RAILS :- Rails are the members of the track laid in two parallel lines to provide an unchanging, continuous and level surface for the movement of trains. Rails are made-upof high carbon steel to withstand stresses.

FUNCTIONS OF RAILS:-

1) Rails provide a continuous and level surface for the movement of trains.

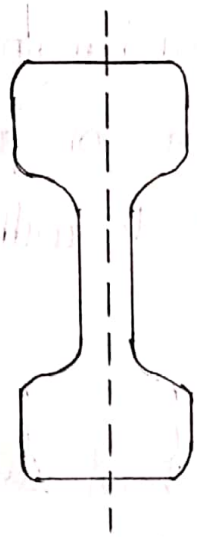
2) They provide a smooth pathway o with very little friction. The friction between the steel wheel and steel rail is about $1/5^{th}$ of the friction between pneumatic tyre and a metalled road.

3) They serve as lateral guide for the wheels.

4) They bear the stresses developed due to vertical loads and thermal forces.

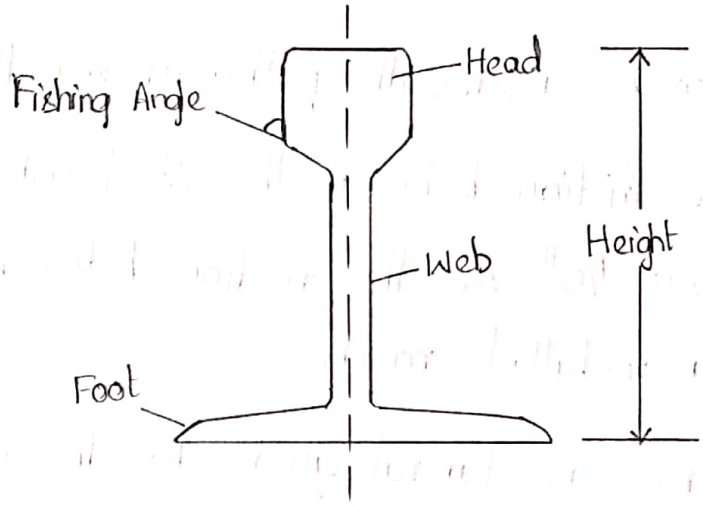
5) They carry out the function of transmitting the load to a large area.

## Types of Rails :-



a) Double headed rail

b) Bull headed rail




c) Flat-Footed rail

## Requirements of An Ideal Rail Section :-

a) The rail should have the most economical section consistent with strength, stiffness and durability.

b) The centre of gravity of the rail section should preferably be very close to the mid-height of the rail so that the maximum tensile and compressive stresses are equal.

c) The distribution of metal in various components of rail like head, web and foot should be properly balanced to fullfill its requirement properly.

The requirements for the design of rail componants are as follows:

Head: The head of the rail should have adequate depth to allow for vertical wear. The rail head should be sufficiently wide so that wide running surface is available, and the rail has desired lateral stiffness

Web:- The web should be sufficiently thick enough to withstand the loads.

Foot:- The foot should be sufficient thick and wide enough to withstand vertical and horizontal forces and stability against overturning.

Fishing Angles: The fishing angles should be such that the tightening of plate does not produce any excessive stress on the web of the rail.

Height of the rail: The height should be adequate so that the rail has sufficient vertical stiffness and strength as a beam

Weights of rails: Though the weights of a rail and its section depends upon various considerations, the heaviest axle load that the rail has to carry the most important role. The thumb rule for maximum axle load with respect to rail section is as follows.

Max. axle load = 560 x sectional weight of rail in lbs per yard & kg per metre

(for rails 90 lbs per yard)

Max. axle load = 560 x 90 lbs = 50,400 lbs or 22.5 tones

Length of Rails:-

Theoritically, the longer is the rail, the lesser would be the no. of joints and fittings required and the lesser the cost of construction and maintenance. Longer rails are economical and provide smooth and comfortable rides.

The length of rail is however restricted due to the following factors.

a) Lack of facilities for transport of longer rails, particular-ly on curves.

b) Difficulties in manufacturing very long rails.

c) Difficulties in acquiring bigger expansion joints for long rails

d) Heavy internal thermal stresses in long rails.

Taking the above factors into consideration, Indian Railways has standardized a rail length of 13m (previously 42ft) for broad guage and 12m (previously 39ft) for MG and NG tracks. Indian railways is also planning to use 39m, and even longer rails in its track system.

## CREEP OF RAILS:-

Creep is defined as the longitudinal movement of the rail with respect to the sleepers. Creep magnitude in rails varies from place to place.

## THEORIES FOR THE DEVELOPEMENT OF CREEP:-

### 1. Wave Motion Theory:

According to this theory, wave motion is setup in the resilient track because of moving loads, causing a deflection in the rail under load.

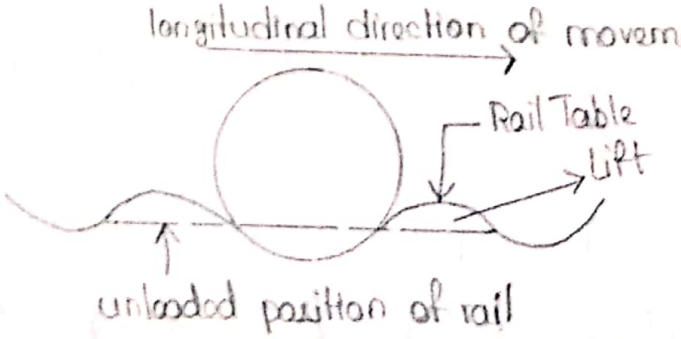



fig:- Wave motio theory for development of creep

The rails generally have a wavy formation. As the wheels of the train move forward, the depression also move with them and previously depressed portion springs back to original level.

The ironing effect of the moving wheels on the wave formed in the rail causes a longitudinal movement of the rail in the direction of traffic resulting in the creep of the rail.

2. Percussion Theory:

According to this theory, creep is developed due to the impact of wheels at the rail end ahead of a joint. The continuous movement of several wheels passing over the joint pushes the facing of landing rail forward causing creep.

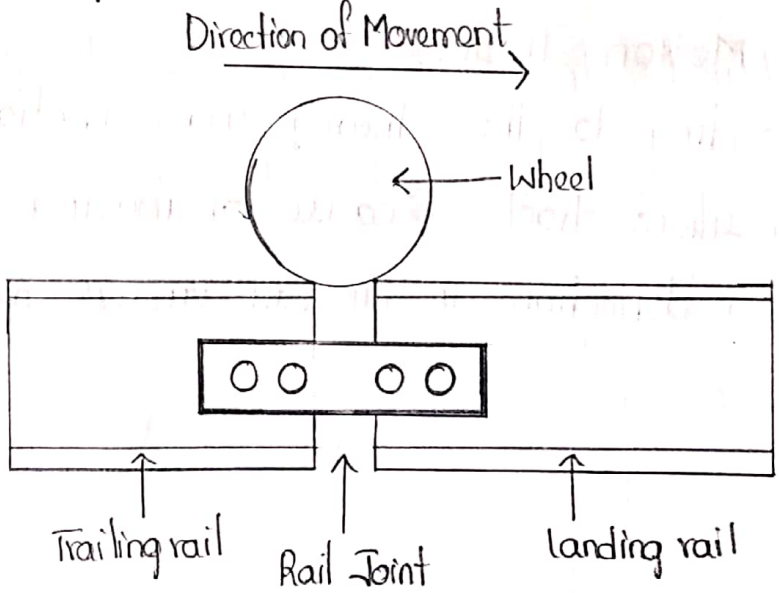



Fig:- Percussion Theory for development of Creep.

3. Drag Theory:- According to this theory the driving wheels of a locomotive has the tendency to push the rail backwards, while the thrust of the other wheels of locomotive and trailing wagon pushes the rails in the moving direction of locomotive causing creep in the logitudinal movement.

## Causes of Creep:-

The factors that are responsible for the development of creep are as follows.

a) Ironing effect of the wheel
b) Starting and stopping operations
c) Changes in temparature
d) unbalanced Traffic
e) Poor maintenance of track.

## Effects of Creep:-

The following are the common effects of creep.

a) Sleepers out of square.
b) Expansion in gaps get disturbed.
c) Distortion of points and crossings
d) Difficulty in changing rails.
e) Effect on interlocking
f) possible buckling of track
g) other effects.

## Measurement of Creep:-

Creep can be measured with the help of a device called creep indicator. Amount of creep is measured by fixing two creep posts (generally rail pieces) driven at 1km interval on either side of the tracks ensuring that the top level is at same level for easy measurement.

A mark is made at the side and the bottom flange of the rail using a chisel on either side of the track. A fishing string is then stretched b/w the two creep posts and the distance b/w the chisel mark and the string is taken as the amount of creep.

Creep greather than 150mm (6inch) should not be permitted on any track and not more than 6 consecutive rails should be found jammed in a single rail track at one location. Creep is avoided at crossings and approach points.

MEASURES TO REDUCE CREEP:-

1. To reduced creep in a track, it should be ensured that the rails are held firmly to the sleepers and that adequate ballast resistance is available.

2. All spikes, screws and keys should be driven properly.

3. The toe load of fastenings should be always slightly more than the ballast resistance.

4. Fixing up creep anchors to the rails effectively reduces the creep in a track.

## Coning of Wheels :-

The thread of wheels of a railway vehicle is made in cone shape at an inclination of 1in 20 to enable the vehicle to move smoothly on curves as coelle as straight tracks, and the same slope is provided in rails, This is known as Coning of wheels.

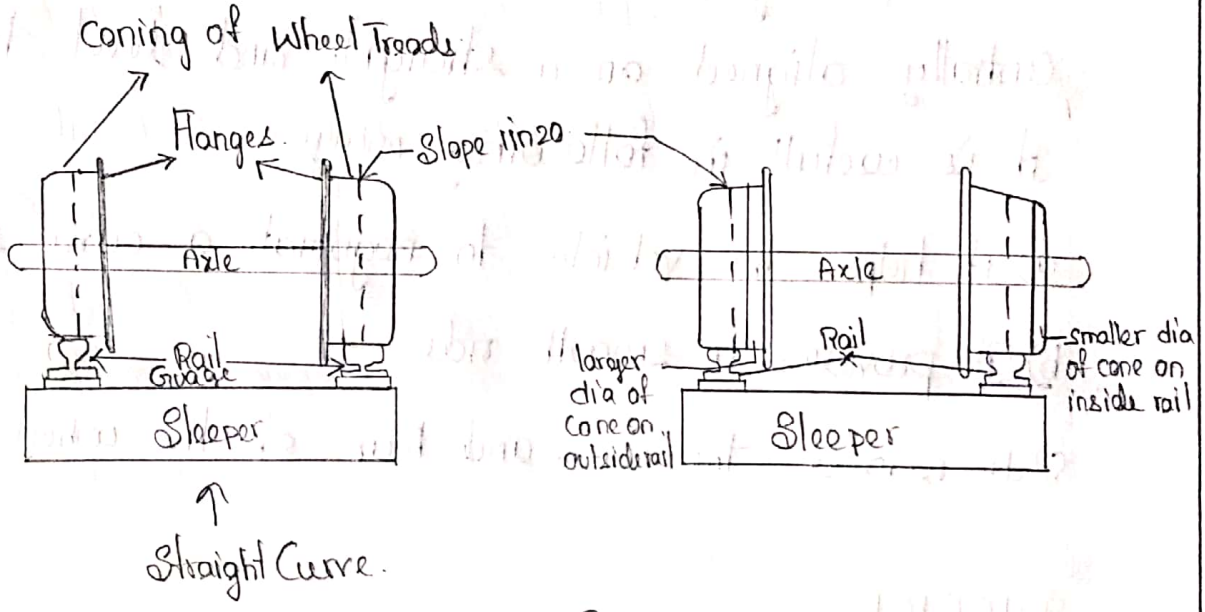



Fig: Coning of Wheels

→ The diameter of wheel is different at different crossection of the wheel, when the train running on the straight track wheel trys to move in any direction, the diameter of the wheel increases over one rail and the wheel assembly is automatically forced to move back in its original central position due to difference of distances moved over two rails.

→ on a curved track, due to centrifugal force the train is forced in outward direction, the diameter on outer track increases and the distance on two tracks are adjusted. Hence the circumference of the tread on the outer wheel is made greater than that of the inner wheel.

→ The coning of wheel helps to keep the vehicle centrally aligned on a straight and level track. It is usefull in following ways:

a) It helps the vehicle to negotiate a curve smoothly.

b) It provides a smooth ride

c) It reduces the wear and tear of the wheel flanges.

SLEEPERS:-

Sleepers are the transverse ties. that are laid to support the rails. They play an important role in the track as they transmit the wheel load from the rails to the ballast.

## FUNCTIONS OF SLEEPERS :-

The main functions of sleepers are as follows:

a) Holding rails in their correct guage and alignment.

b) Giving a firm and even support to the rails.

c) Transferring the load evenly from the rails to a wider area of the ballast

d) Acting as an elastic medium between the rails and to the ballast to absorb the blows and vibrations.

e) Providing longitudinal and latural stability to the permanent way.

f) Providing means to rectify the track geometry during their servic life.

## REQUIREMENTS OF SLEEPERS :-

An ideal sleeper should normally fullfill the following requirements:

a) Minimum maintenance cost.

b) Moderate weight for easy handling.

c) Design of sleepes should be such that it is possible to fix and remove rails easily.

d) Sufficient bearing area so that ballast underneath is not crushed.

## Types of Sleepers :-

The sleepers mostly used in Indian railways are (i) Wooden Sleepers

(ii) Cast iron (CI) Sleepers

(iii) Steel sleepers

(iv) Concrete sleepers.

Comparision of different types of Sleepers :-

| Characteristics | Types of Sleepers | | | |
|---|---|---|---|---|
| | Wooden | Steel | Cast Iron | Concrete. |
| Service life (years) | 12 - 15 | 40-50 | 40 - 50 | 50 - 60 |
| Weight of sleeper for BG (kg) | 83 | 79 | 87 | 267 |
| Handling | Manual Handling | Manual Handling | Manual Handling | No Manual Handling (gets damaged by rough handling) |
| Type of maintenance | Manual & mechanized | Manual & mechanized | Manual | Mechanized only |
| Cost of maintenance | High | medium | Medium | low |
| Guage Adjustment | Difficult | Easy | Easy | No guage adjustment possible |
| Damage | by white ants | corrosion | Corrosion | No damage by ants & corrosion |
| Track Elasticity | Good | Good | Good | Best |
| Creep | Excessive | less | less | Minimum |

BALLAST:-

Ballast is a layer of broken stones, gravel, moorum & any other granular material placed and packed below and around sleepers for distributing load from the sleepers to the formation.

FUNCTIONS of BALLAST:-

i) It provides a level and hard bed for the sleepers to rest on.

ii) It holds the sleepers in position during the passage of trains.

iii) It transfers and distributes load from the sleepers to a large area of the formation.

iv) It provides elasticity and resilience to the track for proper riding comfort.

v) It provides the necessary resistance to the track for longitudinal and lateral stability

vi) It provides effective drainage to the track

vii) It provides an effective means of maintaining the level and alignment of the track.

## Types of Ballast :-

The different types of ballast used on Indian railways are

i) Sand Ballast :- used primarily for cast iron pots. Also used with wooden and steel trough sleepers in area where traffic density is very low. Coarse sand is used as ballast since it has good drainage properties. It causes excessive wear on the top of rail and moving parts of the rolling stock.

ii) Moorum Ballast :- It is used as the initial ballast in new constructions and also as sub ballast. It prevents water from percolating into the formation, It is also used as a blanketing material for black cotton soil.

iii) Coal Ash & Cinder :- It is used in yards and sidings & as the initial ballast in new construction. It is very cheap and easily available.

iv) Broken Stone ballast :- A good stone ballast is generally procured from hard stones such as granite, Quartzite and hard trap. The stone choose should be non porous, free from flakes due to weather. Good quality stones are used for high speed tracks. Most used in Indian Railways.

v) Other types of ballast :- brickbat, gravel, Kankar, earth, materials