Chapter - 1 Railway Transportation & its Development

Role of Railways in transportation :-

Land water & air have been used by the mankind for developing the transport modes like railways, highways, water ways, airways etc. The various modes of transport can be classified in the following ways :-

1) Classifications from surface point of view :-

i) Land transport

Ex :- Highways, railways, cableway, ropeway, etc.

ii) Water transport

Ex :- Canal way, riverway, Ocean way, lake way, etc.

iii) Air transport

Ex :- Airway.

Characteristics of transportation modes.

→ The transportation modes provide following two basic utilities.

(a) Place Utility :- In having men & materials has places where they are wanted. &

(b) Time Utility :- In having men & materials when they are wanted. The suitability of transportation mode depends largely upon its intrinsic merits & characteristics &

can be summerized as :-

(i) The railway have there greatest utilization in the transport of large volumes of heavy & bulk commodities over long distance & in very long distance journeys of passengers with safety, comfort & convenience.

(ii) Road transport :- Provides greater utility in transport over short & long hauls of lighter weight commodities & of lesser volumes, as also for passenger transport for short & medium hauls road transport has shown immense potential in replacing railway in highly advanced countries especially passanger transport due to flexibility in operation & doore to doore service.

(iii) Air transport :- Attains maximum utility where savings of time in transport is of outmost importance rather than the money. Aircraft transport industry ~~with~~ will thus have the objectives of transporting the products or goods having comparatively higher value per unit volume or weight or time.

(iv) Water transport / ways :- Provide facilities of transport of having & bulk commodities where time may not been of much importance. This is the most economical

mode of transport.

(v) Sea ways :- Provide better facilities of transport of heavy & bulk goods over long distance.

(vi) Pipe lines :- Are mostly used for transportation for petrolium products, water, gas sewage, etc. this mode is suitable for transportation of liquids & fluids & cannot been used for transportation of passangers or solid Products.

(vii) Rope ways & cable ways :- Are used mainly for carrying bulk materials like sand, coal, stone, or ores etc. in a hilly mountaneous terrain where any other type of transport is either uneconomical or imposible. It perform the feeder service.

(viii) Belt conveyor system is used for transporting granular material like coal, ore, grain etc. in the form of moving side walks or belt conveyed cars. They also handle the passengers & have potential for future development as carries or urban passenger.

Zonal Railways :-

The entire indian railway system has been divided into 9 zonal railways having different territorial gujurisdictions. The route kilometere of various journal railway gauge is given in table.

It has recently been decided for better administration & management of indian railways to set up following 6 new zones.

Zone	Headquaters
East Coast	Bhuvaneswar
East central	Hajipur
North central	Allahabad
North western	Jaipur
South western	Bangalore
West central	Jabalpur

These Zonal railways take care of railways business in their respective zones & responssible for all management & planning of worcks. Each zonal railway is headed by a general

managers assisted by additional general managers & heads of departments of different disciplines viz. Civil Engg, mechanical, Operations, commercial accounts, Security, signal & Tele-communications, electrical, personnel & medical etc.

Chapter-1 Introduction

The railway have there greatest utilities in the transport of the large volume of heavy on bulk communities over long distances & in a very long distance journey of passenger with safety, comfort & ~~continuous~~ convenience.

- **Railway terminology :-**

(i) **Adhesion of wheels :-**

It is the resistance offered by the friction proper between the metal surface of the rail & the wheel.

(ii) **Ash pits :-**

Those are the long ~~distance~~ masonary pits built longitudinally under the track for discharging of ash from the locomotives.

(iii) **Ballast :-**

Ballast is a granular material packed under & around the sleepers transfer the load from sleepers to Ballast.

(iv) **Ballast Crib :-**

The loose ballast between the two adject sleepers is known as ballast crib.

(v) **Boring :-**

The process of filling the ballast around the sleepers is called boring.

(vi) **Broad Gauge :-**

The gauge of a track in which the

distance between running faces of 2 track rails is 1.676m is called broad gauge.

(vii) Bull headed Rails (B.H. Rails) :-

B.H. rails are those in which head is made little thicker & stronger than lower part.

(viii) Cant or Super-elevation :-

On curves to countercact the effect of centifugal force, the level of outer rail is raised above the inner rail. This raising of outer rail over the inner rail is called super-elevation or cant (e).

(ix) Cant Deficiency :-

The equilibrium cant is provided on the basis of the average speed of different train on the track. this equilibrium cant or super-elevation will form short of that required for speed higher than average speed, the shortage of cant is called cant deficiency.

(x) Chairs :-

These are used to hold the bull headed & duble headed rails. The chairs are fixed to sleepers by round spikes.

(xi) Creep of Rail :-

Creep is the longitudinal moment of rail in the track.

(xii) Coning of wheel :-

The wheels are coned at a slope of

one in twenty to prevent from rubbing the inside face of the rail head & to prevent lateral moment of the axis with its wheel this is known as coning of wheel.

(xiii) Dercailment :-

→ Dercalement occures when moving wheel of a train ore bogie get out of rails.

→ It causes by an accident & often results loss of life ore property damage.

(xiv) Duble headed Rail :-

These arce the rails which have duble headed the bottom at top of the rail arce same cross section.

(xv) Drop pit :-

They arce rectangular deep pits in which wheels of the locomotives arce taken out fore repaires.

(xvi) Embarckment :-

The raised structurce above the grocund level fore carrcying the railway track is called embarckment.

(xvii) Equilibrcium Cant :-

The cant ore super-elevation on the curcve track is provided on the basis of avercage ore equilibrcium speed of the train running overe the section such can is called equilibrcium Cant.

(xviii) Fish Plate :-

This plates resembling in shape of to a fish are used to Provide to continuty between two rails at the rail joint.

(xix) Flat foote Rail :-

The flat footed rail have wider or flattere bottom, so that make an fixed directly on the sleepers, avoiding the necessity of chaires. They are ~~cho~~ called bignole's rail.

(xx) Gauge :-

The gauge of the track in india is measured as the minimum distance between inner running or gauge faces of the 2 rail.

(xxi) Gradient :-

Any deparature of the railway track from the level is known as grade or gradient.

(xxii) Guard Rail :-

Guard rails are extra rail Provided over bridges to Prevent damage & danger in case of dercailment occuring on the bridge.

(xxiii) Rail joint :-

For holding togethere of two adjoining rails incorercect possitions the rail joints are Provided.

→ The rail joints are the weakest part in the

track.

(xxiv) Junction station :-

When two or more railway lines meet at a station it is called junction station.

(xxv) Keys :-

Keys are the tapered pieces of timber or steel to fix the rail to the chairs on metal sleepers.

(xxvi) Left hand turnout :-

A turnout is left hand turnout when the direction is towards the left hand of the main track in the facing direction.

(xxvii) Level crossing :-

When the railway line & a road cross eachother at the same level is called level crossing.

(xxviii) Locomotives :-

It is a machine is trafers chemical energy of fuel to mechanical ~~[illegible]~~ energy of ~~fuel~~ motion.

→ fuel may be water & coal or desel or electricity.

(xxix) Metal Sleeper :-

Sleepers made of cost-iron or steel are called metal sleepers.

(xxx) Meter Gauge :-

The gauge of the track in which distance between the running faces of two

track rails is 1 metere.

(xxxi) Narrow Gauge :-

The gauge of the track in which distance between the running faces of two track rails is 0.76 mtre. & 0.61 mtre.

(xxxii) Platform :-

A rise level surface from where passengers board & a light from trains at the stations is called platform.

(xxxiii) Points & Crossing :-

Points, crossing, crossovers & turnout etc. are countrivances or arrengement by which different routes either parallel or deversion connected to affoid the train to move from one track to another.

(xxxiv) Rails :-

Rails are steel ~~greed~~ girderes which provide the hard & smooth surface for movement of wheels of a locomotive & railway vehicles.

(xxxv) Railway Station :-

Railway Station is a selected place where trains helt for exchange of passenger & goods, weathering, watering, coaling engines or changing of running staff or for sorting of wagons or control of train movements.

(xxxvi) Sleepers :-

Sleepers are member laid transversely under the rails which are meant to support the rails over them & transfer the load from the rail to Ballast.

(xxxvii) Sleeper Density :-

Sleeper density represents the no. of sleepers per rail length in meter.

(xxxviii) Switch :-

A switch consist of a stock rail & tounge rail.

(xxxix) Turnout :-

A complete set of points & crossing with the intervening lead rails are called turnout.

(xxxx) Wagons :-

For transportion of goods, wagons are provided in the goods strain for ~~the~~ transporting different types of goods such as food greains, building materials, animals, cloths, coal, Sugarcane, petrol, Chemicals, oils, explosives, automobiles, perishable goods, etc, there are different types of wagons used.

(xxxxi) Wing Rails :-

Wing rails help in channelising the wheels in their Propere routes & directions meant for their movement. These rails guide the wheel path for movement of trains.

Advantages of Railway :-

Railway have brought about many political, social & economic changes in the life of indian people.

(i) Political advantages :-

The Railway have united the people ~~of~~ have different caste, religion & traditions.

→ with the adequate network of railways the central administration has become more easy & effective.

→ Railway have contributed towards development of national ~~mentality~~ mentality have the ~~mide~~ minde of people.

→ Railway have helped in the mass migration of the population.

(ii) Social Advantages :-

By travelling together into the compactment without any restiction of the caste, feeling of caste different has disappeare considerably.

→ The social outlook of masses has been boa through railway jurney.

→ railway has made it is easiere to reach places of religious importance.

→ Railway have convienced, safe mode of

transport of the country.

(iii) Economic Advantages :-

→ Mobility of people has increased thereby the conjested area can be revolve of populated area can be developed.

→ Mobility of labour has contributed to industrial development.

→ Grow of industrials has been prompted due to transportation of raw material through railways.

→ Railway Provide employment to milion of people & those help in ~~the~~ Solving the Unemployment Problem of the country.

→ Commercial farming is every much help by the railway network through out the country.

Techno economic Advantages :-

→ Cost Saving in transportation of long hound bulk traffic.

→ Energy efficiency.

→ Environment friendlyness.

→ higher Safety.

Classification of Indian railway :-

Broughtly railway has classified the railway lines on the basis of

the importance of routes, traffic carried & maximum permissible speed on the route, in to the following 3 many categories,

(i) Trunk Route
(ii) Main line
(iii) Branch line

(i) Trunk Route :-

on the following 6 routes of B.G & 3 routes of M.G have been classified has trunk routes.

On B.G.

→ Delhi to mughalsarai to Howarch.
→ Delhi to kota to Mumbai.
→ Delhi to jhansi to nagpur to chennai.
→ Howrah to Bagpur to Mumbai.
→ Mumbai to Guntakul to chennai.
→ Howrah to vijayawada to chennai.

On M.G.

→ Lucknow to Gorakhpur to Guwahati.
→ Delhi to jaipur to Ahmedabad.
→ chennai to Madurai to trivandrum.

Main Line :-

All lines other than trunk routes carrying 10 gross milion tonnes (G.M.T) per annum or more for B.G. & 2.5 G.M.T. or more for M.G. or where maximum permissible

Speeds allowed is 100 kmph. for B.G. & 75 kmph for M.G. are classified as main lines.

Branch line :-

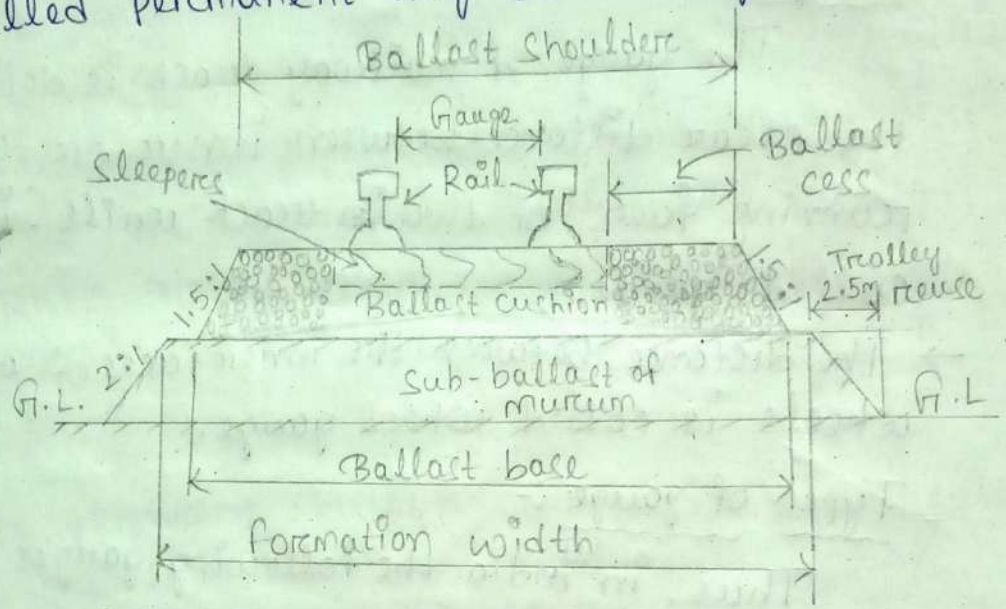
These are classified on the basis of following criteria :-

All those B.G. lines which carrcy less than 10 Gross milion tonnes (G.M.T) per annum & have maximum permissible speed of less than 100 km per hour are classified has branch line & for M.G. track all those lines which carrcy less than 2.5 g.m.t. & the permissible speed less than 75 km. per hour are classified as branch lines.

Chapter-2 Permanent Way

Defination :-

The combination of rails, fitted on sleepers & resting on ballast & subgrade, is called permanent way or railway track.



Components :-

In a permanent way, the rails are jointed in series by fish plate & bolts & then they are fixed to sleepers by different types of fastenings.

Sleepers :-

The sleepers properly spaced, resting of ballast, are suitably packed & boxed with ballast. this layer of ballast on the proper subgrade called formation width.

Rails :-

The rails act as girders to transmit the wheel load to the sleeper.

Ballast :-

The ballast distributes the load over the formation & holds the sleepers in position.

Gauge :-

The gauge of railway track is defined as the clear distance between inner or the running faces of two ~~the~~ track rails. is called gauge.

→ The distance between the inner faces of a pair of wheels is called wheel gauge.

Types of gauge :-

Thus, in india the following gauges are used :-

Types of gauge	Gauge width
(i) Standard Gauge (B.G.)	= 1.67m.
(ii) Metre Gauge (M.G.)	= 1.0 m.
(iii) Narrow Gauge (N.G.)	= 0.762m.
(iv) Feeder track - Gauge (L.G.) (or Light gauge)	= 0.610m.

Requirements of an ideal permanent way :-

permanent track is regarded to be semi-elastic in nature. There is possibility of track getting disturbed by the moving wheel loads. The track should, therefore, be constructed & maintained keeping the requirements of a permanent way, in view,

so as to achieve higher speed & better riding qualities with less future maintenance, following are some of the basic requirements of a permanent way:

(i) The gauge should be correct & uniform.

(ii) The rails should be in proper level, in a straight track, two rails must be at the same level. on curves, the outer rail should have proper superelevation & there should be proper transition at the junction of a straight & a curve.

(iii) The alignment should be correct, i.e., it should be free from kinks or irregularities.

(iv) The gradient should be uniform & gentle as possible. Any change of gradient should be follow by a smooth vertical curve, to give smooth riding quality.

(v) The track should resilient & elastic in order to absorb shocks & vibrations of running track.

(vi) The track should have enough lateral strength, so that alignment is maintained even due to effects of (a) side thrust on tangent lengths & Centrifugal force on curves (b) lateral forces due to expansion of rails, particularly in case of welded rails.

(vii) The readil & super-elevation on curves should be properly design & maintained.

(viii) Drainage system must be perfect for

enhancing safety & durability of track.

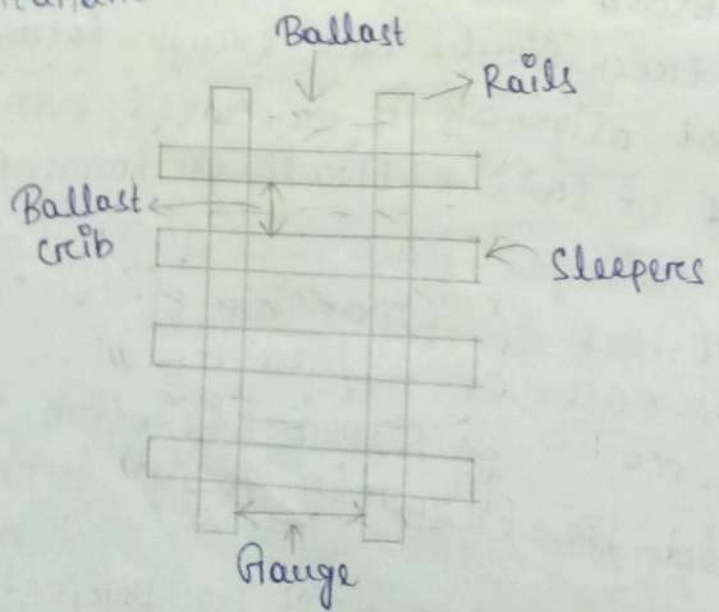
(ix) Joints, including points & crossings which are regarded to be weakest points of the railway track, should be properly designed & maintained.

(x) If there is trouble from the creep, the preventionary measures should be to prevent it.

(xi) The various components of the track i.e., the rails, fittings, sleepers, ballast & formation must fully satisfy the requirements for which they have been provided. If any component is lacking in fulfilling its requirements then either it should be improved or replaced.

(xii) There should adequate provision for easy renewals & replacements.

(xiii) The track structure should be strong, low it initial cost as well as maintanance cost.



(Gauge)

Chapter - 3 Track Material

Rail :-

→ Rail of the railway track is a ~~purpose of carrcy the wheel load~~ steel member which is use for the purpose of carrcy the wheel load of train (Axle load). The rail made of high carbon steel to which stand the wherce & tear.

→ Mostly flat-footed rails are used in railway track.

Function of rails :-

→ Rail Provide a hard, smooth surface for the passage of heavy moving load with minimum friction between rails & wheel.

→ Rail bears stress develop due to heavy vertical load, breaking stress, thermal stress.

→ Rail transmit the load of the train to the sleeper as well as reduce the Pressure & ballast & formation below.

Requirements of Rails :-

Rails act as continuous girders carrcying axle loads. They should meet the following requirements to serve intended Purposes :

(i) They should be of Proper composition of steel. as given above & should be manufactured by open hearth or duplex Process.

(ii) The vertical stiffness should be high enough to

transmit the load to several sleepers underneath. The height of rail should, therefore, be adequate.

(iii) Rails should be capable of withstanding lateral forces. Large width of head & foot endows the rails with high lateral stiffness.

(iv) The head must be sufficiently deep to allow for an adequate margine of vertical wear. The wearing surface should be hard.

(v) Web of rails should be sufficiently thick to bear the load coming on it & should provide adequate flexural rigidity in horizontal plane.

(vi) Foot should be wide enough so that rails are stable against overturning, especially on curves.

(vii) Bottom of the head & top of the foot of rails should be so shaped as to enable the fishplates to transmit the vertical load efficiently from the head to the foot at rail joints.

(viii) Relative distribution of material of rail in head, web & foot must be balanced, for smooth transmission of loads.

(ix) The centre of gravity of the rail section must lie approximately at mid-height so that maximum tensile & compressive stresses are equal.

(x) The fillet radii must be large to reduce the concentration of stresses.

(xi) The tensile strength of the rail piece should not be less than 72 kg/m^2.

(xii) The rail specimen should withstand the blow of "falling weight Test or Tup Test" as

Specified by Indian Railway standards without fracture.

Types of Rail Sections :-

The three types of rail sections which have been tried so far for the construction of railway track are :

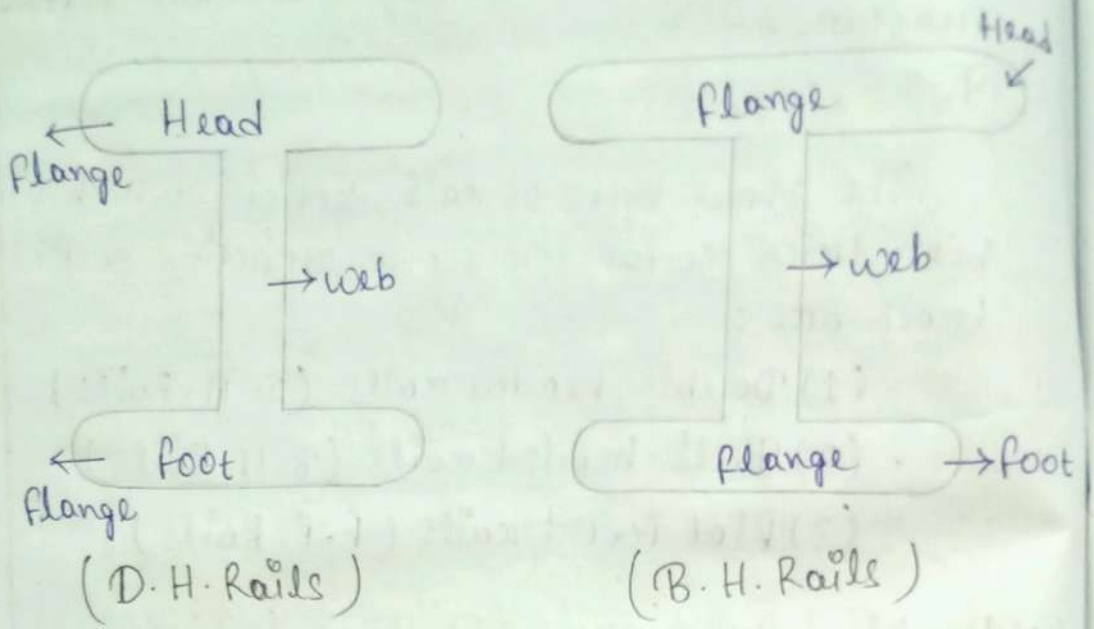
(1) Double headed rails (D.H. Rails)
(2) Bull headed rails (B.H. Rails)
(3) Flat footed rails (F.F. Rails)

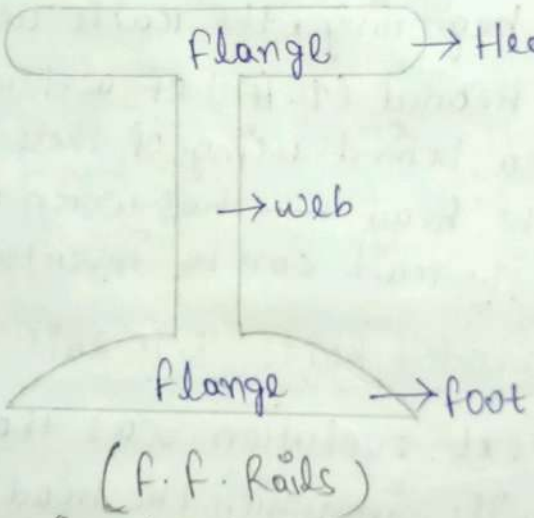
(1) Double headed Rails (D.H. Rails) :-

→ In the beginning, the rails used were ~~bowl~~ double-headed (D.H.) of a dumb-bel section.
→ The idea behind using of these rails was that when the head ~~was~~ has worn out in course of time, the rail can be inverted & reused.

(2) Bull-headed Rails (B.H. Rails) :-

The next evolution was that of a bull-headed (B.H.) rails, in which the head was made a little thicker & ~~sto~~ stronger (i.e. Bull size) than the lower part, by adding more metal to it, so that even after wear, it can withstand stress.





(3) Flat footed Rails (f.f. Rails) :-

→ It was originally thought that the flat-footed rails could be fixed to sleepers directly & would eliminate the need for chairs & keys required for the B. H. rails.

→ However, it was observed that heavy train loads caused the foot of the rail to sink into the wooden sleeper, making the spikes work loose.

→ To remedy this, steel bearing plates were

introduced, between the ~~wood~~ wooden sleepers & the rail, at rail joints & other important places.

→ In india, flat-footed rails are most commonly used.

Length of Rails :-

→ The rails of largere length are preferred to smallere length of rails, because they give more strength & economy for a railway track.

→ The weakest point of a track is the joint between two rails.

→ Lessere the numbere of joints, lessere would be the numbere of fish plates & this would lead to lessere maintenance cost, smoothere running of trains & more comfort to the passengers.

→ Through the long length of the rails is desired, howevere, the length is governed by the following factors :-

(1) The length of the rails is so choosen that the manufactureing cost is most reasonable.

(2) It depends upon the transportation facilities, so only those lengths of rails are possible which can be transported by longest wagons available on the railways.

(3) To some extent, the length is also limited by the facilities of lifting & handling, during the loading & unloading of wagons.

(4) More the length of the rail, more will be the gap required for expanssion of rail due to temperature but, howevere, the expansion is not

Proportional to gap because fastening check the movement of rails, so expansion gap is not limiting factor for length of rails though it effects to some extent.

On indian railways the standard lengths are the following:

Length = 12.80m. (42ft) for B.G. (say 13m)

Length = 11.89m. (39ft) for M.G. (say 12m)

Requirements of an Ideal joint :-

(i) The two rail ends should remain true in line both laterally & vertically when trains move on the track. This is necessary to avoid wheel jumping or changing its correct path of movement.

(ii) The rails joints should be as strong & stiff as the rail itself & should be elastic both laterally & horizontally.

(iii) The rail joints should provide enough space for free expansion & contraction to account for the effect of temperature variations.

(iv) A good joints should be easily disconnectable so that it can be easily taken out without disturbing the whole track for the purposes of changing rail or a fish plate, & lubricating the contact faces.

(v) It should not allow the rail ends to get battered in any case.

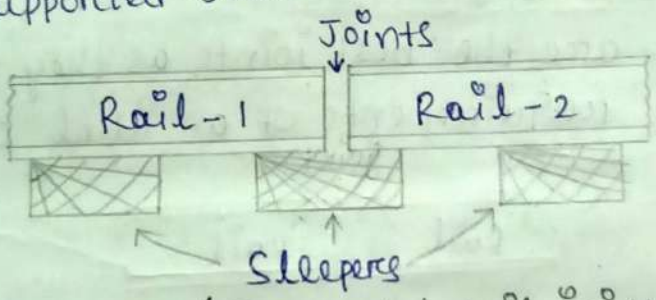
(vi) The joint should fulfill the above requirements with the minimum of initial & maintenance cost (i.e. it should be economical).

Types of Rail joints :-

(1) Supported Rail joints :-

→ When the rail ends rest on a single sleeper called a "joint sleeper". It is termed as "Supported joint". The duplex joint sleeper with other sleepers is an example of the supported joint.

→ Three sleepers support with long fish plate, i.e., combined supported & supported joint is most objectionable. Because in this case when the packing under the outer sleeper gets loose, undue load comes on central sleeper & in turn the loose central sleeper converts this joint into a weak supported joint.

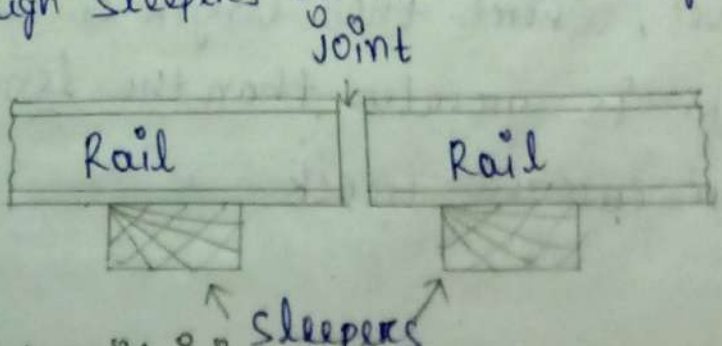


(Supported rail joint)

(2) Suspended Rail joints :-

→ When rail ends are projected beyond sleepers called "Shoulder sleeper". it is termed as suspended joint.

→ This type of joint is generally used with timber & steel trough sleepers on indian & foreign railways.

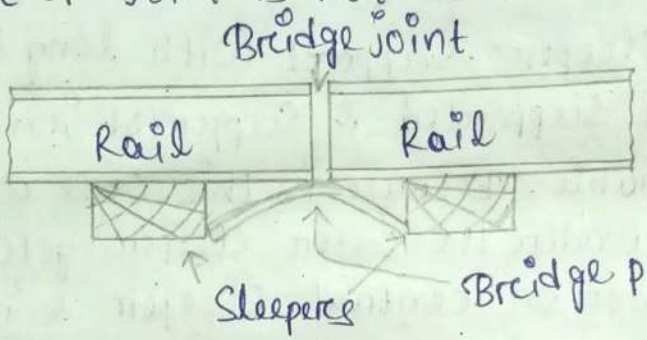


(Suspended rail joints)

(3) Bridge joint :-

→ When the rail ends are projected beyond sleepers as in case of suspended joint & they are connected by a flat or corrugated plate called a "bridge plate", it is termed as a bridge joint.

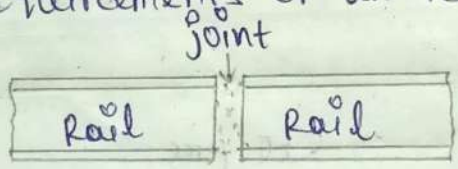
→ This type of joint is not used on indian railways.



(Bridge joint)

(4) Welded rail joint :-

These are the best joints as they fulfil nearly all the requirements of an ideal or perfect joint.

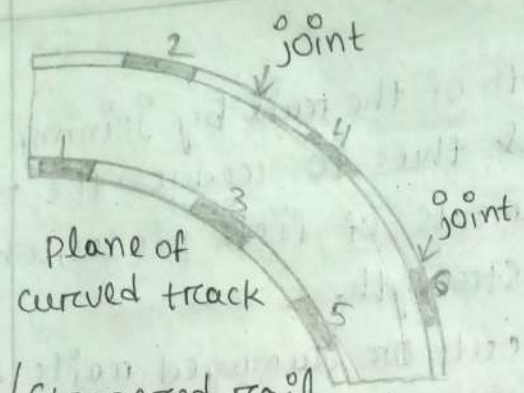


(Welded rail joint)

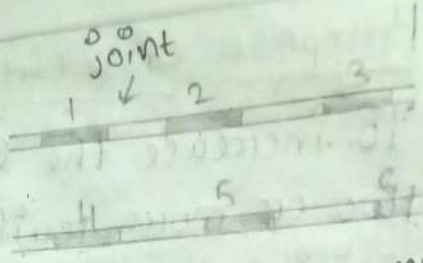
(5) Staggered or Broken joint :-

→ In this type of joint, the joints of one rail track are not directly opposite to the joints of the other rail track.

→ These joints are generally provided on curves, where the length of out curved track is greater than the length of inner curved track.



(Staggered rail joint)



(Square or even joint)

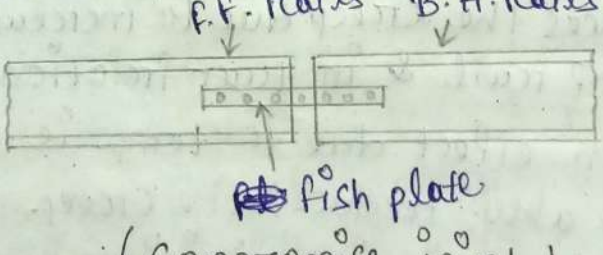
(6) Square or even joint :-

→ The joints of one rail track are directly opposite to the joints of other rail track.

→ This types is generally used on straight tracks.

(7) Compromise joint :-

Where two different rail sections are required to be joined together, it is done by means of fishplates which fit both the rails & this is joint termed as compromise joint.



(Compromise joint)

(8) Insulated joint :-

→ When insulating medium is inserted in a rail joint to stop the flow of current beyond the track-circuited part, it is called insulated joint.

(9) Expansion joint :-

In bridges, provision for expansion & contraction is kept for girderes & rails both.

* Purpose of Welding :-

(i) To increase the length of the rail by joining two or more rails & thus to reduce the no. of joints, & requirements of fish plates, which lead to economy & strength.

(ii) To repair the worn out or damaged rails & thus increase their life.

(iii) To build up worn out points & rails on the sharp curves.

(iv) To build up the burnt portion of rail head which is caused due to slippage of wheels over the rails or other defects or spots in rail steel.

* Advantages of Welding Rails :-

(1) It satisfies the condition of a perfect joint & hence increases the life of the rail, as also the reduction in maintenance cost of track by about 20 to 40 %.

(2) It reduces the creep due to increase in the length of rail & in turn friction as well.

(3) Expansion effect due to temp. is reduced which in turn also reduces the creep.

(4) Due to discontinuity of joints, a source of track weakness is reduced.

(5) Long rail lengths being heavier, dampen the intensity of high frequency vibrations due to moving loads.

(6) Welding increases the life of rails due to decrease in the wear of rails at joints.

(7) Welding facilitates track circuiting on electrified tracks.

(8) Welded rails provides on large bridges for the span length are helpful as they result in better performance.

(9) Welded rails provision on curves is under investigation. However, maximum curve length may be welded depending upon resistance & lateral displacement of track.

(10) The cost of track construction by welding of rails decreases due to less no. of rail joints.

10 march.

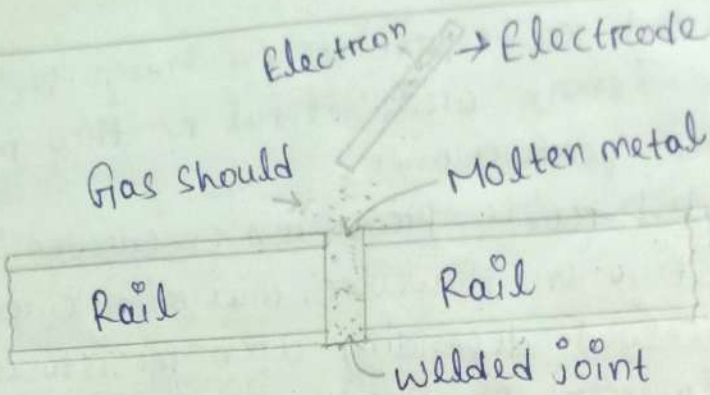
Methods of Welding of Rails :-

(1) Electric Arc welding (or metal Arc welding)
(2) Oxy-acetylene welding (or Gas Pressure welding)
(3) flash butt welding
(4) Chemical or Thermit welding.

(1) Electric Arc welding (or Metal Arc welding):-

→ In this mtd., the current is passed through the rail & at the same time through a thin rod known as electrode. As the electrode approaches the rail an electric arc is formed & with its heat the electrode gets melted, & finally the molten metal of the electrode gets deposited on the rail, providing a firm bond. Mobile electric arc welding plants are available which are easy to handle.

→ This mtd. of welding is used for building up worn out points & crossings, damaged rails & for other small welding operations. Gas shield prevents entering of impurities & air into the molten metal.



(Electric Arc welding)

(2) Oxy-acetylene Welding (or gas Pressure welding):

→ In this mtd, intense heat is produced by combining the oxygen & acetylene gas, which melts the electrode & deposite the molten metal on the rail.

→ This plant consists of two cylinderes (one for oxygen & the other for acetylene). This is best from mobility point of view.

→ This mtd. like electric arc welding is used for repairing worn out or damaged parts of points & crossings. This is specially useful for cutting of steel.

(3) Flash-butt Welding :-

→ In this, Powerful current is passed through two rails, the ends of which are to be jointed together.

→ The width of the gap between two rails is varied till both the ends get heated up to a required temperature.

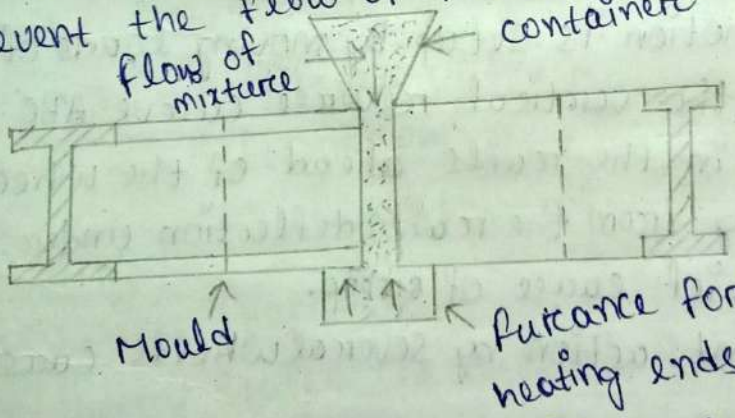
→ Then they are brought in contact with each other resulting in flash.

→ Finally, the current is stopped & rails are Pressed together under a Pressure of 20 tonnes.

→ This mtd. of welding, being most satisfactory, is used for welding of the rails in workshop.
→ This mtd. of welding involves heavy welding plant & that too immoblie & hence uneconomical for small jobs at site. for large jobs at site, this is economical mtd. of welding of rails.

(4) Chemical or Thermit welding :-

→ This involves the use of chemicals, like aluminium & iron oxide.
→ In this mtd, Aluminium & iron oxide are mixed in powder form & ignited.
→ ($Fe_2O_3 + 2Al = Al_2O_3 + 2Fe + Heat$). After the reaction, Fe gets separated & is deposited in the gap of the rail ends which are preheated. Actually, these two ends with chemical mixture. In between the gap are entrapped in a mould to prevent the flow of mixture.



→ The heating of the 2 ends is done by use of a furnace placed at the bottom of the rail joint. After the mixture solidifies, the mould is removed & surface grinding is done.
→ The chemical welding is generally adopted in the process of renewal of rails. this plant is portable in nature & can be used at site as well for welding of rails.

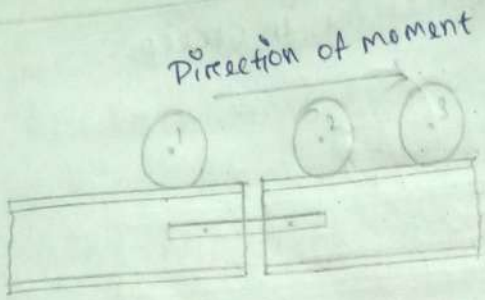
Creep of Rails

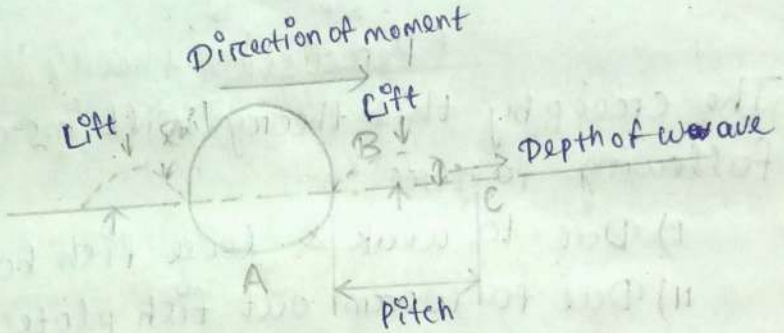
* Defination :-
Creep is defined as the longitudinal movement of rails with respect to sleepers in a track. Creep is common to all railway tracks.

* Indications of Creep :-
(i) closing of successive expanssion spaces at rail joints in the direction of creep & opening out of joints at the point from where the creep starts.
(ii) Marcks on flanges & webs of rails made by spike heads, by scraping or scratching as the rails slide.

Theories of creep :- (causes of creep)
various theories are propounded to explain the different causes of creep.

1. Wave Action or Wave Theory :-
→ Wave motion is set up by moving loads of ~~that~~ wheels. the vertical reverse curve ABC is formed in the rails ahead of the wheels, resulting from the rail deflection under the load, is the chief cause of creep.
→ The joint action by several wheels causes creep.
→ As the wheels move, the lift in front of the moving load is thus carried forward by the wheels & causes creep.





→ The wave action can be reduced (i.e. creep is reduced) by adopting following measures:

(i) Angular & heavy ballast - which develops good interlock.

(ii) Increased stiffness of track.

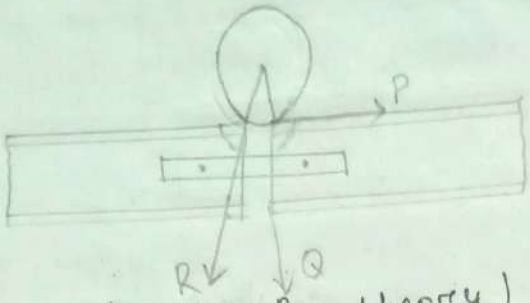
(iii) Lesser sleeper spacing.

(iv) Bigger section of the rail.

2. Percussion Theory :-

→ This theory states the creep is due to impact of wheels at the rail end ahead at joints. The horizontal component 'P' of 'R' tends to cause creep while the vertical component tends to bend down the rail end. Vertically to make a battered rail end. Hence as & when the wheels leave the trailing rail & strike the facing rail end at each joint it pushes the

rail forward resulting in creep.



(Percussion theory)

The creep by this theory will increase due to following factors :

i) Due to weak & loose fish bolts,
ii) Due to worn out fish plates,
iii) Due to ~~wide~~ loose packing at joints,
iv) Due to wide expansion gap,
v) Due to heavy axle loads moving at high speed.

3. Drag or Dragging Theory :-

→ It states that backward trust on driving wheels of the locomotive of train has got a tendency to push the rail off the track backward while the other wheels of the locomotive & the vehicles push the rail in the direction of travel as explained in wave action theory & they have greater effect thus, results in creep of rails in the direction of movement of trains.

4. Starting Accelerating, ~~Sat~~ Slowing down or Stopping of a train :-

→ when a train is a train is starting or accelerating, the backward trust of the

engine driving wheels tends to push the rails backward. when it is slowing down or coming to a stop, the breaking effect to push the rails forward.

8. Expansion or contraction of rails due to temperature :-

→ Creep also occours due to variation in temp. The creep in this case is influenced by the range in temp. variation. location of track where exposed or shady surrounding etc.

i) Steel sleeper track (CST-9) joining/melting sleeper track.

ii) Dips in stretches with long gradients.

iii) Approaches to major structures.

iv) Approaches to level crossings & points crossings.

* Remedies 'or' Prevention of creep :-

Prevention is always better than curce. If creep is not Prevented in time, it will result in dercailment. following arce the common mtd.s adopted to prevent creep.

1) Pulling Back the rails :-

→ If creep is distinctly visible, the remedy is to pull back the rails to their original position.

→ First inspect the track, note the extent of pulling back distance. determine the point from which to.

→ Now start pulling the rails back to their

original positions by means of crow bars.
→ Pulling back the rails is a very slow & tedious process & is only possible when a small length is to be deal.
→ It has, more over, been noticed that rails start creeping immediately after pulling back.

2) Provision of Anchors or Anticreepers :-
→ For creep of 7.5cm to 15cm, in a month 4-anchors.
→ 22.5 cm to 25cm. 6-anchors.
→ Anchors are fastened to the foot of rail & kept in perfect contact with the side of the sleeper.
→ Anchors are fixed to rails either (i) by wedging action; (ii) by clamping.

3) Use of Steel sleepers :-
→ Sleepers should be of such a type & with such fittings that they effectively prevent the rail from creeping on them.
→ Secondly, the sleepers must have a good grip with the ballast to resist the movement of the sleepers in the ballast.

Sleepers :-
Sleepers are members generally laid transverse to the rails on which the rails are supported & fixed, to transfer the loads from rails to the ballast & subgrade below.

Functions of Sleepers :-

(i) To hold the rails to correct gauge (exact in straight & flat curves, loose in sharp curves & tight in diamond crossings).

(ii) To hold the rails in proper level or transverse tilt i.e., level in turnouts, cross-overs, etc.

(iii) To act an elastic medium in betn the ballast & rails to absorb the blows & vibrations of moving loads.

(iv) To distribut the load from the rails to the index area of ballast underlying it or to the girderes in case of bridges.

(v) To support the rails at a proper level in straight tracks & at proper superelevation on curves.

(vi) Sleepers also add to the longitudinal & lateral stability of the permanent track.

Requirements of Sleepers :-

(i) The sleepers to be used should be economical & minimum possible initial & maintenance costs.

(ii) The fittings of the sleepers should be such that they can be easily adjusted during maintenance operations such as easy lifting, packing, removal & replacement.

(iii) The weight of sleepers should not be too heavy or excessively light, i.e, they should have moderate weight, for ease of handling.

(iv) The design of sleepers should be such that the gauge, alignment of track & levels of the rails can be easily adjusted & maintained.

(v) The bearing area of sleepers below the rail seat & over the ballast should be enough to resist the crushing due to rail seat & crushing of the ballast underneath the sleeper.

(vi) The sleeper design & spacing should be such as facilities easy removal & replacement of ballast.

(vii) The sleepers should be capable of resisting shocks & vibrations due to passage of heavy loads of a high-speed trains.

(viii) The design of the sleepers should be such that they are not damaged during packing process.

(ix) The design of sleepers should be such that they are not pushed out easily due to moving trains especially with steel sleepers with rounded ends.

(x) An ideal sleeper should also have an anti-sabotage & anti-theft qualities.

* Classification of sleeper :-

Sleepers can be classified according to the materials used in their construction, in the following categories :-

1) Wooden sleepers
2) Metal sleepers
   (a) Cast iron sleepers
   (b) Steel sleepers
3) Concrete sleepers
   (a) Reinforced concrete sleepers
   (b) Prestressed concrete sleepers

1) Timber or wooden sleepers :-

→ Wooden sleepers are regarded to be best as they fulfil almost all the requirements of an ideal sleeper.

→ The life of timber sleepers depends upon their ability to resist (i) Wear, (ii) Decay, (iii) Attack by vermin, i.e., white ants & (iv) Quality of the timber used. following are the advantages & disadvantages of used wooden sleepers.

Advantages :-

(i) Timber is easily available in all parts of india.
(ii) Fittings for wooden sleepers are few & simple in design.
(iii) These sleepers are able to resist the shocks & vibrations due to heavy moving loads & also give less noisy track.
(iv) Wooden sleepers are easy to lay, relay, pack, lift & maintain.
(v) These wooden sleepers are suitable for all types of ballast.
(vi) They are best for track-circuited operations & moreover, wooden sleepers are over-all economical.

Disadvantages :-

(i) The sleepers are subjected to wear, decay, attack by white ants, spike killing, warping, cracking, end splitting, rail cutting, etc.

2) Metal Sleepers :-

→ Due to the growing scarcity of wooden sleepers, their high cost & short life, metal sleepers are now being widely adopted in india.

→ Metal sleepers are either of steel or cast iron. cast iron is in greater use than steel for sleepers because it is less prone to corrosion.

Advantages :-

(i) Metal sleepers are uniform in strength & durability.

(ii) In metal sleepers, the performance of fittings is better & hence lesser creep occurs.

(iii) Metal sleepers are economical, as life is longer & maintainance is easier.

(iv) Gauge can be easily adjusted & maintained in case of metal sleepers.

(v) For metal sleepers, frequent renewal is not required.

(vi) They have good scrap value, easy in manufacturing & not susceptible to fire-hazards.

Disadvantages :-

(i) More ballast is required than other type of sleepers.

(ii) Fittings required are greater in no., & difficult to maintain & inspection.

(iii) Metals, C.I., or steel, are liable to rusting/ corrosion.

(iv) Metal sleepers are unsuitable for bridges, level crossings & in case of points & crossings.

(v) These sleepers are only suitable for stone ballast & for rails for which they are

manufactured.

(b) Steel sleepers :- In India, thousands of kilometreage of track has been laid using steel sleepers. The design of steel sleepers should fulfil the following requirements :-

(i) The sleepers should maintain perfect gauge.
(ii) It should be possible to fix the rails easily in the sleepers & without moving the sleeper longitudinally.
(iii) The rail should have the sufficient bearing area on the sleeper.
(iv) The sleepers should not be ~~too~~ liable of being pushed easily out of position.
(v) The metal of sleepers should be strong enough as beams.
(vi) They should be sufficiently heavy for stability.

Advantages :-

(i) Steel ~~structure~~ sleepers are casted in one piece.
(ii) The fastening to the sleepers are less in number & simple in nature.
(iii) These have inverted channel section, so light in weight & can be easily handled.
(iv) The gauge, by use of steel sleepers, can be easily adjusted & maintained.
(v) Manufacturing of sleepers can be done by a simple process.
(vi) The life of sleepers is much more than that of wooden sleepers.

Disadvantages :-

(i) In steel sleepers, generally, cracks develop at rail seat which need the use of saddle plate.

(ii) The sleepers, being of metal, are liable to corrosion.

(iii) Steel sleepers like wooden sleepers do not act as insulators & hence interfere with track-circuiting & are not suitable for electrified track.

(iv) The cost of steel sleepers is relatively more than wooden sleepers.

3) Concrete Sleepers :-

→ These sleepers were ended due to chronic shortage of good wooden sleepers & need for better design & economy of sleepers on sustainable basis.

→ These sleepers are mainly of two types :-

(a) Reinforced concrete sleepers

(b) Pre-stressed concrete sleepers

→ Experiments have been conducted in india & aborad on concrete sleepers & it has been proved that concrete is an ideal material for the sleepers for the following reasons:

They are made of a strong homogeneous material, impervious to effects of moisture, & is unaffected by the chemical attack of atmospheric gases or sub-soil salts.

It is moulded easily to size & shape required by scientific investigation, to withstand the stresses produced by fast & heavy traffic.

Advantages :-

(i) These sleepers are free from natural decay & attacks by vermin, insects, etc.

(ii) They have maximum life when compared to other sleepers, the life under normal conditions is 40 to 60 years (As compared to 15-20 years for wooden sleepers).

(iii) This is not affected by moisture, chemical action of ballast, cinder & sub-soil salt.

(iv) There is no difficulty in the track-circuiting, required for electrifying the track.

(v) The high weight of sleepers helps in minimising joint maintenance by providing longer welded lengths (i.e. use of LWR), greater stability of the track & better resistance against temperature variation.

(vi) The sleepers have higher elastic modulus & hence can withstand the stresses induced by fast & heavy traffic.

(vii) Concrete sleepers in the elastic fastenings offers an ideal track in respect of gauge, cross-level & alignment.

Disadvantages :-

(i) The weight of concrete sleeper is as high as 2.5 to 3 times of wooden sleeper, requiring the mechanical appliances for handling.

(ii) These sleepers require pads & ~~pads~~ plugs for spikes.

(iii) They damage the bottom edge during the packing.

(iv) The scrap value is almost nil.

(v) The damages to the concrete sleepers is very [illegible] of derailment.

(b) Pre-Stressed Concrete Sleepers :-

→ ~~Att the disad~~ In Pre-stressed concrete sleepers, the concrete is put under a very high initial compression. The design is based on :-

(i) The maximum permissible compressive strength of 211 kg/cm².

(ii) The minimum cube crushing strength of concrete in the sleeper is 422 kg/cm² at 28 days, &

(iii) The pre-stressed ~~wire~~ wires are stressed to an initial stress of 8.82 kg/cm².

Disadvantages of Pre-Stressed concrete Sleepers :-

(i) These are heavily damaged in case of dercailments.

(ii) The bed of the ballast is Specially prepared.

(iii) These are uneconomical.

(iv) The standard of maintenance for the track, where these sleepers are used, is to be kept very high.

(v) They are more rigid in nature.

(vi) The design & Construction is complicated but even then the desired strength is not developed at the centre of sleepers.

Ballast :-

→ Ballast is the granular material usually broken stone or brick, shingle or kankar, gravel or sand placed & packed below & around the sleepers to transmit load (due to the wheels of the train) from sleepers, to formation & at the same time allowing drainage of the track.

→ It provides a suitable foundation for the sleepers & also hold the sleepers in their correct level & position, preventing their displacement by lateral or longitudinal thrusts.

Functions of Ballast :-

(i) It transfers the load from the sleepers to the subgrade & then distributes it uniformly over a larger area of the formation.

(ii) It holds the sleepers in position & prevents the lateral & longitudinal movement, due to dynamic loads & vibrations of moving trains.

(iii) It imparts some degree of elasticity to the track.

(iv) It provides easy means of maintaining the correct level of the two lines of a track & for correcting track alignment.

(v) It provides good drained foundation immediately below the sleepers & helps to protect the top surface of the formation. This is achieved by providing coarse & rough aggregates with plenty of voids.

Requirements of the good ballast :-

(i) It should be able to withstand hard-packing without disintegrating. In others words, it should resist crushing under dynamic loads.

(ii) It should not make the track dusty or muddy due to powder under dynamic wheel loads but should be capable of being cleaned to provide good drainage.

(iii) It should allow for easy drainage with minimum soakage & the voids should be large enough to prevent capillary action.

(iv) It should offer resistance to abrasion & weathering. Abrasion means wear due to rubbing action of particles with each other & weathering means cracking & shattering of the material due to variation in temperature, moisture & freezing.

(v) It should retain its position laterally & longitudinally under all conditions of traffics, particularly on curves, where it should be able to prevent transverse displacement of sleepers.

(vi) It should not produce any chemical action with rail & metal sleepers.

(vii) The size of stone ballast should be 5 cm for wooden sleepers, 4 cm for metal sleepers & 2.5cm for turnouts & crossovers.

(viii) The material should be easily workable by means of the implements in use.

(ix) The ballast should be available in nearby quarries so that it reduces the cost of supply. It should also fulfil the requirements of quality, amount of traffic, life & maintenance cost.

Types of Ballast :-

The different materials used as ballast in india are broken stone, gravel, sand, ashes or cinders, soft aggregates like moorum, kankere, overburent & broken brickbats, blast furnace slag & sometimes selected earth.

(1) Broken Stone :-

→ This is the best material for the ballast & almost all important tracks are provided with stone ballast. Broken stone satisfies all the specifications & requirements of a good ballast.

→ The best stone for ballast is nonporous, hard & angular, which does not flake when broken. Igneous rocks such as hard trap, quartzite & granite, make excellent ballast & are used in large quantities for high speed tracks in india.

→ where such hard stone is not available, sand stone & limestone which make fairly good ballast are used.

(2) Gravel or River pebbles or shingle :-

→ Gravel comes next in rank for its suitability for use as ballast & is used in large quantities in many countries.

→ This is obtained either from reiver beds or from gravel pits.

→ The smooth pebbles are broken, otherwise they are liable to displace the sleeper due to smooth ness of its particles & the paking does not hold.

→ The process of ramming the ballast under-neath the sleepers is known as "packing".

→ The ballast above this layer which surrounds the sleepers, is loose filled & is known as "Boxing".

→ The loose ballast between the two adjacent sleepers is known as "Ballast crib".

(3) Ashes or Cinders :-

→ This material is available in large quantities on railways from coal being used in locomotives.

→ It has excellent drainage properties as it is very porous.

→ It is cheap & is largely used in sidings but cannot be used for main lines as it is very soft & gets reduced to powder under wheel loads.

→ It is excellent for station yards & for foot-paths particularly in rainy weather as it does not retain water & is not slippery.

→ The great drawback of ashes is its corrosive quality &, therefore, it corrodes steel sleepers & foot of the rails.

(4) Sand :-

→ It is reasonably good material as ballast as it is cheap & provides good drainage (Provided it is free of earth & vegetation). Sand ballast also produces a silent track.

→ The great drawback of the sand is its blowing effect due to vibration.

→ The sand gets into the moving parts & on the track & causes heavy wear.

→ The maintenance of the track, is, therefore,

(5)

(6)

(7)

→ Sand ballast is sometimes covered with a layer of stone or brick or some such material to prevent it from blowing about too much. the coarse sand is preferred to fine sand.

(5) Moorum :-

→ It is the soft aggregate & is the result of decomposition of laterite.

→ The best moorum for ballast is that which contains large quantities of small laterite stone.

→ It is recommended as a ballast for sidings & main tracks.

(6) Brick ballast :-

→ Where no stone or substitute is available for use as ballast, overburent bricks are broken into small sizes & used.

→ It powders easily & produces a dusty track.

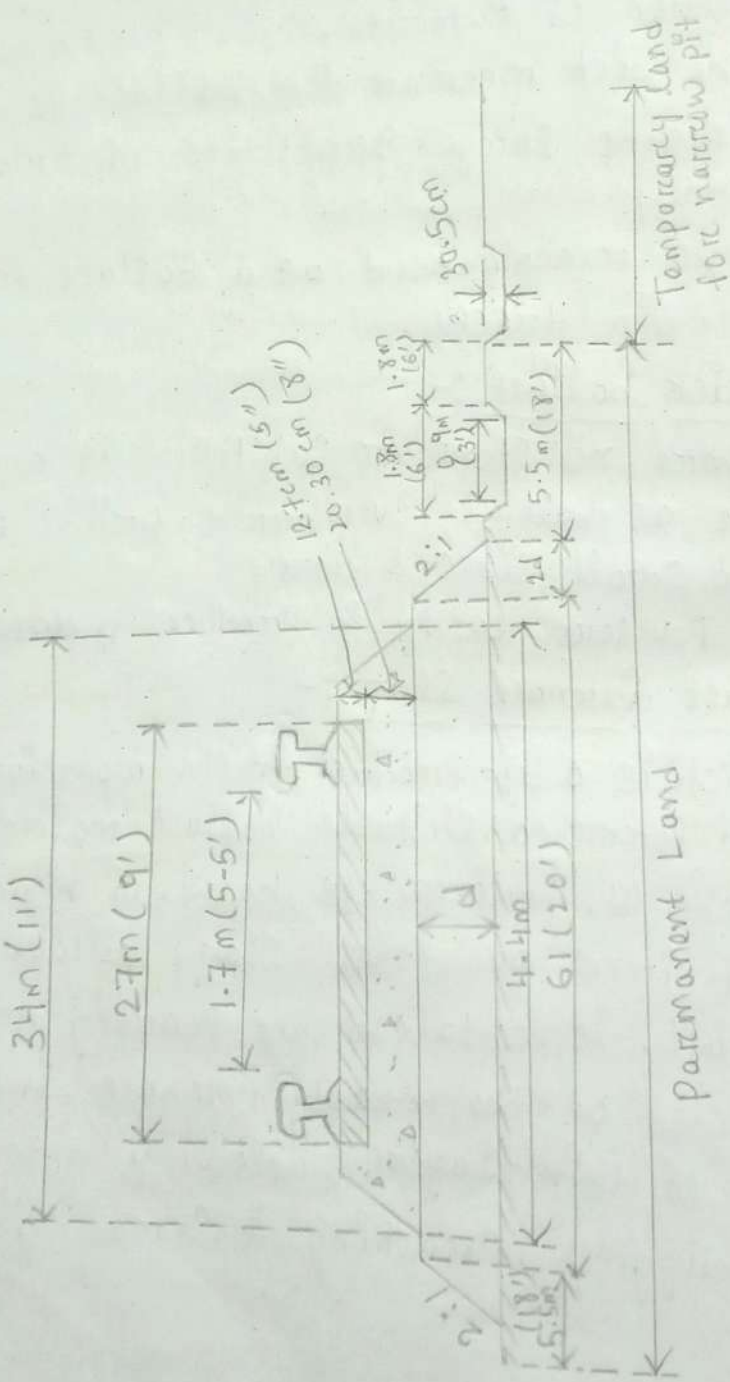
(7) Blast furnace slag :-

→ which is a by-product in the manufacture of pig iron forms a suitable ballast material.

→ It should, however, be hard, of high density & free from gas holes. Slag, suitable for use as ballast, is obtained by pouring molten slag collected at the blast furnace into shallow pits of thin layers, allowing it to cool, & then by digging, crushing & screening.

Chapter-4 Geometrical for Broad gauge

typical cross-section of single broad gauge on straight track :-



The cross-section of a B.G. in Embankment on straight track

Super-elevation or Cant :-

When a train moves around a curve, it is subjected to a centrifugal force acting in the horizontally upto centre of the curve (which is C.G. of the vehicle away from the centre of the curve.

→ To countreact the effect of centrifugal force the outer level of outer rail is raised then the level of inner rail. this is called cant or superelevation.

→ It is denoted by e.

Objectives of Superelevation :-

→ To countreact the centrifuga force of the vehicle (Train) on the curve. It will prevent Dercailment & reduce the wear of & creep of rail.

→ It provide smooth running of train on the curve track.

→ **Relationship of Superelevation (e), Gauge (G), Speed (V) & Radius of the curve (R):**

$$\text{Centrifugal force } (f) = \frac{Wv^2}{gR}$$

Where, f = Centrifugal force
W = weight of the vehicle
v = Speed of the vehicle
g = 9.81
R = Radius of the curve.

Superelevation (e) = $\frac{V^2}{gR} \times G = \frac{GV^2}{gR}$ (If the unit of v is KMPH, $e = \frac{GV^2}{gR}$ - (i) $e = \frac{GV^2}{127R}$ where, unit of V is m./sec. (unit is cm 1-27)

Where,

e = Superelevation

V = Speed of the vehicle

g = 9.81

R = Radius of the vehicle

G = Gauge distance

G for B.G. = 1.676 m.

G for M.G. = 1 m.

G for N.G. = 0.76 m.

kmph = $e = \frac{GV^2}{gR} \rightarrow 9.81$

MPH = $e = \frac{GV^2}{127R}$

cmph = $e = \frac{GV^2}{1.27R}$

Problem

1) If a 8 degree of curve track diverged from a main curve of 5° in an opposite direction of B.G. Calculate the Super-elevation & Speed of the vehicle if maximum speed of the main track is 45 KMPH.

Ans- Given data,

θ = 8° degree

θ of diverse track = 5°

Gauge = B.G. = 1.676 m.

Speed (V) = 45 KMPH = 0.0045

Q - If the data of radius on the curve is missed.

$$R = \frac{1720}{\theta} = \frac{1720}{5}$$

Therefore, Supercelevation $(e) = \frac{V^2}{gR} \times G$

$$\Rightarrow \frac{(0.045)^2}{1.27 \times \frac{1720}{5}} \times 1.676$$

$$\Rightarrow 7.768$$

2) A 5° curve diverged from 3° main curve of B.G. If the speed of vehicle is 35 kmph Then calculate super-elevation.

A:- Given data,

$\theta = 5°$

θ of diverge track 3°

Gauge B.G. = 1.676 m. (G)

Speed (v) = 35 KMPH = 0.035

If data of radius of curve is missed

Then,

$$R = \frac{1720}{\theta} = \frac{1720}{3} = 573.34$$

$$\therefore \text{Super-elevation } (e) = \frac{V^2}{gR} \times G$$

$$= \frac{0.035^2}{1.27 \times 573.34} \times 1.676$$

$$= 2.81$$

Points & Crossings

* **Defination :-**

Points, crossings, turnouts, cross-overs & such related terms are contrivances or arrangements by which different routes either parallel or diverging are connected & afford the means for trains to move from one route to another.

Necessity of points & crossings :-

→ In case of roads, the facilities for turning of vehicles from one path to another, do not require any special arrangement as the wheels have no flanges.

→ The direction of movement of vehicles is controlled by the driver & the steers according to his own sweet will.

→ But this is not true in case of railways because the wheels are provided with flanges inside.

→ So the direction of movement & the diversion of the vehicles to another track are controlled automatically.

→ The problem of diversion of trains from one track to another is solved by special arrangement known as points & crossings.

→ The knowledge of the points & crossings is important in following ways for the operating personal :-

(i) Points & crossings provide flexibility of

movement by connecting one line to another according to requirements.

(ii) They also help for imposing restrictions over turnout switch necessarily retard the movements.

(iii) From safety aspect, it is also important as points & crossings are weak kinks or points in the track.

Turnouts:-

Turnouts is the simplest combination of points & crossings which enables one track either a branch line or a siding, to take off from another track. So the object of turnout is to Provide facilities for safe movement of trains in either direction on both the tracks.

(i) A pair of points or switches.
(ii) A pair of stock rails.
(iii) A vee crossing (GHIJ).
(iv) Two check rails.
(v) Four lead rails.
(vi) 'Switch tie-plate' or 'Gauge tie chair' & crossing tie-plate.
(vii) Studs or stops.
(viii) Bearing plates; slide chairs, Stretcher bars, etc.
(ix) For operating the points - rods, cranks, levers, etc.
(x) For locking System - locking box, lock bar, plunger bar etc.

Important terms used in points & crossings :-

(i) **Facing Direction** :- If someone stands at toe of switch & looks towards the crossing, then the direction is called "facing Direction".

(ii) **Trailing Direction** :- If someone stands at the crossings & looks towards the switches, then the direction is called "Trailing Direction".

(iii) **Facing points of turnouts** are those where trains pass over the switches first & then they pass over the crossing. These are important to specify when the direction of movement of trains is reserved for facing direction.

(iv) **Trailing points of Turnouts** are those on the opposite side of facing points in which the trains pass over the crossing first & then over the switches. These are important to specify when the direction of movement of trains is reserved for trailing direction only.

So every point may be a 'facing' or 'trailing' point or both, depending upon the direction of movement of trains.

(v) **Right-hand & Left-hand Turnouts** :-

→ If a train from main track is diverted to the right of the main route in the facing direction then this diversion is known as right-hand turnout.

→ If a train from main track is directed to the left of the main route in the facing

direction, then the diversion is known as Left-hand turnout.

(vi) Right-hand & Left-hand Switches :-

→ These are termed as left-hand or right-hand switches depending upon left or right when seen from the facing direction i.e., stand at the points & look towards the crossing.

Types of Switches :-

There are two types of switches,

(i) Stub Switch
(ii) Split switch

(i) Stub Switch :-

→ In this type of switch, no separate tongue rail is provided & some portion of the track is moved from side to side.

It is an old form of the switch & has

got many objectionable features in its performance.

→ This type is no more in use & has been replaced by the split switch which is now universally adopted.

(ii) Split Switch :-

In this type of switch a tongue rail is combined with the stock rail.

* Crossings :-

→ A 'Crossing' or a 'frog' is a device which provides two flangeways through which the wheels of the flanges may move, when two rails intersect each other at an angle.

→ The flanged wheels of the train jump over the gap from 'throat' to 'nose' of crossing.

Types of Crossings :-

Crossings can be classified as below;

(A) On the basis of shape of crossing.

(1) Acute angle crossing or "V" crossing or frog.

(2) Obtuse angle crossing or Diamond crossing.

(3) Square crossing.

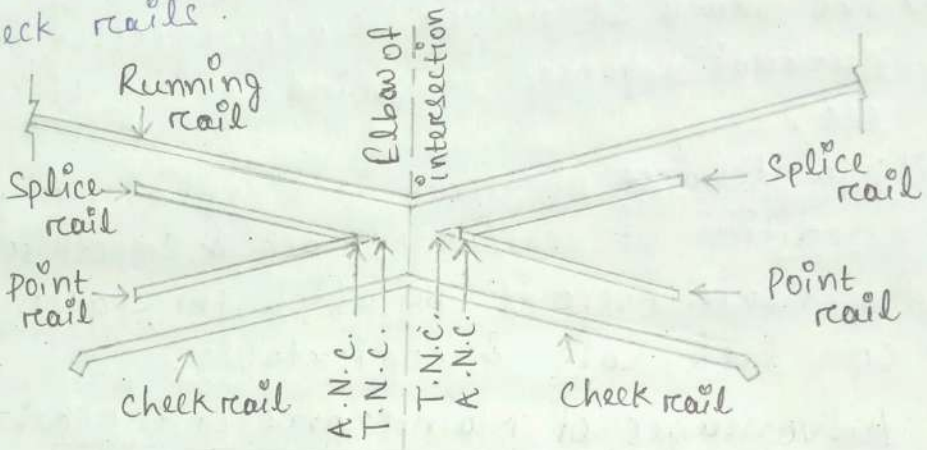
(2) Obtuse angle crossing :-

→ This crossing is obtained when left-hand rail of one track crosses right-hand rail of another track or vice-versa at an obtuse angle.

→ In diamond crossing, a pair of special crossings

is used which is called "obtuse crossing".

→ In case of obtuse angle crossing the long wing rails do not carry the wheels as in case of acute angle crossing, rather act as check rails.

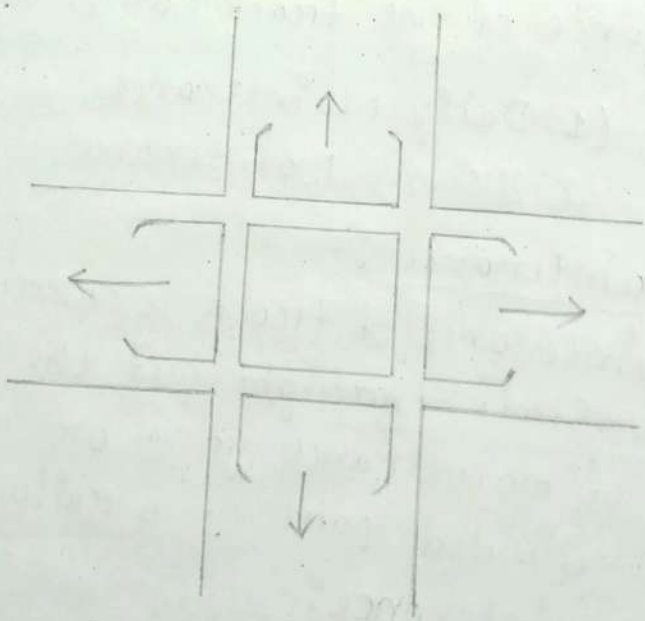


(Obtuse Angle crossing)

(3) Square Crossing :-

→ When two straight tracks cross each other at right angles, they give rise to square crossing.

→ This type of crossing must be avoided on main lines because there is heavy wear due to dynamic loads.



(Square Crossing)

Layering & Maintainance of track Chapter-5

Necessity of Maintenance of track :-

(i) Strength of the track reducing due to regular movement of high speed train.
(ii) The track structure is also effected by natural agency, wind, effect of sunlight, etc.
(iii) Maintenance of track is essential for good condition of railway track & smooth running of train over it. by which the passenger can feel safe & comfortable.

Advantages of Maintenance of track :-

(i) Life span of the railway track will increase.
(ii) A well maintenance track the wide smooth riding quality.
(iii) It reduce the foul consumption.
(iv) It provides safety to the passengers good.

Types :-

Maintenance of the track can be divided into 2 parts, (1) Daily Maintenance
(2) periodic Maintenance

(1) Daily Maintenance :-

→ Daily maintenance of track is carried out by full time staff throught out the year.
→ Number of maintenance gang are made for each sub-divided part of a railway track.

(2) periodic Maintenance :-

→ periodic Maintenance is carried after a interval of 2-3 yrs.
→ During periodic maintenance gauge distance

leveling & alignment & points & crossings are thoroughly check.

→ Each & every defects are detected, find out the reasons & takes the remedy.

→ Maintenance of the track includes,

(i) Surface of rail
(ii) Track alignment
(iii) Gauge
(iv) Proper drainage
(v) Track components
(vi) point & crossing
(vii) Level crossing
(viii) Tunnels
(ix) Bridge

* Duties of a Permanent way Inspector (P.W.I):

→ The duties of the P.W.I. can be divided into three heads :-

(a) Duties in the field work,
(b) Duties in the office work, &
(c) Miscellaneous duties.

(a) Duties in the field work :-

(i) The P.W.I. is personally responsible for maintaining the track in a safe condition for passage of trains. For this purpose, he arranges through his gangs the repair work of defective track efficiently & economically.

(ii) He inspects the track of his section atleast 2 to 3 times in a week, notes down the defects with [illegible] & kilometreage from telegraph posts

by using different symbols for different defects & rectifies them to keep track in best condition for continuous service of track.

(iii) He inspects track by push trolley or by travelling on an engine or a brake van.

(iv) He keeps all the records of (a) Programme or work to rectify the defects & make renewals, (b) Progress of maintenance work, & (c) Relay of track.

(v) He imparts instructions to (a) Gangmate or ganger, (b) keyman, (c) Gateman at level crossing & (d) A.P.W.I & he should see that his instructions are observed sincerely.

(vi) At the time of accidents, he should make the track safe in shortest possible time & should make enquires for the causes of accidents.

(b) Duties in the office work :-

(i) He takes care of the labour & materials, & also maintains the accounts of gangmen, keyman & gangmate as well as of materials.

(ii) He controls the workshops such as Smithy, Carpentry, Welding etc.

(iii) He prepares the estimates of the maintenance work & makes report of works.

(c) Miscellaneous Duties :-

He being the incharge of administration, performs the following miscellaneous duties also.

(i) He attends all the monthly meetings of P.W.Is usually at Divisional Engineer's office.

(ii) He has to attend the inspection if made by Divisional Engineers or Assistant Engineers, etc.

(iii) He also attends the inspection of Government inspectors for railways (G.I.R.) with all the relevant drawings & reports of work.

(iv) He officiates as Assistant Engineer in his absence as & when required.