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LECTURE NOTES

ON

RAILWAY & BRIDGE ENGINEERING

CIVIL, 5TH SEMESTER

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entities.

Transportation :-

One movement :-

Transportation is regarded as an index of economic, social and commercial progress of country.

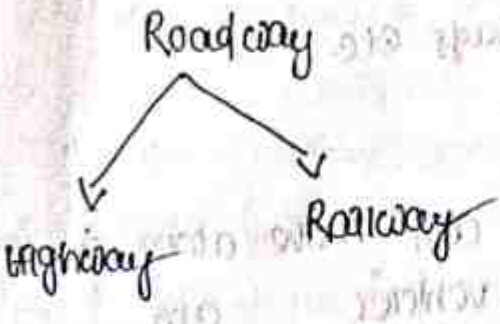
(or)

⇒ The transport industry which under takes nothing more than movement of person and things from one place to another has constituted one of the most important activities of men in every stage of an advanced civilisation.

⇒ Land, water and air have been used by the mankind for developing the transport modes like railways, highways, coastalways, airways etc.

Generally transportation is of 3 types

i) Roadway
ii) Waterway
iii) Railway



Classification from surface point of view :-

Land transport :-
Ex:- Highways, Railways, ropeways, Cableways.

Water transport :-
Canalways, riverways, Oceanways, lakeways etc.

↳ Human porters
↳ Animal transport
↳ Road transport
↳ Rail transport
↳ Water transport
↳ pipe line transport
↳ Cable and ropeway transport
↳ Conveyer transport.

Classification based on the freedom to move laterally and vertically :-

One degree of freedom :-

Those modes in which vehicles are free to move only along a line i.e vehicles are vertically and laterally strained.

Ex:- Railways, pipe line, Cable ways etc.

Two degree of freedom :-

Those modes in which vehicles can move along a line as well as laterally i.e vehicles are restrained only vertically.

ex:- Highway vehicles, ships, boats etc.

Three degree of freedom :-

Those modes in vehicles are free to move in any plane i.e vehicles are neither

laterally nor vertically restrained.

Ex:- Aeroplane and under water vehicles.

Classification According To Energy used for Movement:

↳ Human energy
↳ Animal energy
↳ Electric energy
↳ Steam energy
↳ Solar energy
↳ Petrol and diseal energy
↳ Automatic energy
↳ Other known convential energy (Geothermal energy, batteries.)

Advantages of Railways :-

Railway have brought about many political, social and economical changes like Indian people.

Political Advantage :-

↳ Railways have united the people have different cast, religeons, customs and tradation.
↳ With the adequate network of railway the general administration has become more easy and effective.
↳ Railways have contributed towards development of a national mentality in the ming of people.
↳ Railways have helped in the mass, migration of the population.
↳ The role of railways during emergency in mobilising troops and ware equipments has been very significant.

Social Advantage :-

↳ The filing of isolation has been removed from the inhabitant of the Indian villages.

↳ By travelling together into the compartment without any restriction of cast the filing of cast difference has disappear considerably.

↳ The social outlook of the masses has been broaded through railway journies.

↳ Railway has made it easier to reach places of religious important.

↳ Railways provides a convenint and safe mode of transport for the country.

Economic Advantages :-

↳ Mobility of people has increase their by the congested areas can be relief of congestion and the populared areas can be develop.

↳ Mobility of labour has contributed to industrial development.

↳ During famines, railways have played the vital role in transporting food and clothing to the effected areas.

↳ Growth of industries has been promated due to transportation of raw materials through railway.

↳ Speedy distribution of finished product is achelve through railways.

↳ Railways provides employment to millions of people and thus help in solving the unemployment problem of the country.

↳ Trade develop due to railways their by has increased the earning and standard of living of Indian people.

↳ Land values have increased due to industrial development which ultimately result in the increase of national wealth.

↳ Due to the mobility of product through railways the price stabilization of communities could be possible.

↳ Commercial farming is very much helped by the railway network through out the country.

Technoeconomic Advantages :-

↳ Cost saving in transportation of long haul bulk traffic.

↳ Energy efficiency (Railway consume 1/7th of fuel used by the road sector)

↳ Environment friendliness higher safety.

↳ Efficient land used and easy in capacity expansion.

Classification Indian Railways :-

↳ Railway board has classified the Indian railway lines on the basis of the importance of route. Traffic carried and maximum permissible speed on the routes in the following 3 main categories.

↳ Trunk route

↳ Main line

↳ Branch line

Trunk route :-

The following 6 routs of broad gauge, 3 routes of meter gauge have been classified as trunk routes according to broad gauge.

On broad gauge (1.67 mt) :-

↳ Delhi - Mughalsarai to Howrah
↳ Delhi - Kota - Mumbai
↳ Delhi - Jhansi - Nagpur - Chennai
↳ Howrah - Nagpur - Mumbai
↳ Howrah - Vijayawada - Chennai

On Meter gauge (mt) :-

↳ Lucknow - Gorakhpur - Gorakhpur
↳ Delhi - Jaipur → Ahmedabad
↳ Chennai - Madras - Trivandrum

Trunk routes :-

Item	Broad gauge	Meter gauge
maximum permissible speed	120 km/hr	80 km/hr
Railway section	52 kg/mt or heavier	37.2 kg/mt (i.e 75R)
Ballast cushion	25 cm below sleeper	25 cm below sleeper
Degree of curvature	$7\frac{1}{2}$	Suitable degree
Design speed for new network	160 km/hr	100 km/hr

Main line :-

All lines other than trunk routes per annum or more for broad gauge and 2.5 GMT or more for MG or where maximum permissible speed allowed is 100 km/hr for broad gauge and 75 km/hr for meter gauge are classified as main lines.

The following specification have been laid down for main lines railway board.

Items	Broad gauge	Metergauge
GMT / Annum	>/10	>/ 2.5
Maximum permissible speed	100km/hr	75km/hr
Track relaying period	20years	30years
Rail section	52kg/m	37.2 kg/m
Design speed for new track	120km/hr	75km/hr

Branch line :—

These are classified on basis of following criteria

↳ All those broad gauge lines which carry less than 10 gross million tons (GMT) per annum and have maximum permissible speed of less than 100km/hr are classified as branch lines.

↳ For meter gauge tracks all those lines which carry less-than 2.5 GMT per annum and have maximum permissible speed of less-than 75km/hr are classified as branch lines.

↳ The tracks classification would vary depending upon the requirement of traffic subjects to the following condition.

↳ Broad gauge locomotive and bobs wagons would be allowed to operate over all branch lines at a responsible speed.

↳ No new rails will normally be used on branch lines

Wagons :—

For transportation of goods, wagons are provided in all goods train. For transporting different types of goods such as food grains, building

Materials, animals, cloth, coal, sugarcane, petrol, chemicals, oil, automobiles etc. There are different type of coaches are used in the railway.

Classification of Indian Railway based on speed criteria:-

All broad gauge routes in India railways have also been classified based on speed criteria according to this method the broad gauge railway line can be divided into the following 5 groups.

Group-A lines:-

They consist of those trunk routes on which the trains are running or are meant for running. The train at a speed of 160km/hr or more.

At present the following routes comes under this category.

- Centrals / New Delhi to Howrah by a rajdhani route.
- New Delhi to mumbai central via kota by a rajdhani route
- New Delhi to Chennai central by ground trunk route.
- Howrah to mumbai via nagpur.

Group-B lines:-

- They consist of these routes on which the trains with a maximum speed of 130km/hr are running or are intended to run.
- At present nearly 13 routes come under this category.

Ex:- Allhabad to Bhusaval, Kalyani to Chennai, Khadgpur to Vijyabada, Howarth to mumbai, Delhi to kota, Ambala to pathankot, Ambala to nagiasarai, Baroda to Ahamadabad.

Group - C line :-

They consist of all routes of mumbai, Kolkata and Delhi.

Group - 'D' line :-

Group 'D' lines all other routes in the country where maximum permissible speed at present less than 100km/hr.

Group - E line :-

The other routes and branch lines where the permissible speed limits are less than 100km/hr.

Chapter-2

Railway Terminology

Adhesion of Wheels :-

⇒ It is a resistance offered by the friction present between the metal surface of the rail and the wheels.

⇒ This is one of the factor which imposes limitation in rising the speed beyond certain limit and depend upon the condition of the wheel and rail surface, speed of train and the load.

Adzing of sleepers :-

To provide a cant of 1 to 2 in the rail, wooden sleepers have to be cut to this slope at rail side. This process of cutting the wooden sleepers are in 2D slope is known as adzing of sleepers.

Ash pits :-

These are long masonry pits build longitudinally under the track per discharging of ash form locomotive.

Audible signal or tug signal :-

Sometimes a container containing suitable explosive input on the top of railway so that there is explosion with a loud voice when trues are passes over the rail. This arrangement is called as audible or tug signal.

Ballast :-

Ballast is the granular material packed under and arround the sleeper to transport the loads from sleeper to ballast. It helps in providing elasticity to the track.

Ballast crib :-

The loose ballast bet^n two adjacent sleepers is known as ballast crib.

Bearing plate :-

Bearing plates, to reduce the intensity of pressure, particularly on soft varieties of sleeper, a rectangular plate of mild steel or cast iron is introduced betn the rails and the sleepers, this plate is called bearing plate.

It distribute the load over a large area of timber sleepers.

* Blocking Joint :-

on the ballast which contain too much of these dust & the fish plates at the joint are loose the dust is sucked up under the block of wheels and appear in a layer on the surface, this happening is called blocking of joints.

Boxing :-

This process of filling the ballast arround the sleeper is called boxing of ballast. This ballast boxes the sleeper.

* Broad gauge :-

The gauge of a track in which the distance between the running faces of two track rails is 1.676m is termed on broad gauge (BG).

* Buckling of Rail :-

The railway track gets out of the original position due to buckling it the expansion of rail due to rise in temperature is prevented during hot weathers, this is known as buckling due to rise in temperature rails.

* Bull headed Rail :-

Bull headed rails are those in which head is made little thicker and stronger then lower part i.e foot by adding more metal at the top.

* Cant (or) super elevation :-

On curves the counter act the effect of centrifugal force, the level of outer rail is raised above the inner rail by a certain amount the raising of outer rail over the inner rail is called super-elevation or cant.

* Cant deficiency :-

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

* Capacity of the track :-

Capacity of the track is the number of trains that can run safely on a track / hr.

* Centre bound sleepers :-

The repeated application of load on the end cause greater depression at the end as compare to the central position of the sleeper, so the sleeper is said to centre bound.

* Chairs :-

C.I Chairs are used to hold the bull headed and double headed rail. These Chairs are then fixed to sleeper by round spikes.

* Check rails :-

Check rails are provided on the opposite side of the crossing location for guiding one wheel of vehicle and thus to check the tendency of another rail to lying over the crossing.

* Coning of wheel :-

The wheels are coned at a slope of 1 in 20 to prevent from rubbing the inside face of

the rail head and to prevent lateral movement of axel with its wheel, this is known as coning of wheel.

Creep of Rails :-

Creep is the longitudinal movement of rails in a track. It occurs due to several trifles reasons. The effect of creep tends to drag the track if ballast is insufficient to hold the rails.

* Cutting :-

When the ground has to cut it called as cutting.

Cutting is termed as shallow cutting when the depth is 3mt or less and is called deep cutting when the depth is more than 3mt.

* Derailing switch :-

All siding and shunting lines are isolated from running lines. The isolation is provided by means of a track joint, called derailing switch. If derailing switch is open a bogie in the siding loop starts moving ons on to its wheels derailing.

* Double headed rails :-

These are the rails which have double head the bottom and top of the rails are of the same cross-section.

* Drop pits :-

They are rectangular deep pits in which wheels of the locomotive are taken out for repairs.

* Temporary diversion :-

It is a temporary shifting of a track alignment from its original position. If some heavy or time consuming works like repairing branches track crash occ in blocking, reballasting etc, are to be done on original track.

* Rebuilding of bridge

* Embankment :-

The raised structure above the ground level for carrying the railway track is called embankment. When height of embankment is more the side slope are stepped for better stability of slopes.

*Equilibrium cant or super elevation :-

If the cant or super elevation on the curved track is provided on the basis of average or equilibrium speed of the train running over the section, then such as cant is called as equilibrium cant.

* Facing direction :-

A point is called a facing point when train is running in facing direction only. The rail wheels pass over the switches first and then over the crossing.

* Fish plate :-

These plates resembling in shape to a fish are used to provide the continuity bet^n the two rails at the rail joint. They also provide the required gape for expansion, and contraction of rails due to temperature vibration. They are made up steel.

* Flange way clearance :-

This is the distance bet^n the adjacent faces of the stock rails or running rails and the check or guard rails. It is provided for 3 movements of the wheel flanges.

* Flange way depth :-

It is the vertical distance bet^n the top surface to the running rails or stock rails top to the surface of the heel block which is used bet^n stock rail and check rail.

*F.F Rails :-

F.F rails have wider or flatter bottom so, that they can be fixed directly on the

section, avoiding the necessity of chairs. They are also called tigonoy rails.

*Formation :-
Formation is the prepared sub grade ready to receive the ballast

*Gauge :-
The gauge of a track in India is measured as the minimum distance betn the inner running or gauge faces of the two rails.

* Gradient :-
Any departure of a railway track from the level is known as grade or gradient. It is called an % gradient, when the track rises in the direction of motion, and a down gradient when track falls loaded in the direction of moment.

*Guard Rail :-
Guard rails are extra rails provided over bridges to prevent damage and danger in case of the derailment occuring on the bridge.

* Grade compensation :-
This amount of gradient is reduced whenever a curve and a gradient have to be provided together. The reduction in grade is known as grade compensation on curve.

* Heel :-
Tapered rails ~~on the~~ at location where they are fixed to the main rails is known as heel.

* Heel divergence :-
Heel divergence is the distance betn the running faces of stock rails i,e gauge face of stock rails and gauge face of the tongue rails. When measure at the heel of switched.

* Scrap Rail :-

These rails which get bended due to impact action or stress over the end of the rails are known scrap rails. These rails get worn down and destroyed at the ends

Interlocking :-

The device achieve through mechanical or electrical agencies for the movement locking between the levers is called interlocking.

↳ It avoids the possibilities of confusion and danger of passing wrong signals and thus prevents conflicting movement.

Joint in rail/Rail Joint :-

↳ For holding together two adjoining rails in correct position the rail joints are provided.

↳ Joints are the weakest parts in the track.

Keys :-

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

Function of ballast :-

Ballast performs the following functions

↳ It transfers the load from the sleepers to the subgrade and then distributes it uniformly over a larger area of the formation.

↳ It holds the sleepers to position and prevents the lateral and longitudinal movement due to dynamic loads and variations of moving trains.

↳ It imparts some degree of elasticity to the track.

↳ It provides easy means of maintaining the correct levels of the two lines of a track and for correcting track alignment.

↳ It provides good drainage foundation immediately below the sleepers and helds to protect the top surface of the formation.

↳ This is achieved by providing coarse and rough aggregate with plenty of voids.

Kinks :-

↳ The lateral movement of the end of the rails out of its original position due to several causes, such as loose joint, defective gauge etc from shoulders are called kinks.

↳ More kinks result in rough running of train.

Lead or crossing lead :-

It is the distance from the hill of switch to the theoritical nose of crossing, the distance being major along the straight.

Lead Rail :-

↳ In a turn out lead rails are the length of rails from the hill of the toe of the crossing.

↳ These rails are of the normal rail section.

Left hand turn out :-

A turn out is called as left hand turn out when the direction is towards the left of the main track it is in facing direction.

Linking Gauge :-

The labour who fixes rail to the sleepers together with fish plates is called linking gauge.

-ve cant (or) -ve super elevation :-

When the turn out or branch line branches off from a main line on the curve on the opposite side then at a point from where both the tracks diverge it is ~~called~~ not possible to provide cant for both the

tracks at the same place.

↳ In such cases on the branch line where the outer rail is below the inner rail is said to have -ve cant or -ve superelevation.

Turnout :-

A complete set up point and crossing with the intervening lead rails is called a turnout.

Permanent track :-

It is the track which is of permanent nature and handles the normal commercial traffic born which it is meant it is called as permanent track or permanent way.

Rail :-

Rails as steel girds which provide the hard and smooth surface for movement of wheels of a locomotive and railway vehicles.

Railway Engineering :-

Railway engineering is the branch of civil engineering which deals with the construction and maintaince of the railway track for efficient and safe movement of track on it.

Railway track :-

Railway track is a structure provided by the rails fitted on sleepers resting on ballast and subgrade for passanger of wheels.

Railway zones :-

In India railways have been divided into 9 zones.

↳ Central
↳ Western
↳ Northern
↳ North- Eastern
↳ Eastern
↳ South- Eastern
↳ Southern
↳ South central
↳ North- east frontier.

Definition :-

↳ The combination of rails fitted on sleepers and resting on ballast and subgrade is called the railway track (or) permanent way.

↳ Sometimes the temporary tracks are also laid for convenient of earth and materials during construction works.

Components of a permanent way :-

* Sleeper :-

Sleepers are the members laid transversly under the rails which are meant to support the rails over them and transfer the load from rails to the ballast.

Sleeper density :-

Sleeper density represents the number of sleepers per rail length in mt.

Sleeper Crib :-

↳ A track is temporarily supported for repair and alternative work by piers over a stack of timber sleepers called sleeper crib.

↳ This adopted small bridges and culvert by dry bed is available.

* Formation :-

In a permanent way the rails are joint

in series by fish plates and bolts and then they are fix to sleeper by different types of fastening. Then sleepers properly spaced, resting on ballast are further packed on boxed with ballast the layer of ballast is on the prepared subgrade called formation.

* Ballast :-

The sleepers hold the rails in proper position with respect to the sleeper width and length, gauge and level and transmit the load from rails to ballast and the ballast distribute the load over the formation and holes the sleeper in position.

* Ballast Cushion :-

On curve track super-elevation is maintained by ballast and the formation is levered, minimum ballast cushion is maintain are the inner rail while the outer rail gets kept more ballast cushion.

↳ The crushing of ballast under the sleeper is called ballast cushion.

* Requirement 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 tracks should their be constructed and maintain keeping the requirements of a permanent way.

Following are some of the basic requirements of a permanent way

↳ The gauge should be correct and uniform.

↳ The rails should be in proper level. On a straight track two rails most be at the same level on curves the outer rails should have proper super-elevation and they are should be proper transition at the Junction of a straight and a curve.

↳ The alignment should be correct i.e. it should be free from kinks or irregularities.

↳ The gradiant should be uniform and as gentel as possible if any change of gradiant should be followed by a smooth vertical curve to give smooth riding quality.

↳ The track should be elastic and resilent in order to absorve shocks and vibration of running track.

↳ The tracks should have enough lateral strain, so that alignment is maintain, given due to effect of
i) Side thrust on tangent length, and centrifugal force on curves.
ii) Lateral forces due to expansion of rails particularly in case of welded range rails.

↳ The super-elevation on curves should be properly designed and maintain.

↳ Drainage system most be perfect for enhancing safety and durability of track.

↳ Joints, including points and crossings which are regulated and regarded to be weakest point on the railway track, should be properly designed and maintain, so

↳ If they are is trouble from the creep the measure
prevention) reasons should be to prevent it.

↳ The various components of track i/e rails, fittings, sleepers, ballast and formation much fully satisfy the requirements for which they have been provided. If any components is lacking in fullyfillingits requirement then either it should be improve or replaced.

↳ There should be adequate provision for easy renewal and replacement.

↳ The tracks structure should be strong, low in initial cost as well as maintaince cost.

Gauges in Railway track

Definition :-

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

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

Different Gauges in India and Abroad :-

↳ In 18th century the british railway where using the flanges on the outside of the rails and the gauge was defined as the the distance betn the outer faces of the rails.

The gauge then maintain was 5'.

The position of rail of track was not change in view of economy and clear distance between inner faces was defined by gauge.

↳ So present gauge = past gauge - 2x rail width at top

$$= 5' - 2 \times 1\frac{3'}{4}$$

$$= 4' - 8\frac{11}{2} \text{ (or) } 1.435 \text{ mt}$$

↳ A gauge of 1.439mt is the standard gauge in most of the countries even today.

Type of gauge	Gauge width
Standard gauge (B.G)	1.67mt
Meter gauge (M.G)	1mt
Narrow gauge (NG)	0.762mt
Feeder track gauge (Light gauge (L.G)	0.610mt

Selection of gauge :-

The following factors govern the choice among the different gauges.

↳ Cost of construction :-

they are each time increase in the initial cost is to select a wider gauge (BG) this is due to the following reason.

↳ The cost of bridges, tunnels, station, buildings, staff quarters, signal, cabins and level crossings is the same for all the gauges.

↳ The cost of earth work, ballast, sleepers, rails etc comp evolved proportionally increase in gauge width.

↳ There is little proportional increase in the land for permanent track with increase in gauge.

↳ The cost of rolling stocks is independent of the gauge used for the same volume of traffic.

We can therefore conclude that there is not an appreciable increase in cost due to increase in width of gauge.

Volume and Nature of traffic :-

↳ It is evident that with greater traffic volume and greater load carrying capacity the train should be run by a better locomotives.

↳ For heavier loads and higher speeds the wider gauge are required, because subsequently the operating cost for tonne km is less for higher carrying capacity.

Development of the Areas :-

↳ Narrow gauges can be used to develop the thinly populated areas by joining the under developed areas with developed or urban areas.

Physical features of the country :-

Use of narrow gauge in hilly regions where broad and meter gauges are not possible due to steep gradients and sharp curves in plane also, where high speed is not required and the traffic is light and (N.G) is a right choice.

Speed of Movement :-

↳ The speed of a train is almost proportional to the gauge.

↳ Speed is the function of diameter of wheels, which in turn is limited by the gauge.

↳ The wheel diameter is generally 0.75 times that of the gauge.

↳ The lower speeds discourage the customers and so for maintaining higher speed the broad gauge is preferred.

Purpose of providing fish plates :-

Fish plates are using rail joint to maintain the continuity of the rails. A fish plate is 457mm long and provided with holes of diameter 23mm at a spacing of 114mm per cross-section there. are manufacture of steel and are also designed that they fit in bet^n the head and foot of rail.

Purpose of Fish plate :-

↳ They should hold the adjoining ends of rails in correct horizontal and vertical plane.

↳ They should allow free longitudinal movements of rails due to temperature variations.

↳ They should be able to resist all type axes.

↳ They should be able to bear the vertical and lateral stresses which come at joint without any distortion.

↳ They should allow easy to renewal and replace mod of rails in case of wears and damage.

Requirement of Good Ballast :-

↳ It should be able to withstand hard packing without disintegrating. In otherword it should resist crossing under dynamic load.

It should not make the track dusty or muddy due to powder under dynamic wheel, loads but should be capable of being clean to provide good drainage.
It should allow easy drainage with minimum soakage and the void should be large enough to prevent capillary action
It should offer resistance to absorption and the weathering capacity. (Absorption means wear due to rubbing action of particles with each other and weathering means cracking of the materials due to vibration in temperature, moisture and freezing.)
It should not provided any chemical action with rail and metal sleepers.
It should retain its position laterally and longitudinal under all condition of traffic particularly on curves where it should be able to prevent transverse displacement of sleepers.
The size of stone ballast should be 5cm but wooden sleepers, 4cm but metal sleepers and 2.5cm but tarmacers in coal.
The ballast should be available in near by quarries, so that it reduces the cost of supplied. It should also reduce the requirement of quarry, amount of traffic, life and maintaince cost.

Materials which are commonly used in ballast:—

- Broken stone
- Gravel or River pebbles
- Ashes or cinders
- Sand
- Moorum
- Kankar
- Brick ballast
- Ballast slag
- Selected earth.

Broken Stone :-

↳ This is the best material for the ballast and almost all important tracks are provided with stone ballast.

↳ Broken stone satisfies the all requirement of a good ballast.

↳ For stability broken stone ballast is better than unbroken material. Graded stone of 5.08 cm to 1.9 cm size is found to provide the maximum stability. On the other hand workability is better which smaller size ballast say 1.9 cm size.

Gravel (or) River pebbles :-

↳ Gravel comes next to rank for its stability, suitibility, for use as ballast and is used in large quantities in many country. This is obtain either from river beds or from gravel pits.

↳ The smooth pebbles are broken otherwise they are lead to displace the sleeper due to smoothness of its particles and the packing does not hold. The process of ramming the ballast under the sleeper is known as packing.

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 cheaper and largely used in siding but can not be used for main lines as it is very soft and gets reduce to powder under wheel loads and makes the track and foot pasticularly in rainy season weather as it does not retain water and is not slipy.

Sand :—

↳ It is responsible good material as ballast as it is cheap and provides good drainage.

↳ Sand ballast also produces a silent track and has been found to be particularly good for packing pot sleepers.

↳ The great draw back of the sand is its blowing effect due to vibration. The sand gets into the moving parts and on the track and causes heavy wear, the maintaince of track is their for difficult.

Moorum :—

It is the soft aggregate and it is the result of decomposition of laterite and has a red or sometime a yellow colour.

↳ The best moorum for ballast is that which contain large quantities of small laterite stone. It is recommended as a ballast for sidings and main tracks, when they are newly laid and the embankments are not sufficiently consolidated.

Kankar :—

~~↳ It is one~~

↳ When stone is not nearby the available on the track, it is used as a road metal and as ballast for railway tracks.

↳ It is soft in nature and reduces to powder under loads. It is used for MG and NG tracks with light traffic and when a better type of the ballast is not available.

Brick ballast :—

↳ When no stone and substitute is available for used as ballast over ben burnt bricks are broken into small sizes and used.

↳ It powders easily and produces a dusty track. Rails of tracks laid on brick ballast many a time get corrugated brick ballast however each having good bore drainage.

Ballast Slag :—

↳ It should however be hard of high density and free from gases holes. Slag suitable for used as ballast, is obtained by pouring, molten slag collected at the blast furnace into shallow pits of thin layer.

Selected Earth :—

For sidings earth is of suitable quality is sometimes used as ballast. It is also sometimes used on new formation as at a temporary measure.

↳ In decreased (harden) clay and decomped rock are suitable material.

Selection of Gauges :—

According to the following factors we can choose the different types of gauges.

↳ Cost of construction.
↳ Volume and nature of traffic.
↳ Development of the areas
↳ Physical features of country.
↳ Speed of movement.

Cost of Construction :—

There is little increase in the initial cost if we select a wider gauge i.e due to the following reasons.

↳ The cost of bridges, tunnels, station, buildings, staff quarters, signal, cabin and level crossings is the same for all the gauges.

↳ The cost of earthwork ballast, sleepers, rails etc exceed proportionally increase with

gauge coldth.

4) There is little proportional in the area of land bort permanent track with increase in gauge.

4) The cost of rolling stock is independent of the gauge used bort the same volume of traffic.

We can their bort conclude that there is not an appreciabe increase in cost due to increase in width of gauge.

Volume and Nature of traffic :—

It is evident that with greater traffic volume and greater load carrying capacity the train should be run by a better traction technique are better locomotives bort heavier loads and high speed the wider gauge are required because subsequently the operating cost per tonne-km is less bort higher carrying capacity.

Development of the areas :—

Narrow gauges to be used in the to develop the thinly populated areas by joining the under developed areas with in develop areas.

Physical features of Country :—

Use of narrow gauge is wanted or needed in hilly region, where broad gauge and meter gauge are not possible due to step gradiant and sharp curve. curve.

In plain area while high speed is not requires and traffic is light narrow gauge is correct choice.

Speed of movement :—

The speed of train are almost proportionate to the gauge speed is the function of diameter of wheel, which is turn in is limited by the gauge. The wheel diameter is generally 0.75 times of the gauge.

4. Lower speed discourage the customer and so for maintaing high speed the bread gauge is pertered.

Causes of Creep and its prevention :-

Causes of Creep :-

Various theories are proposed (Approved) to explain the different causes of creep but non of them gives the true ~~beatures~~ picture but most causes of creep in rail, the various causes are

i) Wave action or wave theory
ii) Percussion theory
iii) Drag or dragging theory.

Wave action :-

Wave motion is set up by moving loads of wheels. The vertical reverse curve is formed in the rails are ahead of the rails, resulting from the rails deflection under the load is the chief cause of creep. The wheels push the wave, with a tendency to force the rails in the direction of traffic.

On a particular rail the joint action by several wheels causes creep, as the wheels move the rail infront of the moving load is thus carried forward by the wheels and causes creep, where as the rail at the rails of the wheel gets back to its normal position.