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DYNAMIC STRUCTURE OF TRACK GEOMETRY

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ABSTRACT

The main objective of this work is to increase the speed of railway. For increasing the speed of railway, the most important part is track geometry. Since the main things are protect the people and comfort of passengers are desired and also avoid the accident. The concerned from dangerous situation like accident is depends on the wheel rail forces in the track plane and comfort of passengers is depends on motions of passengers within the train. The overall dynamic structure of track geometry alignment decides the nature of high speed of railway. The track geometry, track interaction and simulation are three parts of work which deals for increasing the speed of train. In track geometry, the main part is gauges which are used for each high speed rails. The track interaction i.e. track plane acceleration, cant deficiency, cant excess, cant gradient, equilibrium cant needs for developing the high speed rail services in near future.

Keywords: Gauges, geometry, railway, speed, track.

INTRODUCTION

The railroad is the life line of our nation. In a developing country like India where quickly growth of economy, technological advancement and multinational competitive atmosphere are taking place. Railway also needs to develop its network and quality of service and that in a competitive atmosphere. Quality of track is directly linked with the quality of service to the customer in terms of physical comfort and time saving. For reduces any fault in track geometry, change in maintenance strategy or set of plans intended to achieve the new high speed line. This studies primary deals with track geometry and secondary deals with constantly changes and progresses of railway. In railway system, most important component is rails. Rail is a surface which provides the surface for the movement of wheels. They are very strong and lasts a long time without breaking. The main function of rails in a railway track are to provide a continuous and level surface for the movement of the trains with minimum friction. It also provides strength, durability to the track. The rail bears the stresses which are developed by vertical loads, thermal loads or breaking effects. All those stresses need to reduce its effect. The track geometry has smooth and efficient operation with respect to train performance. The cost of replacement and maintenance of track are removed. Such optimisation studies must be done for each individual section of proposed high speed line. Advance maintenance planning reduces also

costs since the limited human and equipment resources can be better used.

TRACK GEOMETRY

Design track geometry

Track geometry is defined as three dimensional geometry of track layout and this geometry used in design, construction and maintenance of the tracks. It is a very important for the behaviour of trains. The main quantities used for designing the track are as given below:

- Track rail
- Track gauge
- Track cant
- Cant gradient
- Transition curve
- Vertical curve
- Horizontal curve
- Super elevation

Track rail

The rail section is designed for nominal weight which provides the metal for distribution in various components which is used in rail track.

Components of rails

The main components of the rails are head, web and foot.

Head: The head is upper portion of the rail. The shape of rail head is quite sharp. These are designed for fit the shape of wheel tyre of train. Since they have good riding qualities and contact stresses are reduces.

Web: The web is middle portion of the rail. The shape of web should be sufficiently thick.

Foot: The foot is base of rail. It is made flat to distribute the oncoming wheel load properly.

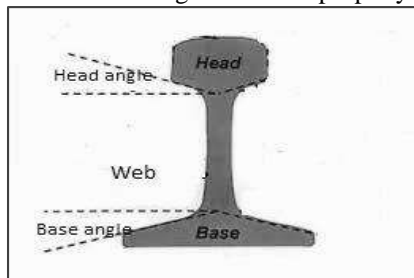


Fig. 1 Track rail

Types of rail

There are three types of rails. These are double headed rail, bull headed rail and flat footed rail.

Double-headed rail: The head and foot of the rail had the same profile. The main advantage is that, when the head became damage, then the rail could be turned over and re-used.

Bullhead rail: Bullhead rail is slightly similar to double-headed rail. The profile of head of the rail is not the same as that of the foot. The cost of this method is very high. Also the maintenance cost is more. These are more suitable where lateral loads are more important than vertical load.

Flat footed rail: The profile of head of the rail is different from the foot. In flat footed rail, foot of rail is very flat. Flat footed rail provides the greater track stability. Maintenance of this type of rails is very simple and cost is low. The cost of construction of flat-footed rails is less than the other types of rails. The main advantage is that, the replacement procedure for these rails is easy.

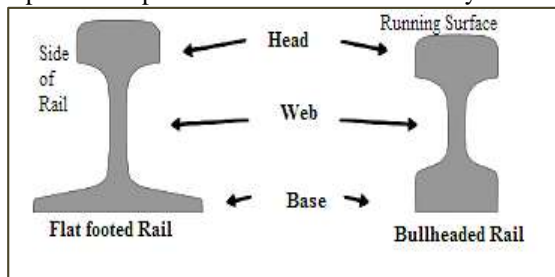


Fig.2 Types of rails

Track gauge

Track gauge or rail gauge is defined as the distance between the two rails on a railway track. There are four types of track gauge. These are as follows:

- Broad gauge,
- Standard gauge,
- Meter gauge,
- Narrow gauge

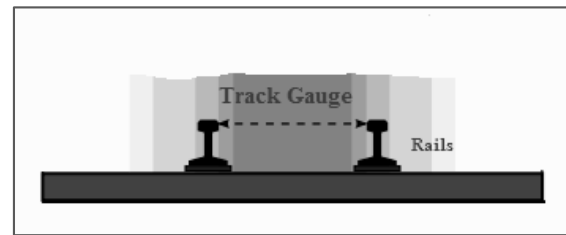


Fig. 3 Track gauge

Broad gauge: Broad gauge railway is greater than the standard gauge of 1,435 mm (4 ft, 8 1/2 in).

Meter gauge: Generally, the meter gauges are mostly used in urban, sub-urban area having dimensioned is 1,000 mm (3 ft 3 3/8 in).

Narrow gauge: A narrow gauge railway is a railway whose track gauge is narrower than the 1,435 mm (4 ft 8 1/2 in) of standard gauge railways. Narrow gauges are generally used in hilly region.

Standard gauge: The standard gauges are most widely used gauge in the world. The dimension of this gauge is equal to 1435mm

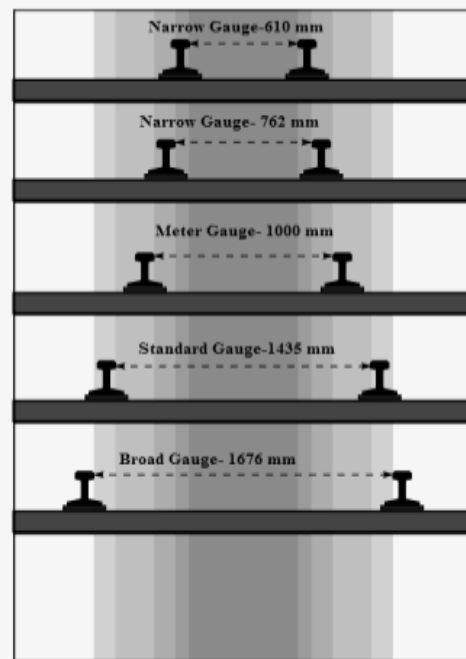


Fig. 4 Types of gauges

Track cant

The difference between the levels of the two rails in a curve is called as cant. The cant is measured in terms of angle instead of height difference. The positive cant and negative cant are two types of cant. When the outside rail is at higher elevation than the inside rail, it is called as positive cant. When the outside rail is at lower elevation than the inside rail, it is called as negative cant. The main functions of cant are distribute the load across rails, reduce wheel wear, improve the passenger comfort.

Cant Gradient

The cant is said to be measurement of the difference between the outer rail and the inner rail. The cant is measured in term of angle instead of height difference. The rate of change of cant is used to determine the suitable cant gradient for a given design speed.

Transition curve

When the straight track section is changes into a curve then it is said to be transition curve. A track transition curve is a mathematically calculated curve on a section of railway. Transition curves are used between tangent track and circular curve.

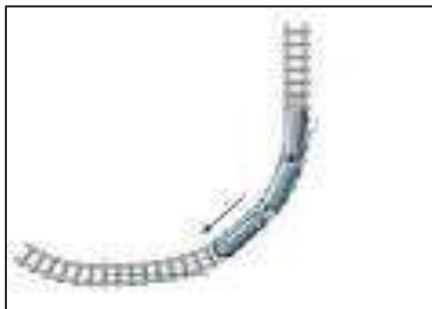


Fig. 5 Transition curve

Vertical curve

The vertical curve is track layout on vertical plane. The concepts of cant and gradient are involves in vertical layout of the track. The vertical curves are designed to avoid the uneven surface or irregularities riding of track. It is used to change the slope.

Horizontal curve

The horizontal curve is track layout on horizontal plane. This curve is connected between two straight tangent sections. It is used to change the alignment or direction of track. There are four types of horizontal curves. They are described as follows:

Simple: The simple curve is an arc of a circle.

Compound: This curve normally consists of two simple curves joined together and curving in the same direction.

Reverse: A reverse curve consists of two simple curves joined together, but curving in opposite direction.

Spiral: The spiral is a curve that has a varying radius. It is used on railroads and most modern railways.

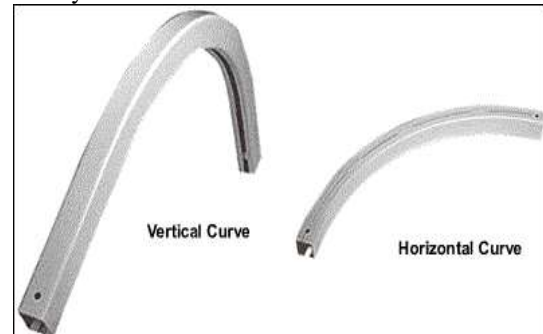


Fig. 6 Vertical and Horizontal curve

Super elevation

The difference in elevation between the outer rail and inner rail is called as super elevation. Super elevation is the amount by which one rail is raised above the other rail. It is positive when the outer rail on a curved track is raised above inner rail and is negative when the inner rail on a curved track is raised above the outer rail.

Formula for super elevation is given by

$$e = (G \cdot V) / (1.27 \cdot R) \text{ meters}$$

Where, e is elevation in mm.

G is the gauge of track in mm.

R is the radius of the curve in metres.

V is the velocity in m/s.

TRACK INTERACTION**Cant Deficiency**

When the cant is less than the equilibrium cant, so called cant deficiency. When a train travels around a curve at a speed higher than the equilibrium speed then cant deficiency occurs. The cant deficiency is determined by the following factors:

- Track construction
- State of track components
- Track alignment

Cant deficiency 'hd' is the difference between equilibrium cant 'heq' and actual cant 'ht'. This is determined by the following equation:

$$hd = heq - ht$$

Track plane acceleration

The vehicle has two accelerations one is horizontal centrifugal acceleration and another is gravitational acceleration. Constant acceleration means a constant change of velocity. This could mean a constant change of speed, a constant change of direction or a combination.

Equilibrium cant and balance speed

When the speed of the train and the amount of cant are in balance, it is called equilibrium. For a fixed value of cant, the speed that creates balance is called equilibrium speed. For a constant speed of a running train, the amount of required cant to achieve the balance is called equilibrium cant.

CONCLUSION

By using the proper arrangement of components of track in alignment then the speed of modern railway is definitely increases. High speed trains are being increasingly adopted on world railways, in view of the many advantages than they offer. When the improvement in railway system then the train technology offers advantage in the increase of speed.




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