TRACK STRESS

Stresses on the track due to the various kinds of forces applied on it are discussed in the following sections. Lateral forces: The lateral force applied to the rail head produces a lateral deflection and twist in the rail. Lateral force causes the rail to bend horizontally and the resultant torque causes a huge twist in the rail as well as the bending of the head and foot of the rail. Lateral deflection of the rail is resisted by the friction between the rail and the sleeper, the resistance offered by the rubber pad and fastenings, as well as the ballast coming in contact with the rail.

Longitudinal forces: Due to the tractive effort of the locomotive and its braking force, longitudinal stresses are developed in the rail. Temperature variations, particularly in welded rails, result in thermal forces, which also lead to the development of stresses. The exact magnitude of longitudinal forces depends on many variable factors. Contact stresses between rail and wheel: Hertz formulated a theory to determine the area of contact and the pressure distribution at the surface of contact between the rail and the wheel. As per this theory, the rail and wheel contact is similar to that of two cylinders with their axes at right angles to each other.

Stresses on ballast: The load passed onto the sleeper from the rail is in turn transferred to the ballast. The efficacy of this load transmission depends not only on the elasticity of the sleeper but also on the size, shape, and depth of the ballast as well as the degree of compaction under the sleeper. Pressure on formation or subgrade The live as well as dead loads exerted by the trains and the superstructure are finally carried by the subgrade. The pressure on the subgrade depends not only on the total quantum of the load but also on the manner in which it is transferred to the subgrade. The spacing between the sleepers; the size, depth, as well as compaction of the ballast under the sleeper.

CONING OF WHEELS: The Surface of wheels are made in cone shape at an inclination of 1 in 20, and the same slope is provided in the rails (see fig), this is known as coning of wheels. The diameter of wheel is different at different cross section of the wheel, when the train running on the straight track try 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.

Purpose:

1. To keep the train its central position of the rails, coning does not allow any sidewise movement on a straight track.
2. To allow the wheels to move different distances on a curved track and thereby reduce wear and tear.
3. Creep in rails
4. In railways, creep is the gradual, longitudinal movement of a rail along the sleepers in the direction of dominant traffic. It is caused by forces from trains starting and stopping, the wave-like motion of the track under wheels, and temperature changes. Creep can cause issues like distorted track geometry and is often managed using anchors or by periodically pulling the rails back into position.

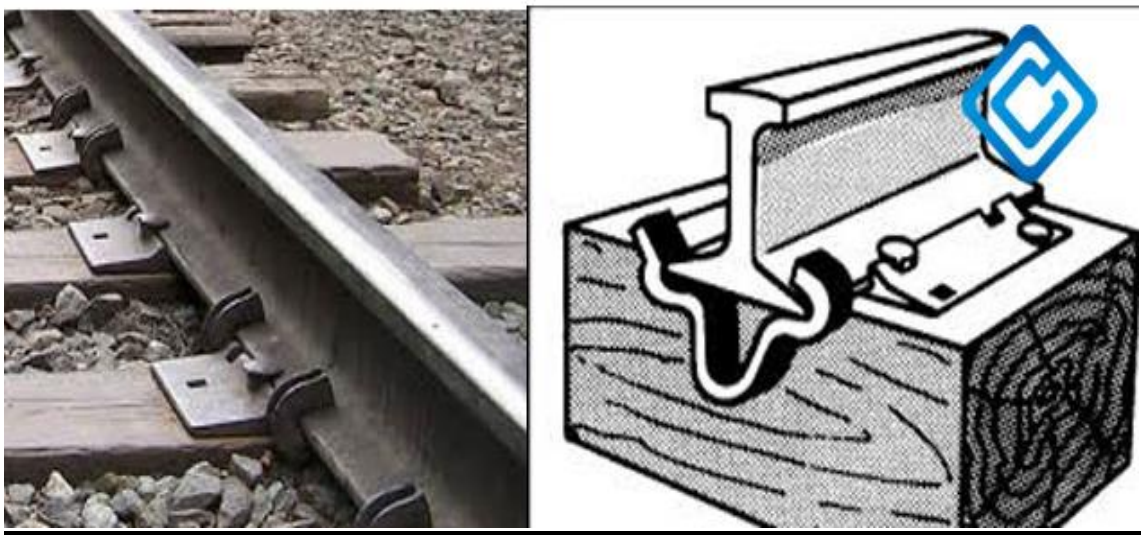
Causes and Effects for Creep of Rails: The main factors that produce the orbital creep force are the following points.

- Longitudinal force of train gravity on the slope.
- Braking force produced by stopping to slow down a train.
- The temperature force generated by the influence of temperature changes and the tensile force caused by the distortion of the rail under the dynamic load of the wheel.
- Longitudinal horizontal force produced by wave-shaped deflection of rail under rolling dynamic load of wheel.
- Rail creep does a lot of damage to the track. The size of gaps in railway tracks is distributed evenly. Due to creep of rails, gap between railway track at one end gradually deforms until it disappears and even expands the rail. The gap between railway track at the other end are stretched, causing fishplate bolts to be pulled or broken. This causes the sleeper to rotate to form the deviation, causes the track to sink and not smooth, produces the low joint and so on disease.
- Prevent the Creep of Rail
- 1.Strengthen the anti-creep resistance between sleeper and ballast bed
- It is necessary to ensure that the thickness of the ballast below the sleeper is sufficient, the ballast at both ends of the sleeper is wide enough to strengthen the

tamping. Carry out railroad maintenance regularly, keep the railroad line smooth, tamp down the ballast bed. In addition, the serious dirty ballast bed should be cleaned to prevent slurry and mud from boiling and bottom climbing to reduce the longitudinal resistance of the line.

Anti-creeping equipment such as rail anchor

Rail anchor is a kind of equipment which can effectively prevent longitudinal displacement of rail. Installation of rail anchor can effectively improve the quality of railway lines and ensure traffic safety, and will greatly reduce the cost of rail creep and maintenance, thereby reducing the cost of railway transportation.



Keep the clamping force of rail fasteners

In order to increase the resistance between rail and fishplate, rail and rail tie plate, rail tie plate and railway sleeper, the bolts should be tightened in time, floating track spikes and fasteners should be tightened. For damaged spikes and fasteners, they should be replaced and refurbished in time.

ROUTE ALIGNMENT SURVEYS

Route alignment surveys for railways are a series of surveys (including reconnaissance, preliminary, and location surveys) used to determine the best path for a new track. These surveys collect data on the terrain, obstacles, and resources to find a route that is the shortest, safest, most economical to build and maintain, and meets traffic needs. Modern methods like GPS and GIS are used alongside traditional techniques for accuracy and efficiency.

ROUTE ALIGNMENT SURVEY: Prior to survey the available maps of proposed area are studied. This helps in fixing suitable alignment facilitate various surveys work. The various engineering surveys which are carried out for the choice of route of a new railway line survey can broadly be divided in to three categories.

1. Reconnaissance Survey
2. Preliminary Survey
3. Location Survey.

1. Reconnaissance survey:

A reconnaissance survey is the first engineering survey which is carried out in territory which has not been previously surveyed for the purpose of laying a new railway line. The main objects of reconnaissance survey are as follows:

1.To obtain a general knowledge of the whole territory and

2. To obtain information regarding the salient feature of the territory.

Importance of reconnaissance survey: By reconnaissance survey, a number of possible alternative routes between two points can be worked out. This information becomes useful at a later stage in the selection of best possible route between two points. The successful conduct of the reconnaissance survey entirely depends on the personal qualities and engineers such as training and experience, capacity of observation and interpretation of the features of the territory etc.

Reconnaissance Survey and Information Gathered are generally two categories

a. Traffic Reconnaissance Survey
b. Engineering Reconnaissance Survey.

(a) **Traffic Reconnaissance Survey:** This consists of collection of the information regarding the following:

1. General character of the country and extent of cultivation
2. Local industries and religious festivals
3. The general conditions such as prosperity of people in the locality and density of population and its distribution
4. The probable amount of traffic to be served by a new railway line
5. The probable new traffic lines to be opened up to join large trade centres
6. Nature and volume of exports and their destination and origin

7. The amount of imports and centers of their distribution
8. Possibilities of development of new industries and irrigation schemes as a result of new railway lines.

Engineering Reconnaissance Survey: Engineering Reconnaissance Survey, the following information is collected

1. Physical features of a country
2. The surface formation of the ground
3. Nature of soil
4. Streams and rivers in the area especially those likely to be crossed by the track, their direction of flow, approximate width and depth
5. Positions of hills and lakes Instruments used in Reconnaissance survey a. Aneroid barometer b. Prismatic compass c. Binocular telescope d. pedometer.

2. Preliminary Survey: The object of preliminary survey is

a. To conduct the survey work along the alternative routes (found out by reconnaissance survey) with the help of theodolite and levelling instruments
b. b. To determine the greater accuracy the cost of railway line along these alternative routes involving cost of removing obstruction, construction of bridges etc
c. c. To decide the most economical and efficient route

Importance of Preliminary Survey: The preliminary surveys decide the final route and recommend only one particular route in preference to other alternative routes. The x-sections of all representative points along the route and feature of the country are marked. The cross sections are taken at 500ft interval normally. Similarly where the route crosses a river, the river is surveyed in detail for about one mile on either the upstream and downstream sides. The detail maps are prepared and the cost of different alternatives is calculated accurately to select the most economic routes.

3. Location Survey The location survey is carried out in two stages

- Paper Location
- Field Location

Paper location The final route selected is put up on paper and details such as gradient, curves, contours etc are worked out. The long sections and formation levels are sorted out and working drawings are prepared for all small and large structures.

Field Location The field location transfers the paper location to the ground to have a good profile as in paper location. It also gives the requirements of the construction engineer such as benchmarks, levels, measurements etc. The centre line pegs are driven at every 1000 ft or 300 m along the centre line of the track. Every change in direction, the beginning and end of a curve and the intersection of tangents are clearly marked. Sufficient benchmarks are established at a distance not more than ½ miles along the alignment to which levels can be referred and gradients can be transferred.

Instruments Used in Location Survey

1. Theodolite
2. Precise Level
3. Steel Tape

Conventional railways use older, manual methods with individual track sections and wooden or older concrete sleepers, resulting in a bumpy "clickety-clack" sound and more maintenance downtime. Modern methods utilize advanced machinery for track construction and maintenance, incorporating continuous welded rails (CWR) and modern concrete or steel sleepers for a smoother, stronger, and higher-capacity track that can support higher speeds and reduce maintenance time.

Conventional methods

- **Track:** Comprised of individual, short sections of rail joined by heavy bars and bolts, which causes the "clickety-clack" sound.
- **Sleepers:** Typically made of wood or older-style concrete.
- **Speed and capacity:** Designed for lower speeds, lighter axle loads, and lower traffic volume.
- **Maintenance:** Relies heavily on manual labor, which is time-consuming,

disruptive to traffic, and requires long periods of speed restrictions after work.

- **Alignment:** Survey and planning are done through manual, time-consuming methods, which can be costly and less precise

Modern methods

- **Track:** Uses continuous welded rails (CWR) that are joined together, creating a much smoother and stronger track.
- **Sleepers:** Modern concrete or steel sleepers are used to improve track structure.
- **Speed and capacity:** Supports high-speed and higher-capacity operations due to its strength and design.
- **Maintenance:** Employs mechanized and modern maintenance techniques, like measured shovel packing, which are faster and more precise. This allows for more frequent maintenance and shorter speed restrictions.
- **Alignment:** Utilizes modern technology like image processing for faster, more accurate, and less expensive route planning.