CMR INSTITUTE OF TECHNOLOGY

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Improvement Test

Sub:	Transportation Engineering- II							Code:	10CV63
Date:	31/05 / 2017	Duration:	90 mins	Max Marks:	50	Sem:	VI	Branch:	CIVIL

Note: Q1 is compulsory. Answer any four full questions from Q2 to Q6.

		Marks	OBE	
			CO	RBT
1.	Define super elevation. With usual notation derive an expression for the super elevation of B.G., M.G. and N.G. track.	[10]	CIV603.2	L2
2.	Define Windrose diagram. Explain any one method of constructing Wind rose diagram to determine the best orientation for the runway.	[10]	CIV603.4	L2
3.	List the various elements of an airport and explain its component parts with a neat sketch of the layout.	[10]	CIV603.1	L1
4.	A 5° curve diverges from a 3° main curve in the reverse direction in the layout of a B.G. yard. If the speed on the branch line is restricted to 35 kmph, determine the restricted speed on the main line.	[10]	CIV603.3	L3
5. (a)	With neat sketches explain different types of rail joints.	[05]	CIV603.1	L1
(b)	What are the requirements of a good ballast material?	[05]	CIV603.1	L1
6. (a)	With a neat sketch explain the procedure of measurement of creep.	[05]	CIV603.1	L1
(b)	What are the requirements of a permanent way?	[05]	CIV603.3	L1

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Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CIV603.1	Describe the functions of different component parts of a railway track, railway stations, airport, tunnels and harbours	2	0	0	0	0	1	1	1	0	1	1	1
CIV603.2	Calculate and determine the resistances developed in a track	3	2	0	1	0	1	1	0	0	1	1	1
CIV603.3	Calculate the materials required and superelevation to be adopted for safety conditions	2	0	0	1	0	1	1	1	0	1	1	1
CIV603.4	Determine the best orientation of runway and the runway length for an airport	2	2	1	1	0	1	1	0	0	1	1	1
CIV603.5	Describe modern methods of landing systems and tuneling adopted in the site conditions	2	0	0	1	0	1	1	0	0	1	1	1
CIV603.6	Design an exit taxiway as per requirement	2	1	1	1	0	1	1	0	0	1	1	1

Cognitive level	KEYWORDS
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

PO1 - *Engineering knowledge*; PO2 - *Problem analysis*; PO3 - *Design/development of solutions*; PO4 - *Conduct investigations of complex problems*; PO5 - *Modern tool usage*; PO6 - *The Engineer and society*; PO7- *Environment and sustainability*; PO8 – *Ethics*; PO9 - *Individual and team work*; PO10 - *Communication*; PO11 - *Project management and finance*; PO12 - *Life-long learning*

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Improvement Test – May 2017
Solutions

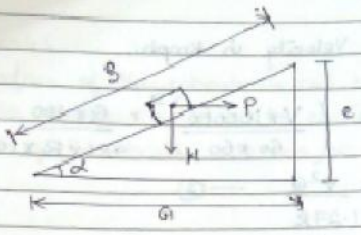
Sub:	Transportation Engineering II	**Code:**	10CV63
Sem:	VI	**Branch:**	CIVIL

1. Superelevation :

To counteract the effect of centrifugal force, the level of outer rails is raised above the inner rail by a certain amount to introduce the centripetal force. This raised elevation of outer rail above the inner rail at a horizontal curve is called super elevation.

Derivation:

Relationship between superelevation (e), with gauge (G) Speed (V) and radius of the curve (R)



It is evident that the rotation will take place about the vertical axis and since centrifugal force acts at right angles to the axis of rotation, its direction will be horizontal

Let W = Weight of moving train in (kg)
v = Speed of vehicle in m/sec.
V = Speed of vehicle in kmph.
R = Radius of curves in m.
G = Gauge of tract in m
g = Acceleration due to gravity in m/s^2
α = Angle of inclination
S = Length of inclined surface in m

Centrifugal force is given by $P = \frac{Wv^2}{gR}$ — ①

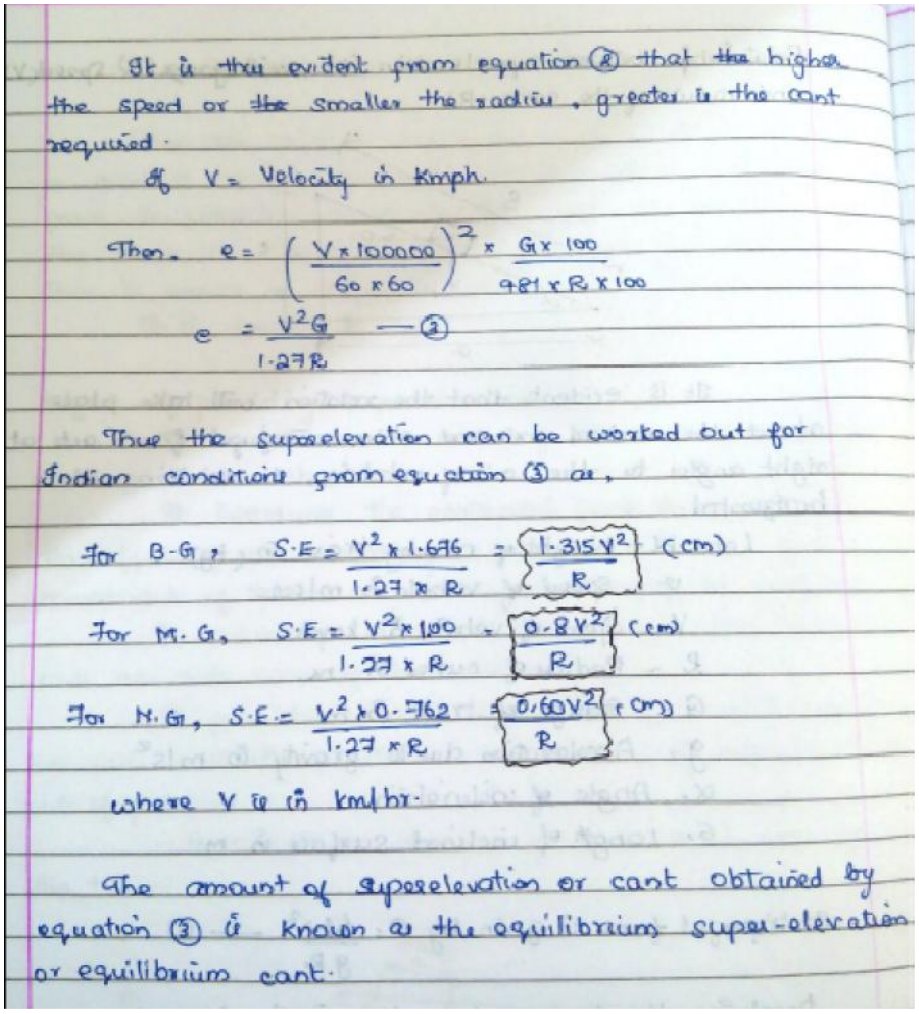
Resolving the forces along the inclined surface, we get

$P \cos\alpha = W \sin\alpha$

$\frac{Wv^2}{gR} \times \frac{G}{S} = W \times \frac{e}{S}$

where v is in m/s.

$\therefore e = \frac{v^2}{gR} \times G$ — ②



2. **Windrose diagram**:

The wind data, i.e. direction, duration and intensity are graphically represented by a diagram called wind rose. The wind data should usually be collected for a period of at least 5 years and preferably for 10 years, so a s to obtain an average data with sufficient accuracy.

Wind rose diagram can be plotted in two ways:
Type I: Showing direction and duration of wind
Type II: Showing Direction, duration and intensity of wind

Type I wind rose:

This type of wind rose is illustrated in the figure. The radial lines indicate the wind direction and each circle represents the duration of wind.

Example:

Assuming that the total percentage of time in a year during which the wind blows from north direction is 10.3 percent, the value is plotted along the north direction in the figure. Similarly other values are also plotted along the respective directions. All plotted points are then joined by straight lines as shown in the figure.

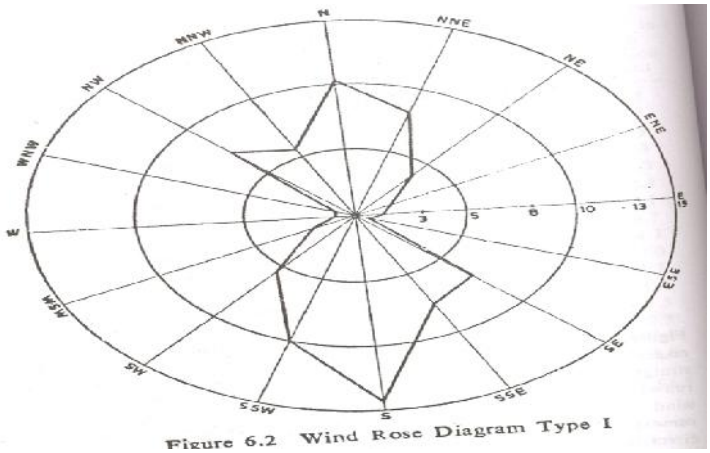


Figure 6.2 Wind Rose Diagram Type I

The best direction of runway is usually along the direction of the longest line on wind rose direction. From the figure, the best orientation of runway is thus along NS direction.

3. Layout of an airport:

Basic components of an airport:

- Terminal buildings
- Runway
- Taxiway
- Aprons
- Hangars
- Signs
- Markings
- Lights

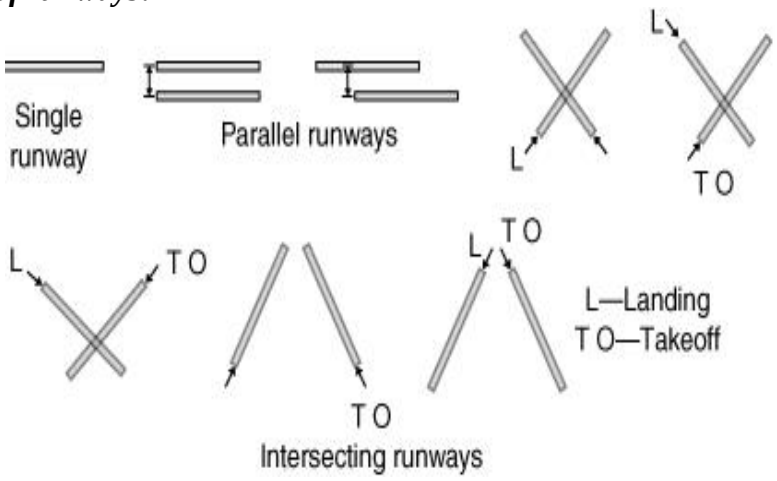
Terminal Buildings / Airport Terminal:

- Spaces where passengers board or alight from flights.
- Basics facilities available are Ticket counters, luggage check-in or transfer, security checks and customs.
- It has all the necessary facilities for passengers to check-in their luggage, clear the customs and have lounges to wait before disembarking.
- May have cafes and lounges to serve as waiting areas for passengers.

Runways:

- It is the area where an aircraft lands or takes off. It can be grass, or packed dirt, or a hard surface such as asphalt or concrete.
- The runways have special markings on them to help a pilot in the air to tell that it is a runway (and not a road) and to help them when they are landing or taking off.
- Runway markings are white and they have numbers on the end denoting the runway's compass direction.
- Some airports have more than one runway going in the same direction, so they add letters to the end of the number R for right, C for center, and L for left.
- They may have white stripes down the middle , and solid white lines on the edges

***Types of runways*:**



Taxiways:

- They are used by the aircraft to get to and from their parking place and the runway.
- The taxiways look a lot like runways, but are not as wide as the runway and don't have the same kind of markings.
- Taxiway markings are yellow. Instead of numbers, taxiways use letters (like A, B, or C) for names.

Aprons:

- Aprons are areas where the aircraft park and they are also called as ramps.
- They may vary in size, from areas that may hold five or ten small planes, to the very large areas that the major airports have.

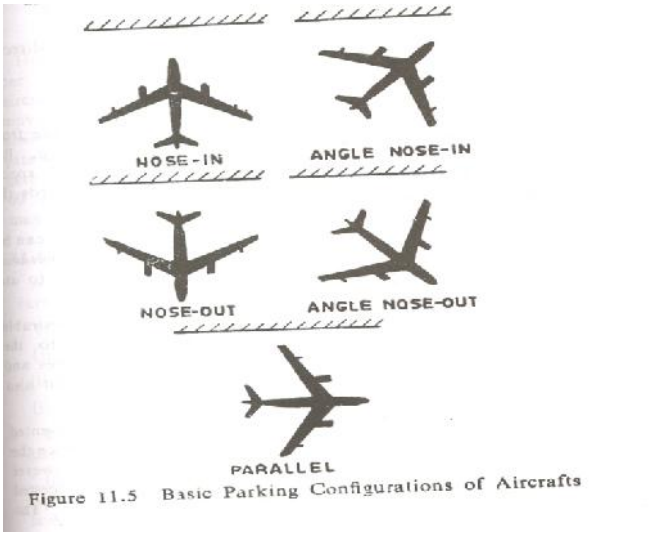


Figure 11.5 Basic Parking Configurations of Aircrafts

Hangars:

- It is an enclosure for servicing, overhauling and doing repair works of the aircrafts
- It is constructed of steel frames, covered with galvanized iron sheets and provided with machine shops and stores for spare parts.
- The size of hangar depends on size of aircraft and its turning radius
- Its number depends on peak hour volume of aircrafts and demand of hangars on rental basis.

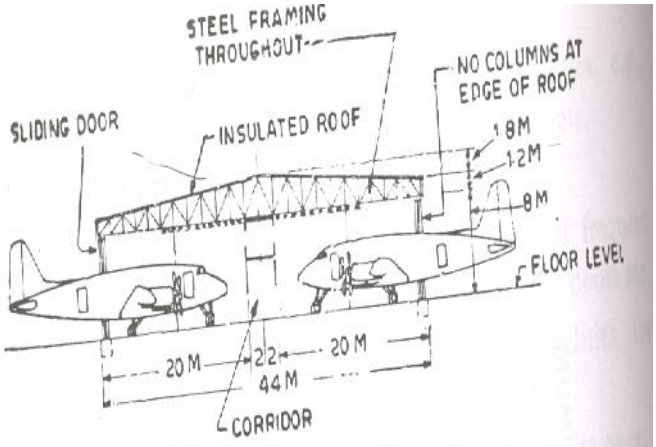


Figure 11.11 Hangar

4. Numerical

A 5° curve diverges from a 3° main curve in reverse direction in the layout of a B.G. yard. If the speed on the branch line is restricted to 35 kmph determine the restricted speed on the main li

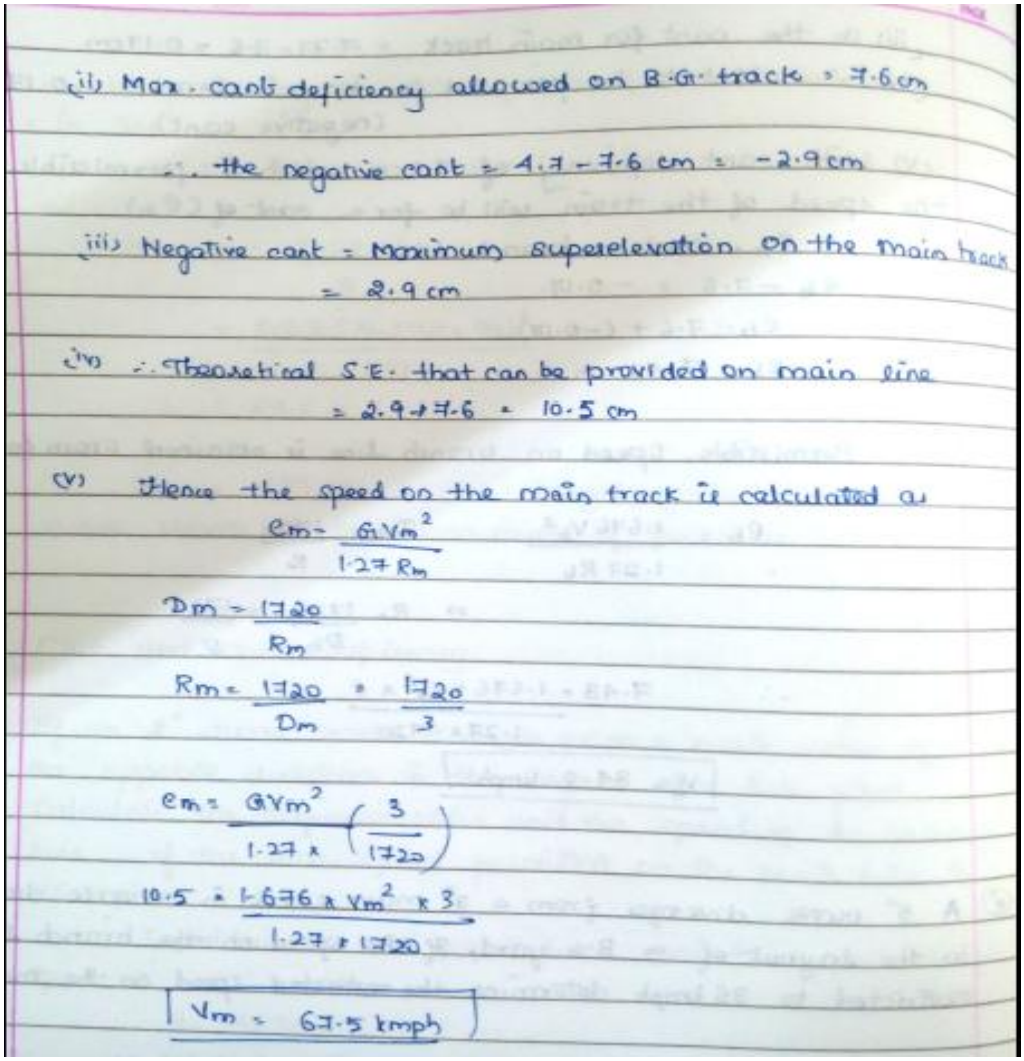
i) Superelevation on branch line e_b is calculated as

$$e_b = \frac{GV^2}{1.27R} = \frac{1.676 \times 35^2 \times 5}{1.27 \times 1720} = 4.7 \text{ cm}$$

$D = \frac{1720}{R}$

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

e_b - cant deficiency of branch line = -ve cant on branch line



5. A) **Rail joints:**

The type of rail joints depends upon the position of the sleepers or the joints.

1 Classification According to Position of Sleepers

Three types of rail joints, come under this category.

Supported joint In this type of joint, the ends of the rails are supported directly on the sleeper. It was expected that supporting the joint would reduce the wear and tear of the rails, as there would be no cantilever action. In practice, however, the support tends to slightly raise the height of the rail ends. As such, the run on a supported joint is normally hard. There is also wear and tear of the sleeper supporting the joint and its maintenance presents quite a problem. The duplex sleeper is an example of a supported joint (Fig. 16.1).

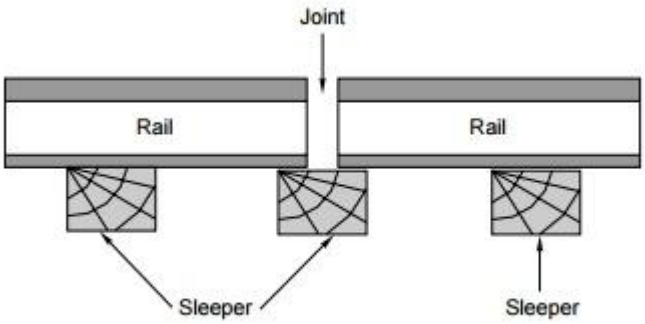


Fig. 16.1 Supported rail joint

Suspended joint: In this type of joint, the ends of the rails are suspended between two sleepers and some portion of the rail is cantilevered at the joint. As a result of cantilever action, the packing under the sleepers of the joint becomes loose particularly due to the hammering action of the moving train loads. Suspended joints are the most common type of joints adopted on railway systems worldwide, including India (Fig. 16.2).

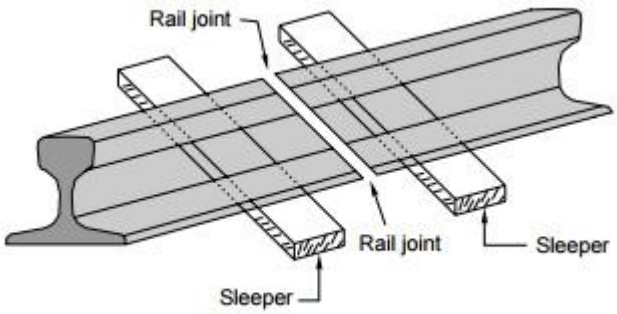


Fig. 16.2 Suspended joint

Bridge joints The bridge joint is similar to the suspended joint except that the two sleepers on either side of a bridge joint are connected by means of a metal flat [Fig. 16.3(a)] or a corrugated plate known as a bridge plate [Fig. 16.3(b)]. This type of joint is generally not used on Indian Railways.

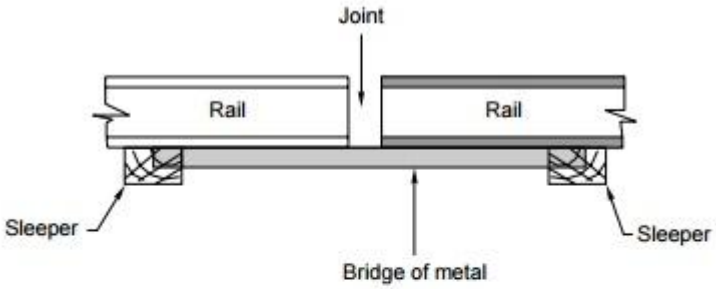


Fig. 16.3 (a) Bridge joint with metal flat

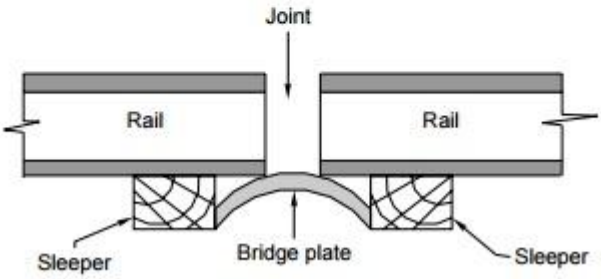


Fig. 16.3 (b) Bridge joint with bridge plate

2 Classification Based on the Position of the Joint

Square joint In this case, the joints in one rail are exactly opposite to the joints in the other rail. This type of joint is most common on Indian Railways (Fig. 16.4).

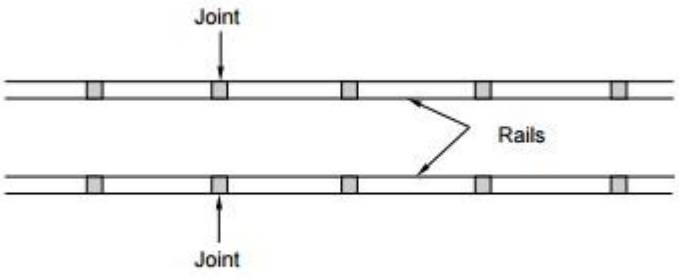


Fig. 16.4 Square joint

Staggered joint In this case, the joints in one rail are somewhat staggered and are not opposite the joints in the other rail. Staggered joints are normally preferred on curved tracks because they hinder the centrifugal force that pushes the track outward (Fig. 16.5).

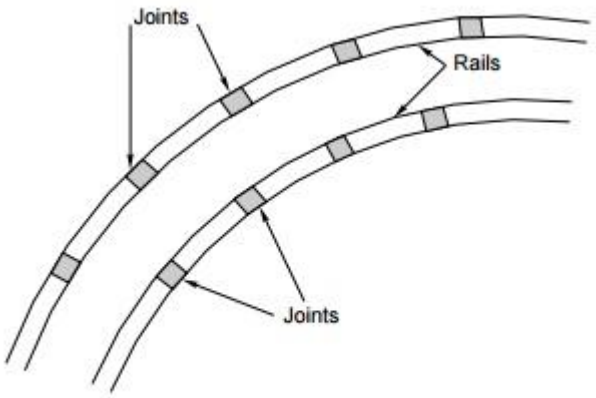


Fig. 16.5 Staggered joint

B) Requirements of ballast material

The ballast must not be too rigid and also elastic in nature

- The ballast must maintain the required depth for uniformly distributing the load.
- The ballast must not be brittle, it should have enough compressive strength so that it does not get crushed by moving fast loads.
- It should have good drainage properties to drain off water and not absorb it
- The ballast material should be cheaply and easily available
- It should not cause any chemical abrasion to rails or sleepers.
- It should resist abrasion and weathering conditions.
- It should be able to transfer load uniformly and maintain super elevation when required

6. A) Measurement of creep:

Creep can be measured with the help of a device called creep indicator. It consists of two creep posts, which are generally rail pieces that are driven at 1-km intervals on either side of the track. For the purpose of easy measurement, their top level is generally at the same level as the rail. Using a chisel, a mark is made at the side of the bottom flange of the rail on either side of the track. A fishing string is then stretched between the two creep posts and the distance between the chisel mark and the string is taken as the amount of creep.

According to the prescribed stipulations, creep should be measured at intervals of about three months and noted in a prescribed register, which is to be maintained by the the permanent way inspector (PWI). Creep in excess of 150 mm (6 in.) should not be permitted on any track and not more than six consecutive rails should be found jammed in a single-rail track at one location. There should be no creep in approaches to points and crossings.

B) Requirements of a permanent way:

Following are the basic requirements of a permanent way:

(i) The gauge should be uniform and correct.
(ii) Both the rails should be at the same level in a straight track.
(iii) On curves proper superelevation should be provided to the outer rail.
(iv) The permanent way should be properly designed so that the load of the train is uniformly distributed over the two rails.
(v) The track should have enough lateral strength.
(vi) The radii and superelevation, provided on curves, should be properly designed.
(vii) The track must have certain amount of elasticity.

(viii) All joints, points and crossings should be properly designed.
(ix) Drainage system of permanent way should be perfect.
(x) All the components of permanent way should satisfy the design requirements.
(xi) It should have adequate provision for easy renewals and repairs.
(xii) The alignment should be correct.
(xiii) The track should process sufficient elasticity. It should also possess sufficient lateral rigidity and stiffness so that it may withstand the lateral thrust and centrifugal forces.
(xiv) The track should possess high resistance to damage at the time of derailment and its maintenance cost is minimum.