if curve is more than 8° for BG and more than 14° for MG.



* Fish plates \rightarrow connecting one rail to next rail.

* Sleepers \rightarrow transfer point load to the form of UDL.

* Ballast \rightarrow transfer line load to the form of UDL.

* Rails \rightarrow it convert rolling of wheel into point load.

Note: \rightarrow Manganese steel is used in the manufacturing of metro and mono rails.

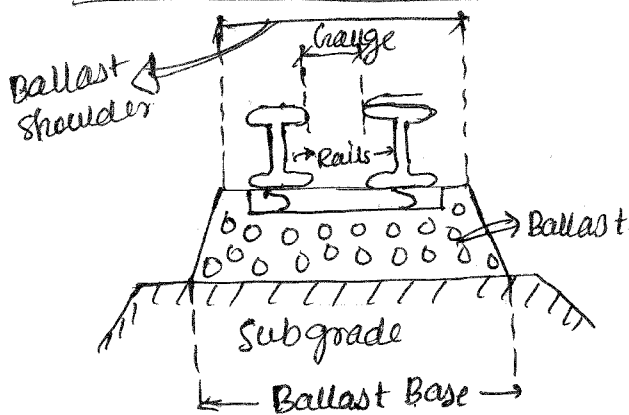
obj # Length of Rails : \Rightarrow • Since joints are weakest point of railway track & they require fasteners also, number of joints are required to ^{be} reduce. Hence larger rails are preferred to smaller rails & as they would give strong rails & economical rails.

• Rail length is restricted by transportation limitation and due to gap required for expansion joint ($L \times \Delta T = \Delta l$, $(L \uparrow) \rightarrow \Delta l(\uparrow)$)

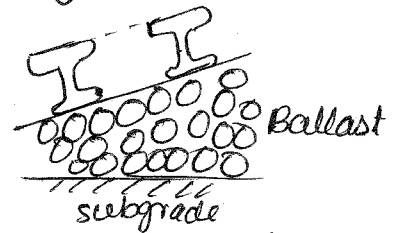
obj • Rail length for "BG" track is 12.8 m (\approx 13m)

• Rail length for "MG" track is 11.89 m (\approx 12m)

Permanent way / Railway track : \Rightarrow • Combination of rails fitted on sleeper, resting on ballast & subgrade is called permanent way.



• On curve, super elevation is maintained by Blast & formation is levelled.



• On this way rails are joined by Fish plates & Bolts.

obj • Permanent way is regarded as Semi-elastic in nature.

Requirement of an Ideal permanent way : \Rightarrow (i) Gauge should be correct & uniform.

(ii) It should be elastic to absorb the vibration of track.

(iii) Drainage should be perfect.

(iv) It should be properly maintained & design.

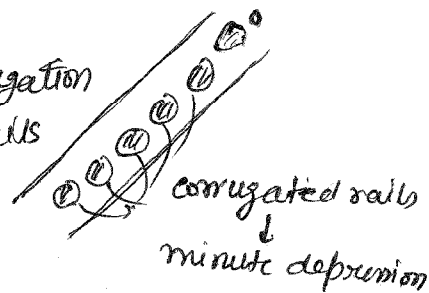
(v) It should have sufficient lateral strength.

Defects in Rails : \Rightarrow (1) Corrugated Rail : \Rightarrow • The corrugation of the rails

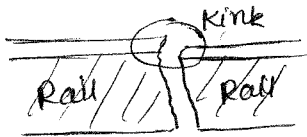
are minute depressions on the surface of the rails.

• These are created at the place where either brakes are applied (eg on curves) or where trains start.

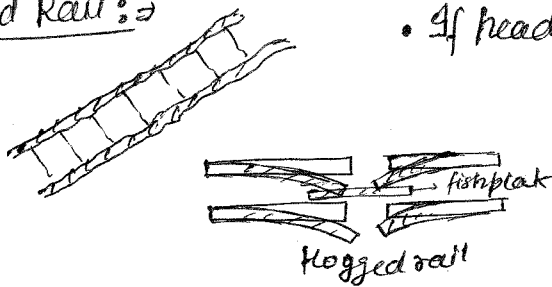
• When train passes over it, it makes roaring sound.



- (2) Kink in Rails ⇒ • When ends of the adjoining rails, move slightly out of position, kinks are formed.
- These occur due to loose packing of joint.

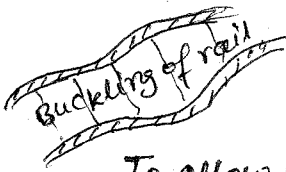


(3) Hogged Rail ⇒



- If head of the rail gets bent down due to impact action of rail it is termed as hogged rail.

(4) Buckling of Rail ⇒



- If gap is not sufficient or not available then thermal expansion would cause thermal stresses that lead to buckling.

- During summers due to rise in temperature, the expansion of rail occurs.

To allow this expansion, certain gap in b/w two rails is provided at the end joints.

- Buckling may also take place if fish plates are tightly bolted.

Gauges in Railway Track ⇒

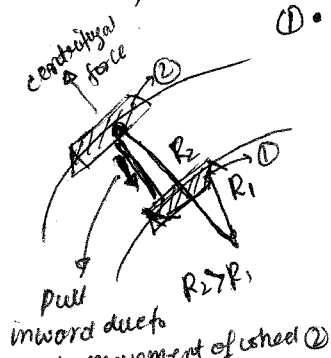
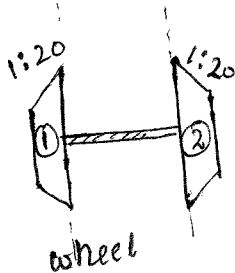
- It is defined as clear distance b/w inner or running faces of two track rails.

Type of gauge	
(i) Narrow gauge	→ 0.762 m
(ii) Meter gauge	→ 1 m
(iii) Standard gauge	→ 1.435 m (Not used in India)
(iv) Broad gauges	→ 1.676 m

- BG is preferred over MG & NG as:

- It gives more stability. (operations stability like joint providing, switch the track).
- It offers higher speed.
- It can take more load.
- It is more economical.

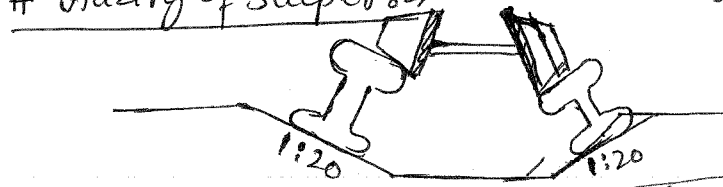
Coning of the Wheel ⇒ • The wheels of the train are made at a slope of 1:20. This is known as coning of the wheel.



- Coning is done on a straight track to keep the train just in central position during movement so that distance travelled by two wheels are always same.

(2) Coning on curved track is also done to overcome the effect of centrifugal force. Coning of wheel also reduce wear and tear of flange. Here skid permitted is 0.029 m per 1° of central angle.

Adzing of sleepers ⇒



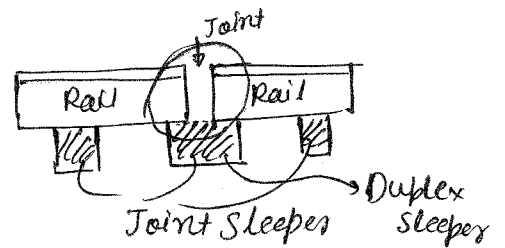
coning → ~~raised sleepers~~ coning wheel out on curve &
adzing → sleeper on slope

• For the effective use of coning of wheels the rails are not laid horizontal. These are laid on angle or slope of 1:20 on sleeper termed as adzing of sleepers.

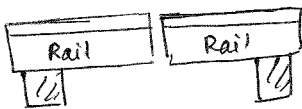
Rail Joints ⇒ • Rail joints are necessary to hold together the adjoining ends of the rails in correct position both in Horizontal & Vertical direction.

• Joints are of following types:

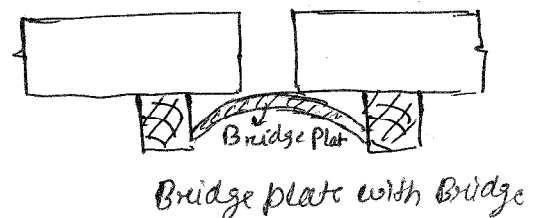
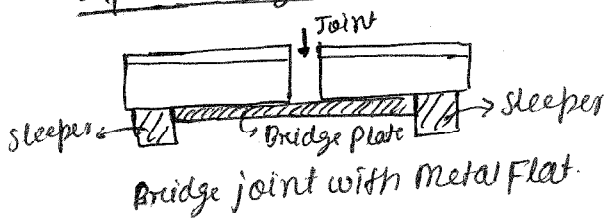
(a) Supported Rail Joint ⇒ • When the rail ends rest on a single sleeper called joint sleepers, the joint is termed as supported Rail Joint.



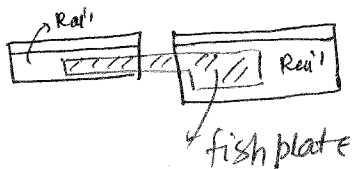
(b) Suspended Rail Joint ⇒ • When rail ends are projected beyond sleeper called shoulder sleepers, the joint is called as suspended rail joint.



(c) Bridge rail Joint ⇒ • When rail ends are projected beyond sleepers as in case of suspended joint & they are connected by a flat or corrugated plate the joint is termed as Bridge rail joint.



(d) Compromise Joint ⇒ • When two different rail section are joined by fish plate, the joint is termed as compromise joint.



(e) Expansion Joint: \Rightarrow • To allow the thermal expansion at the end joints of so rail, so gap is provided, this type of joint is termed as expansion joint.

(f) Welded Joint: \Rightarrow • These are considered to be the most strongest joint in rails.

Need of Welding of Rails: \Rightarrow • To increase the length of rail by joining two or more rails.

- To increase the life of rail track & reduce maintenance cost.
- To avoid the used of expansion joint at the ends of rails.
- To reduce creep & buckling of rail ends.
- To maintain proper gauge & alignment of rails.

Types of Welded Rail: \Rightarrow It depends upon length.

(a) Short Welded rail (SWR): \Rightarrow • If ^(In India) 3 or 5 or 10 rails length are welded together at both ends it is termed as short welded rail.

(b) Long welded rail (LWR): \Rightarrow • If 200m length of rail (for BG) and 300m (for MG) is welded at both the ends it is termed as LWR.

• Its maximum length can go upto 1000m.

(c) Continuous Welded Rail (CWR): \Rightarrow • If welded rail is longer than 1 km extending from 1 station to another is termed as CWR.

Length of Welded Rail: \Rightarrow

increase in length 'l' of rail due to temp rise " Δt " is

$$\Delta l = l \alpha \Delta t$$

$$\text{Strain in the rail} \Rightarrow \epsilon = \frac{\Delta l}{l} = \alpha \Delta t$$

$$\text{Thermal stress in rail } (\sigma_T) = \epsilon \cdot E_s = \alpha \Delta t \cdot E_s$$

$$\text{Force developed in rail } F = \sigma_T \times A = (\alpha \Delta t \cdot E_s) \times A \quad A \rightarrow \text{Area of Rails}$$

