ACCIDENT SITE –

OBSERVATIONS
&
PARAMETERS –

JOINT RECORDING

Presented by

STC/NBQ

ACCIDENT

Any occurrence which affects or may affect the safety of the Railways, its engine, rolling stock, P-way works, passengers, servants or others or which interferes the normal working of Railways.

Accidents are the result of:-

- Human failure;
- Equipment failure;
- System failure;
- Acts of Providence.

Recording of evidence and related data

- To be done before restoring the track & vehicles.
- To locate the initial point of derailment
- To identify the first derailed vehicle
- To arrive at the exact cause

Any investigation will be meaningful if the recordings are made properly.

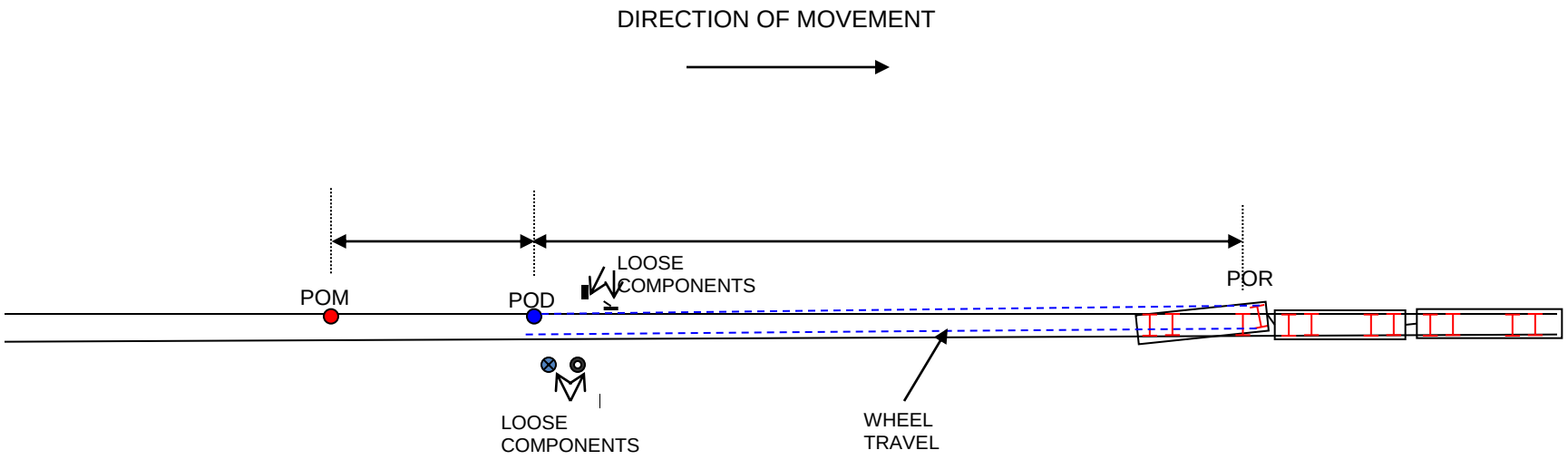
SEQUENCE

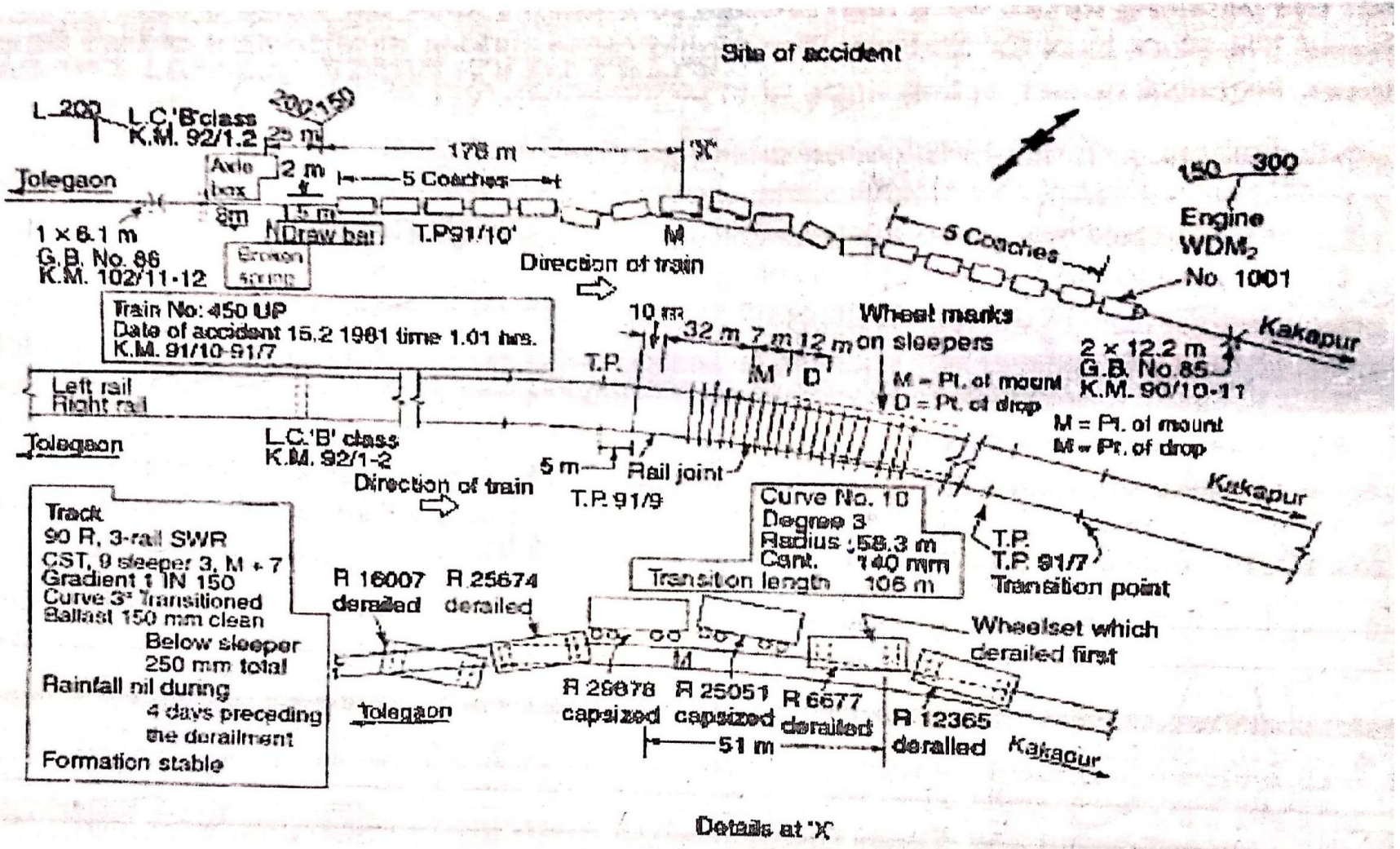
- First considerations
- Site sketch
- Flange marks.
- Operational defects/failures
- Track survey & examination

First considerations

- Rapid observation
- Position of vehicles
- Wheel marks
- Position of loose components

Site sketch


DIRECTION OF MOVEMENT
POM
POD
LOOSE
COMPONENTS
POR
LOOSE
COMPONENTS
WHEEL
TRAVEL



TYPICAL SKETCH OF ACCIDENT SITE

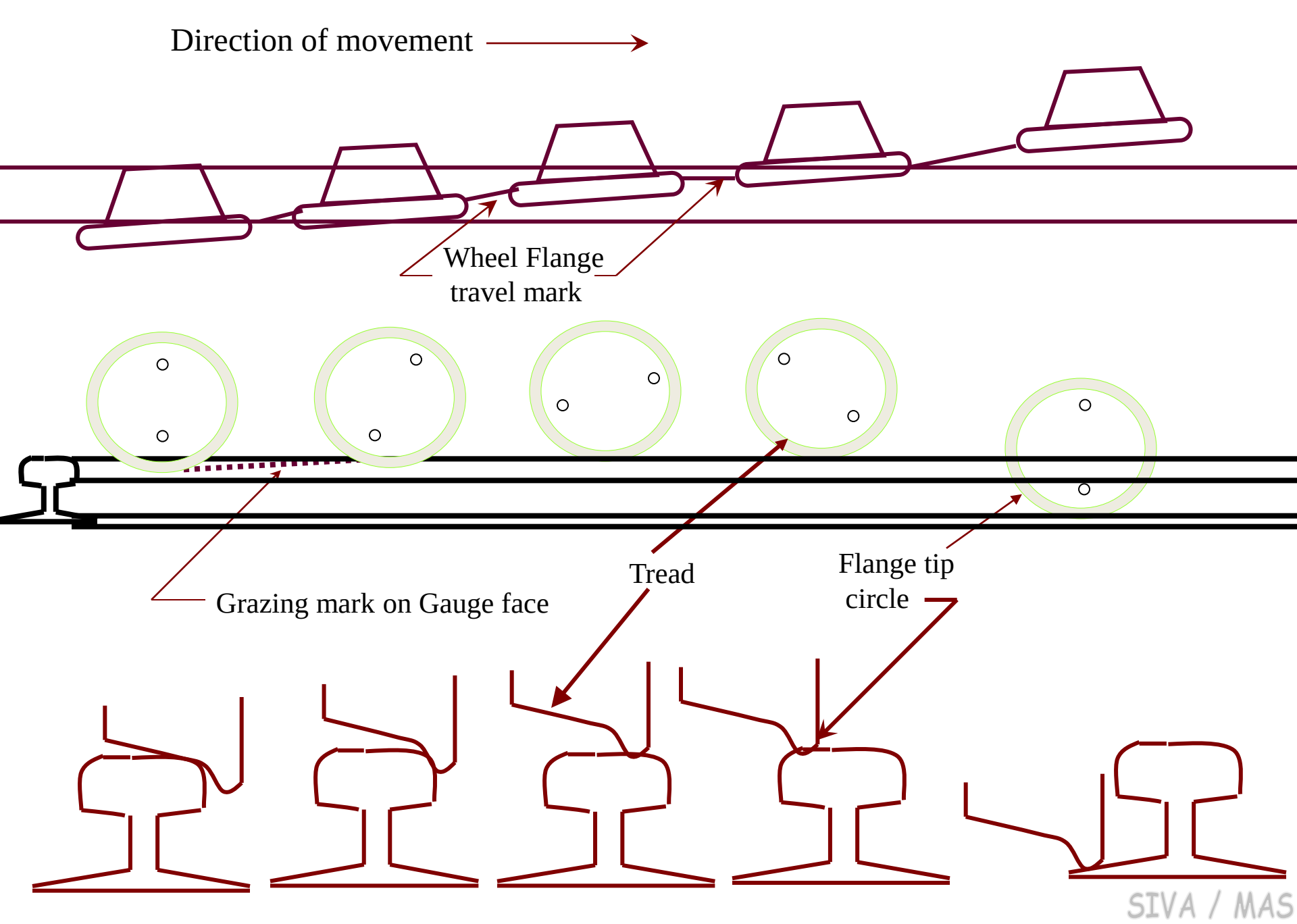
TO BE JOINTLY SIGNED BY		
SUPERVISOR (C&W)	SUPERVISOR (TRAFFIC)	SUPERVISOR (P.WAY)

Flange marks.

- Flange mount mark (Point of Mount-POM)pom.ppt

- Flange travel mark (To decide derailment is sudden or gradual)
  - Length of travel
  - Path followed after mounting
  - Marks are strong or faint
  - single or multiple
  - Continuous or intermittent

- Wheel drop mark (Point of drop)

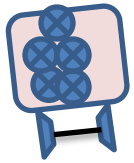


SIVA / MAS

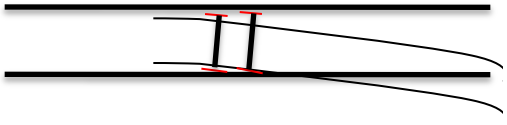
GRADUAL DERAILMENT

Operational defects/failures

- Speed
- Loading



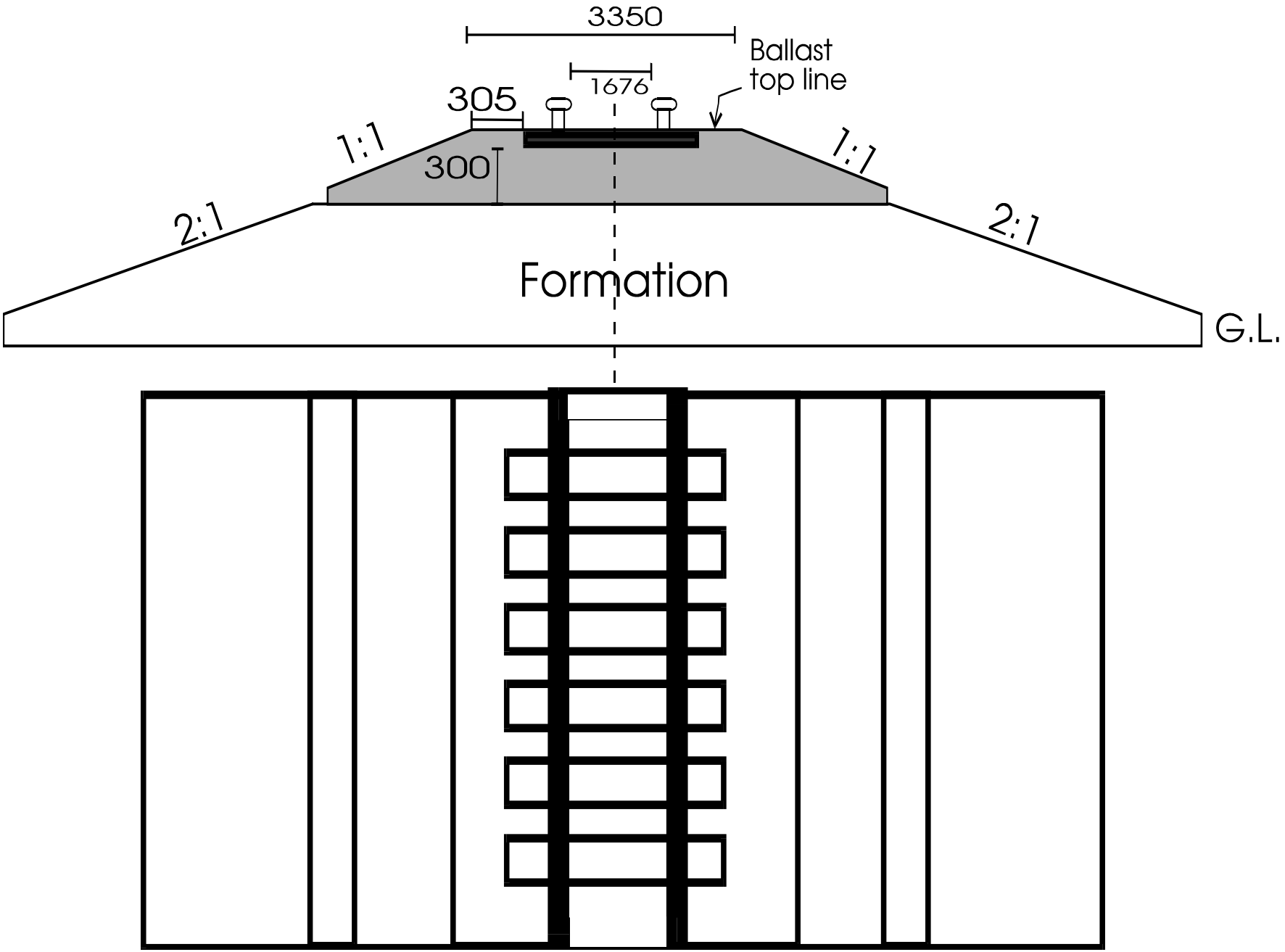
- Wrong marshalling
- Mis manipulation of point
- Staff failure
  - Improper setting/securing of points
  - Operation of point under wheel movement



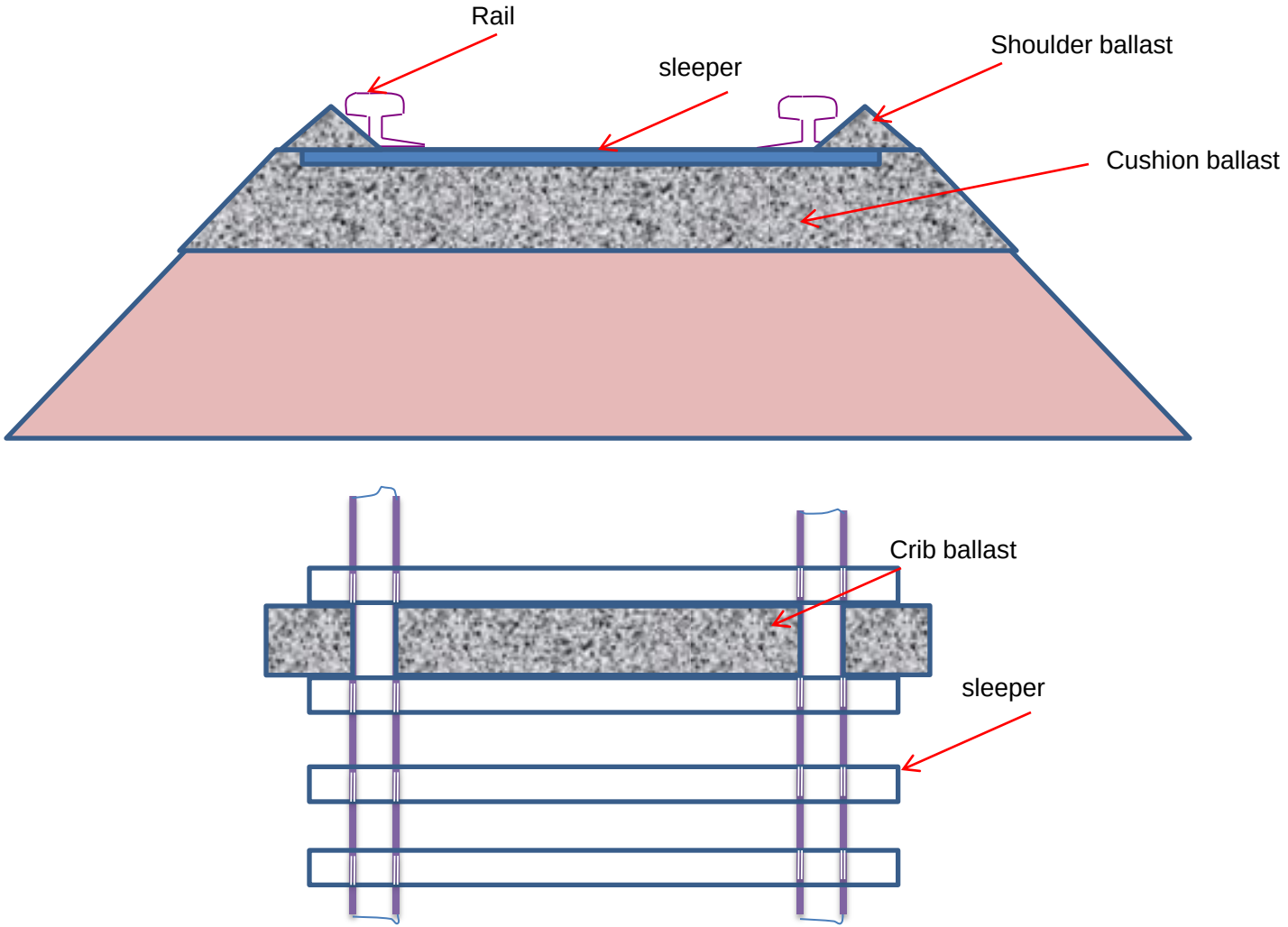
  - Obstruction between toe & stock rail
  - Loose coupling
- Improper train operation

Permanent Way

- Formation
- Ballast
- Sleepers& fastenings
- Rails


3350
Ballast
top line
1676
305
1:1
1:1
300
2:1
2:1
Formation
G.L.

Formation


Rail
sleeper
Shoulder ballast
Cushion ballast
Crib ballast
sleeper

Ballast

Provided over the formation as cushion.

Importance of Ballast:

- Absorbs shocks.
- Absorbs vibration.
- Distribute the wheel load to the formation.
- Controls the lateral & longitudinal movement of track.
- Keeps the track in position and at required level.

The recommended ballast size is 50 mm.

Minimum depth of ballast cushion

(Ref. para 262-(2)(a) of IRPWM)

Route	Recommend depth
A	300 mm
B & C	250 mm
D	200 mm
E	150 mm

- **Cushion Ballast:** The depth of ballast below the bottom of sleeper.
- **Crib Ballast**: Provided in between sleepers .
- **Shoulder Ballast:** Provided beyond the sleeper edge .

Sleepers& fastenings

Slide chair

Round spike

PSC sleepers**:** Pandrol clips are used on either side of the rail, Liner inserted between the foot of the clip.

PSC Layout

Pandrol clip (or) Elastic rail clip

Fastenings:

- Hold the rails and maintains the gauge with in limit.
- Transmit load from rail to formation through ballast.
- Absorbs high frequency vibration.
- Provide resistant support.
- Provide lateral & longitudinal strength of the track.
- Permit verification of track geometry.
- Resist longitudinal creep of the rail.
- Resist tilting or overturning of rail.

Rails

Section of rails :(BG)

60 kg – Section of 1 m rail length weight 60 kg

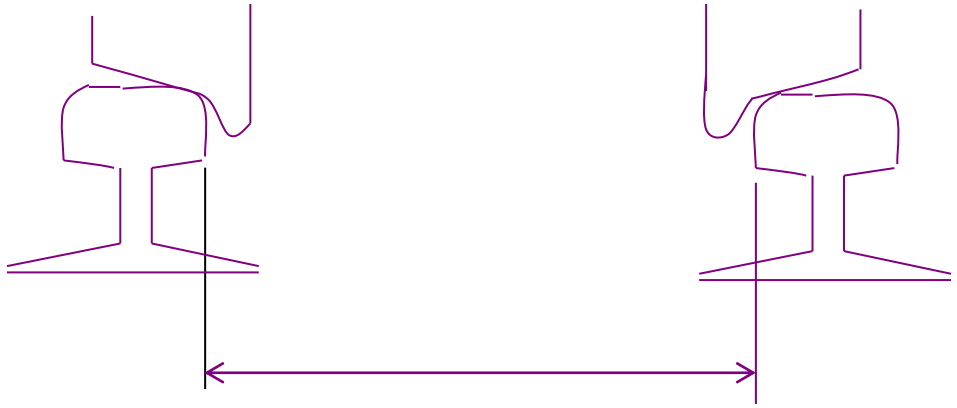
52 kg – Section of 1 m rail length weight 50 kg

Causes for rail deterioration:

- Corrosion and rusting
- Wear on rail table.
- Flattening of rail table.
- Wear on gauge face
- Hogging of rail end.
- Battering of rail ends
- Wheel burns.

GAUGE

The distance between two running edges of right and left rails.

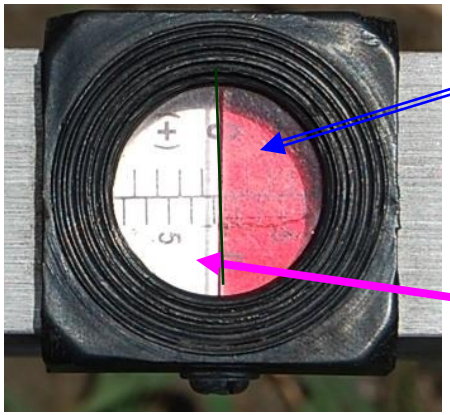


Braod Gauge	Tolerance
a) On straight	-6 mm to + 6mm
b) On curves with radius 350 m or more	-6 mm to + 15mm
c) On curves with radius less than 350 m	upto + 20 mm

Note : These tolerances are with respect to nominal gauge of 1676 mm.

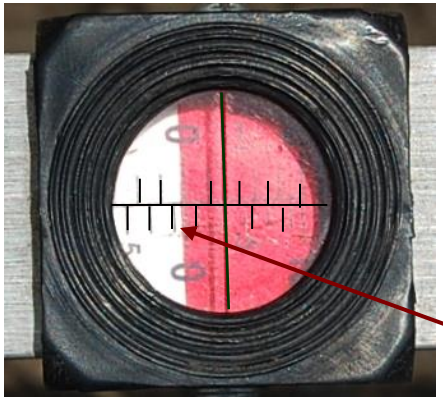
(Ref IRPWM page 224 (e) (v)

- Tight gauge: less than nominal track gauge.
- Slack gauge: more than Nominal track gauge



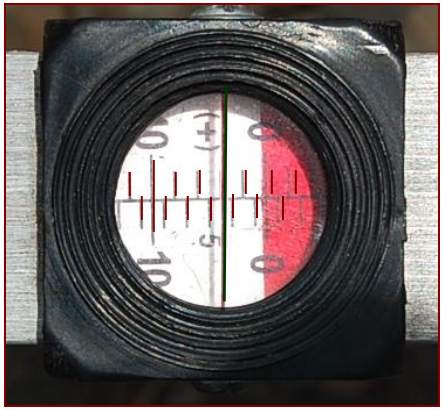
Reading in red scale –Tight gauge

Reading in white scale –Slack gauge



In this case the measurement in red scale i.e 3 is coinciding with the reference line .

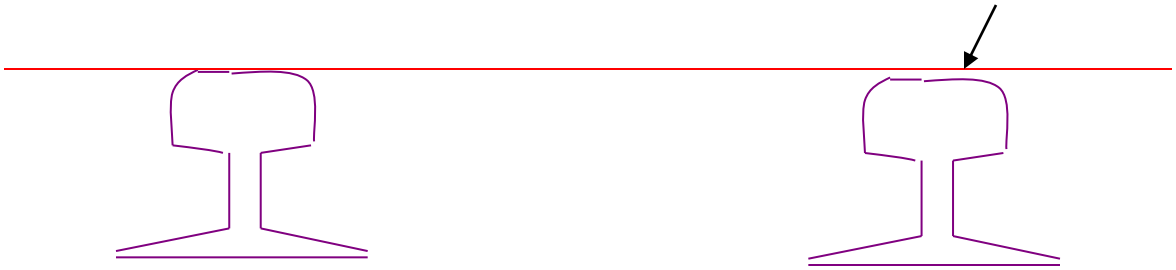
It indicates that the gauge was tight by 3 mm i.e. 1676-3 = 1673mm

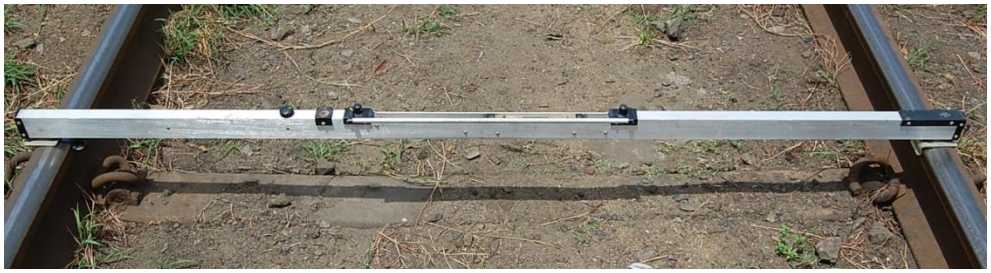


In this case the measurement in white scale i.e. 4 is coinciding with the reference line. It denotes that the gauge reading is slack by 4 mm i.e. 1676+4 = 1680 mm

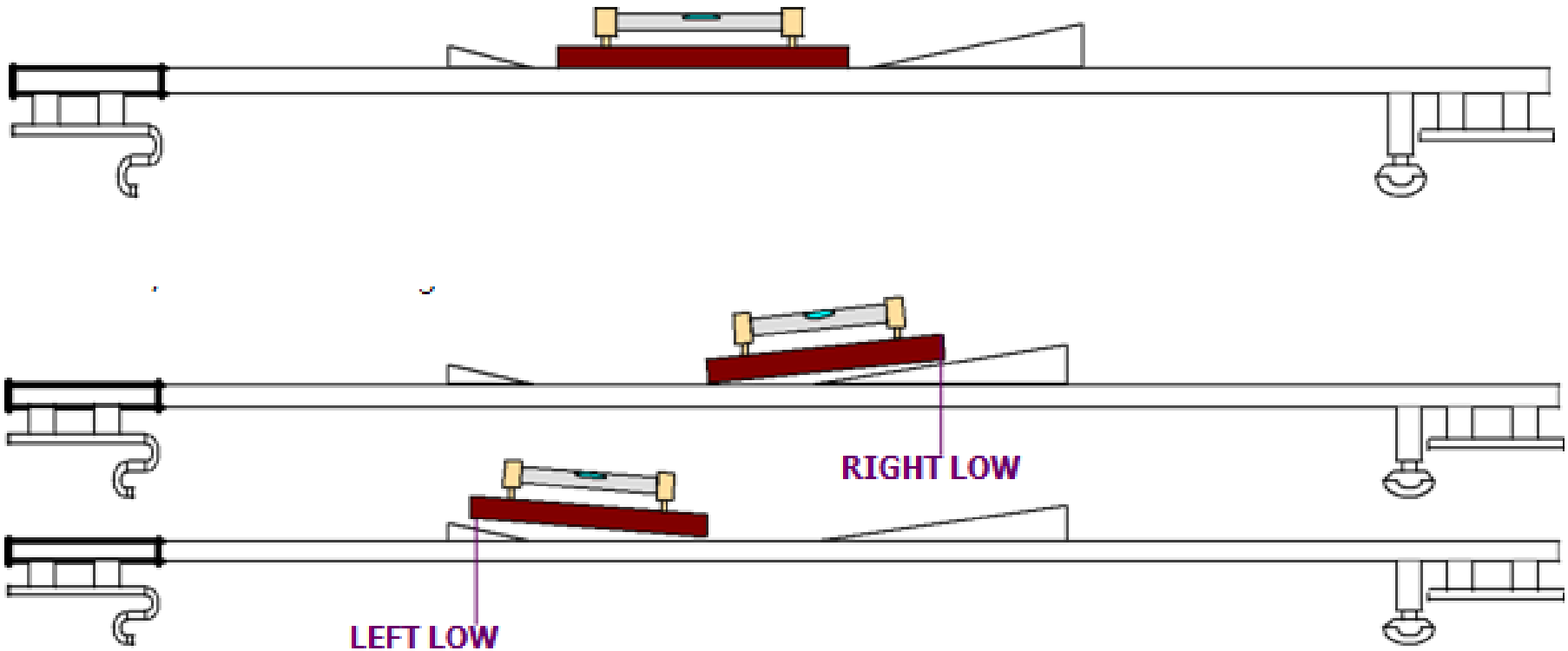
CROSS LEVEL

The relative difference in the height of right and left rail at a given point on the track





CROSS LEVEL

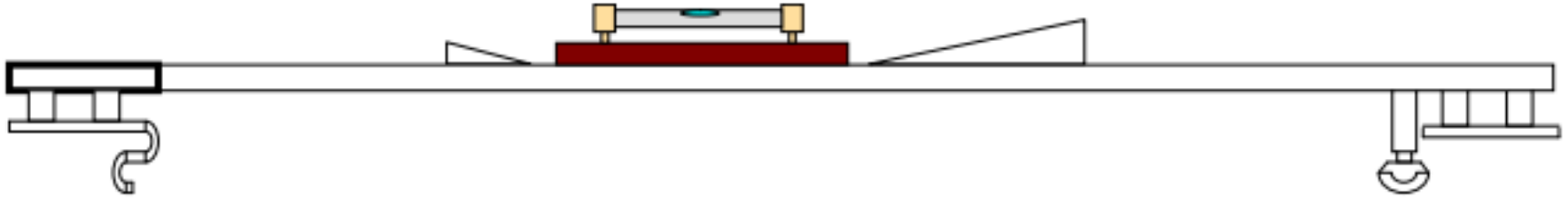


Cross level

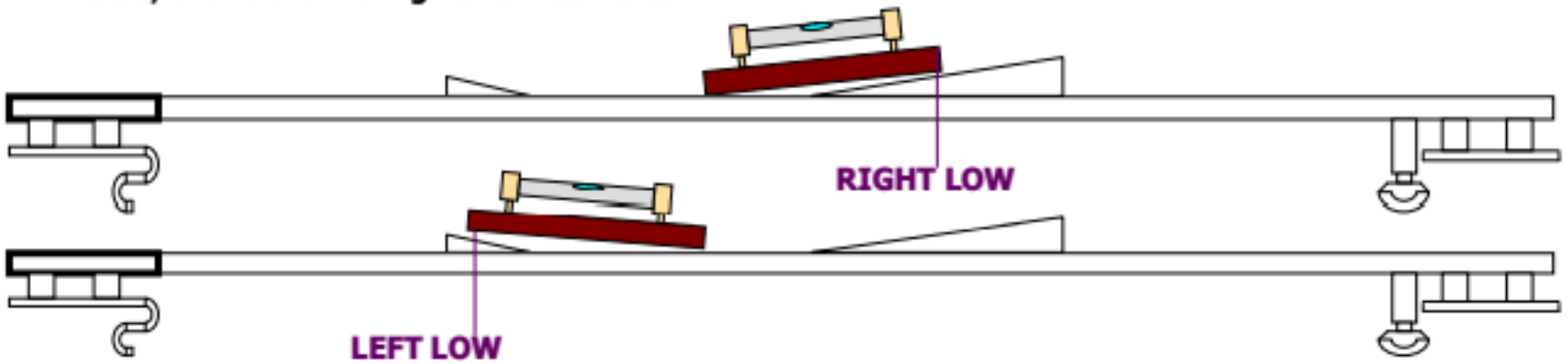
- The cross level readings should be recorded in free as well as under load conditions for every sleeper up to 30 m and an interval of 3 m from 33 m to 300 m.

In the above sketch the spirit level is in between the slopes as it indicates that the both the RH & LH rail are in same level

Cross level

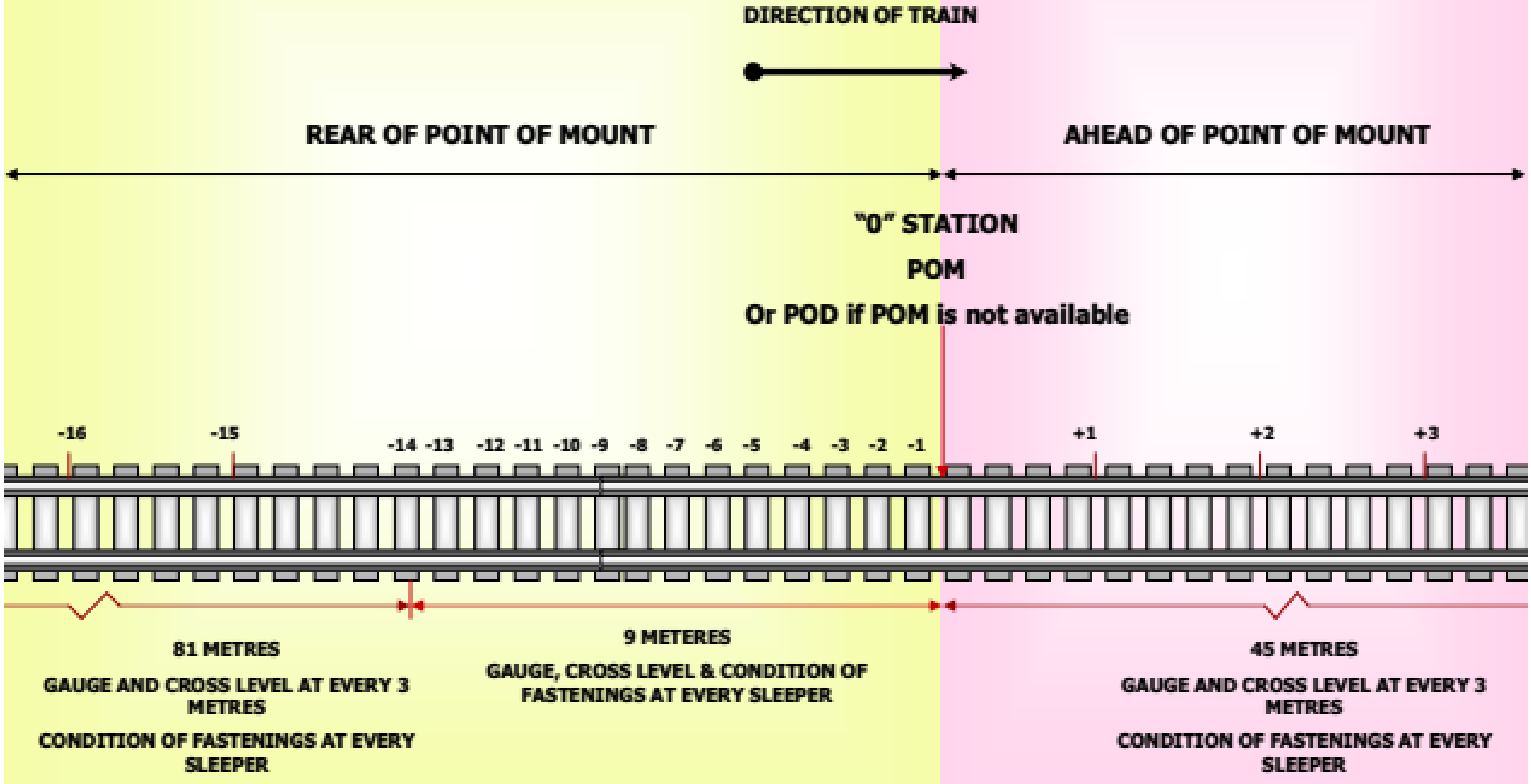


6. If the bubble in the spirit level is at centre, the level is correct. If the bubble moves to the left side, the left rail is high and vice-versa.



In the above sketch the spirit has come to level when it is moved over the LH side slope. It means that the Left side is at lower level than the Right side. The edge of the spirit level touches the 4th division after 0 i.e. 8 mm. It indicates that left side is 8 mm lower in level than the Right side.

MARKING OF STATIONS FOR RECORDING TRACK PARAMETRES



TWIST

Twist is the variation in cross level per metre

Effect of twist:

- Twist has an adverse effect on running.
- Plays an important role in derailment.
- Load distribution to the wheels is disturbed.

Calculating the effective twist

From the readings of the cross level, twist is calculated for wheel base of the first derailed vehicle

Twist = $\frac{\text{Algebraic difference of cross levels (mm)}}{\text{Wheel base (m)}}$

Station	Distance between stations	Cross level readings
0	-	5 RL
-1	1 M	7 RL
-2	1 M	3 RL
-3	1 M	2 LL
-4	1 M	8 LL

the twist for 4m wheel base is (i.e between 0 station and 4th station)

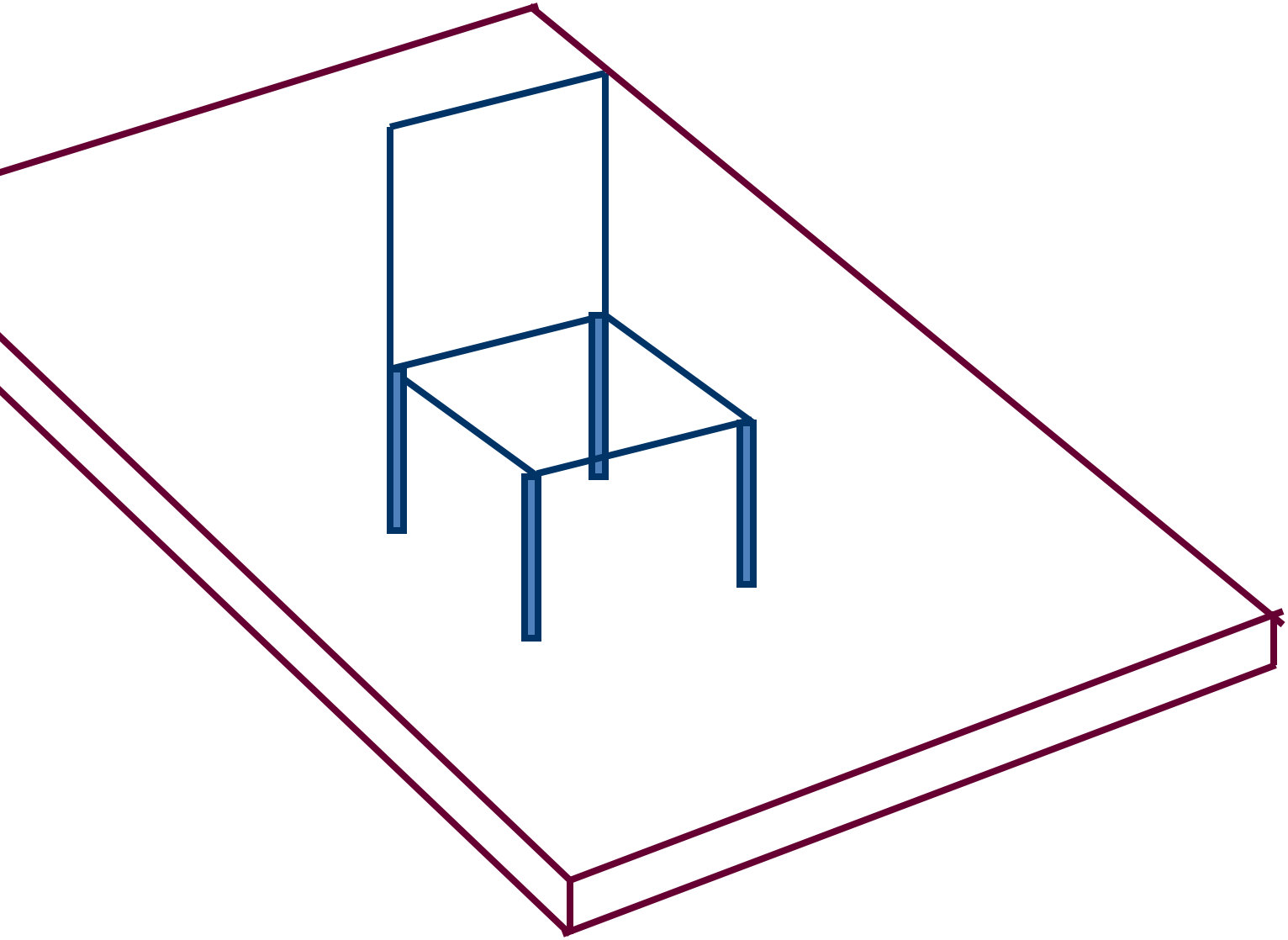
0 station 5 RL

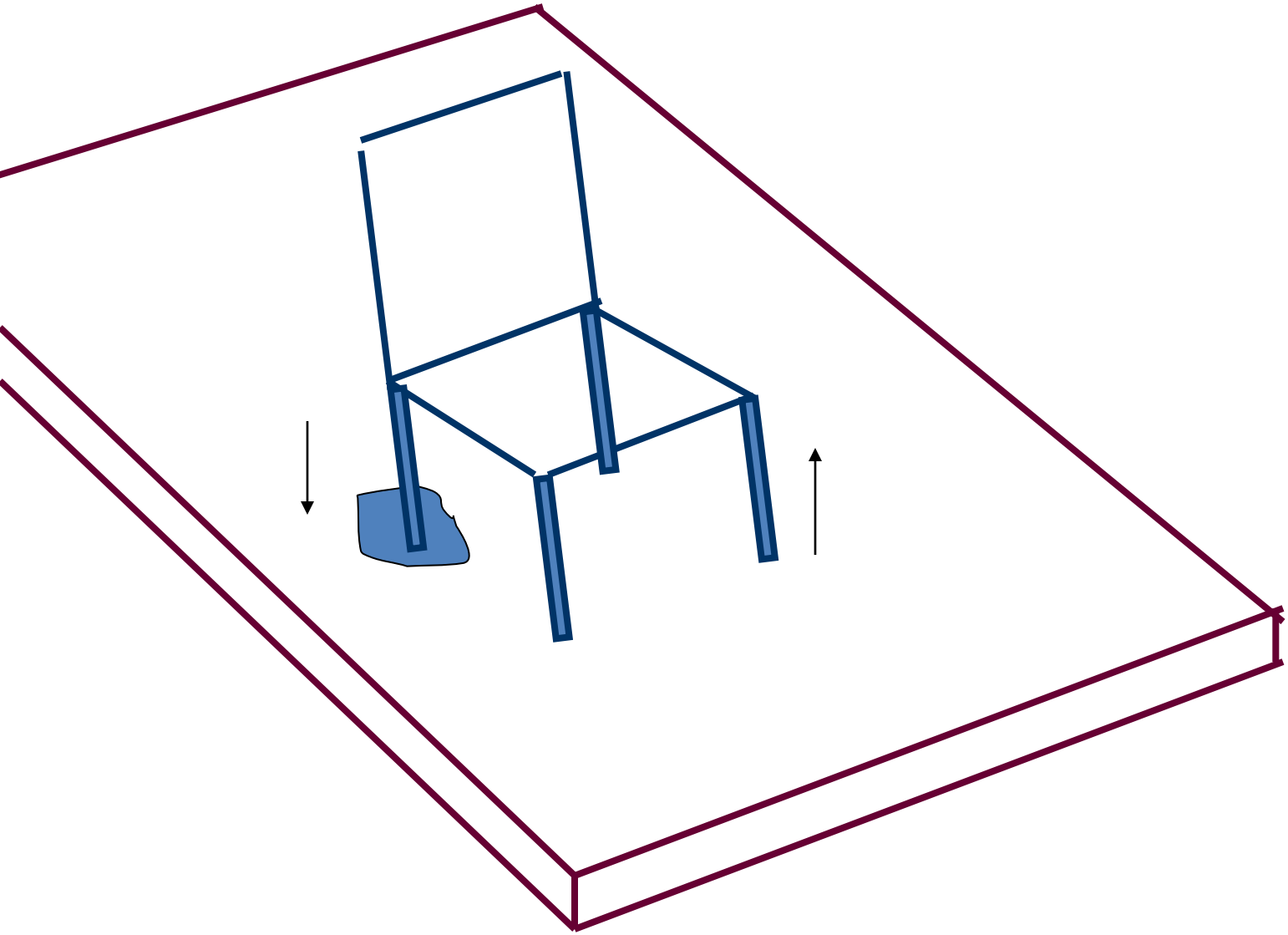
– 4th station 8 LL

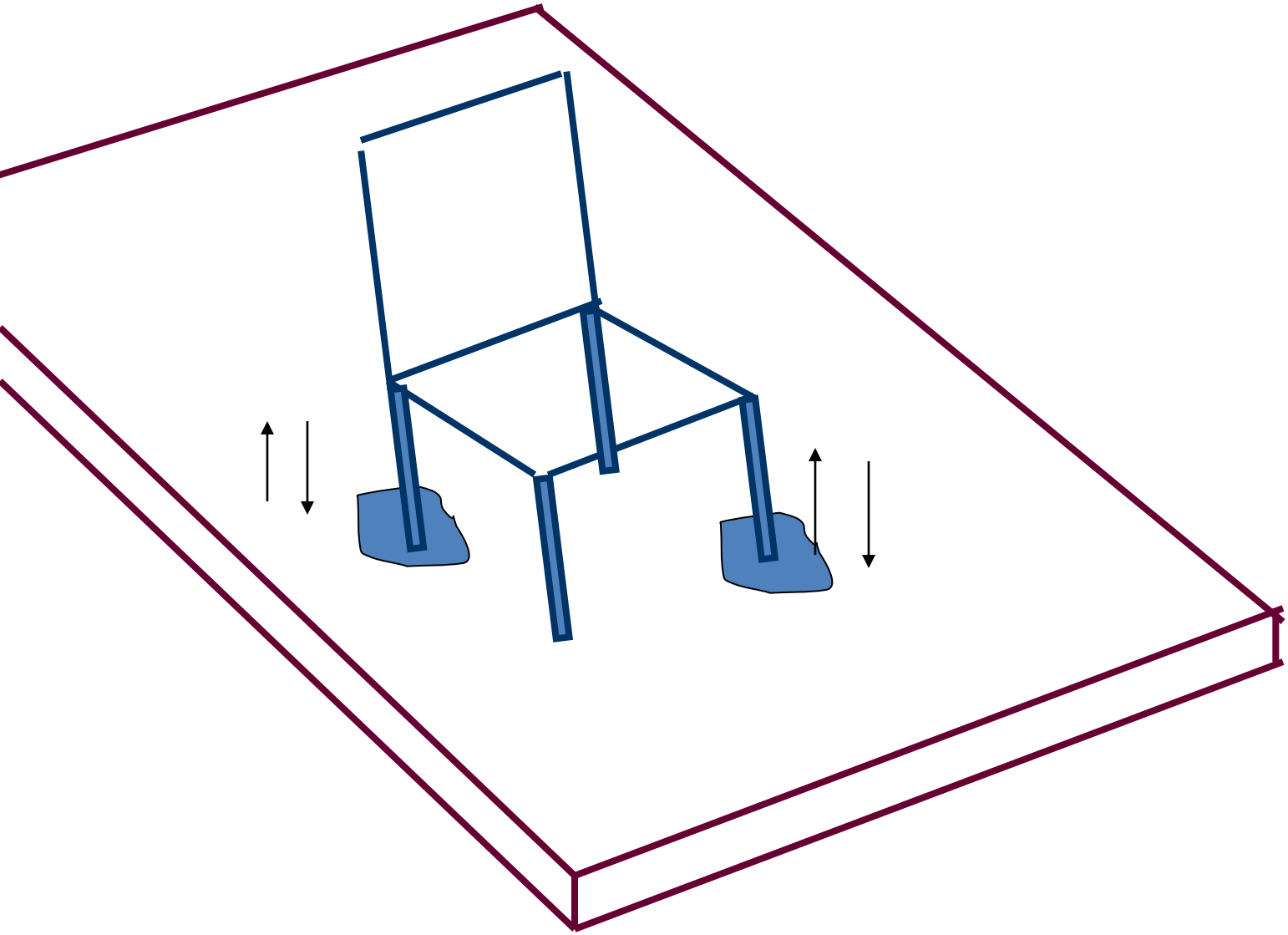
Algebraic sum 13mm Twist = 13/4 = 3.25 mm/m

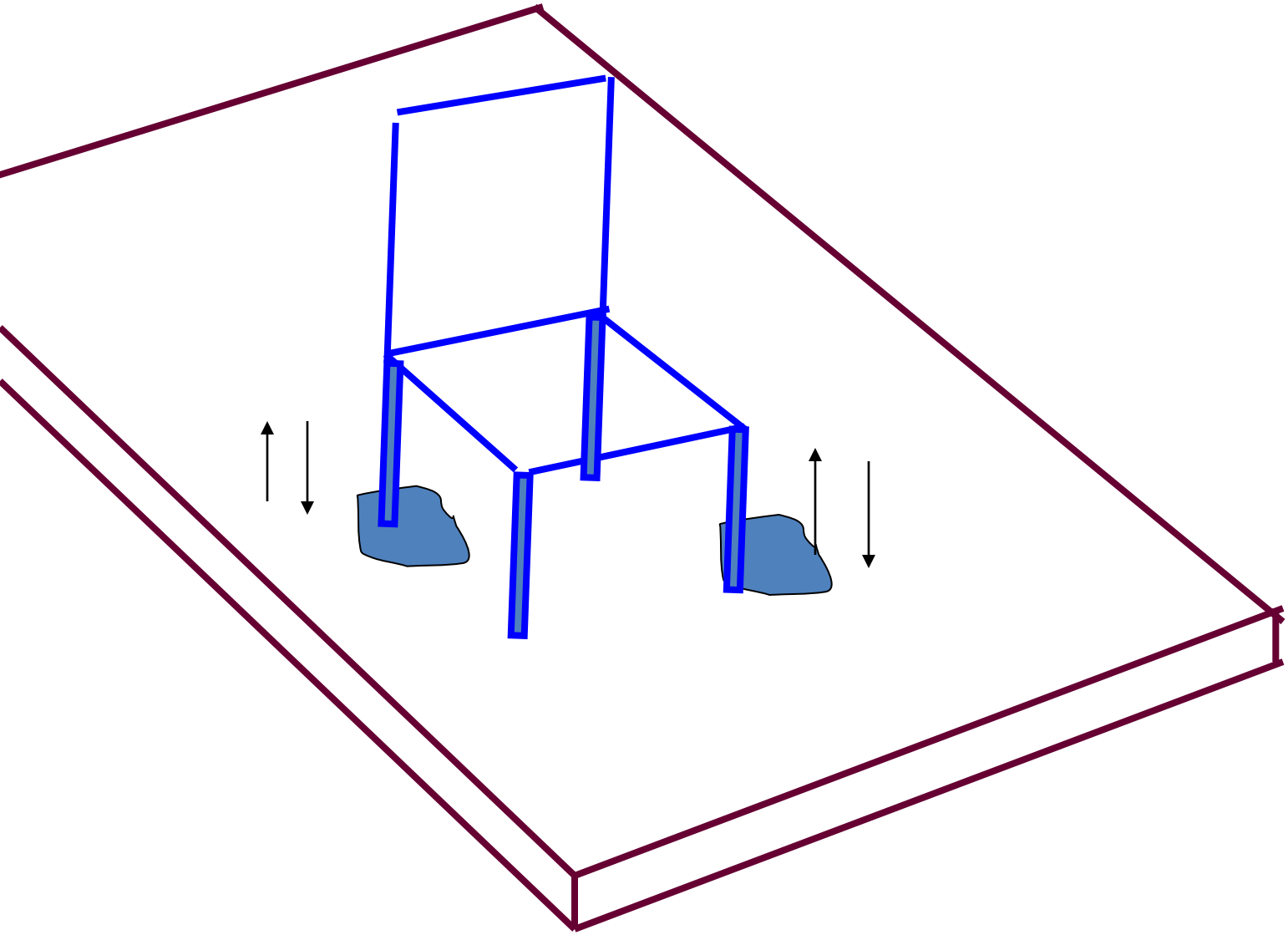
Limits for twist:

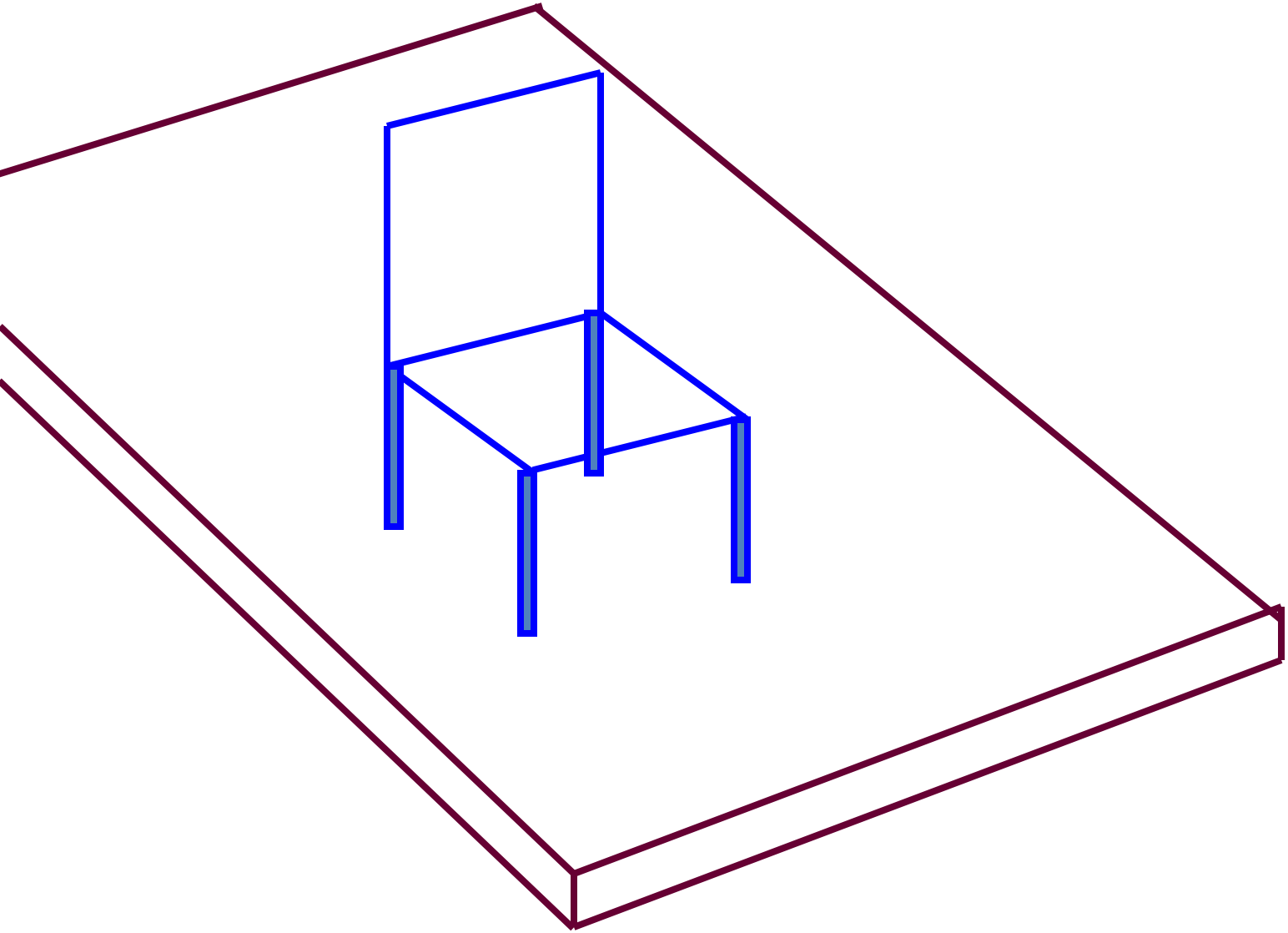
- *No upper limits have been prescribed in IRPWM.*
- *For a curved track a maximum of 1.4 mm per metre relaxable upto2.78 mm per metre has been prescribed vide IRPWM para 296.ii (a).*
- *we can interpret, that the maximum permissible twist for the straight track is 2.78 mm per metre.*
- *Para 607 of IRPWM categories a track with twist of 2.78 mm per metre as 'D' grade which is the lowest classification for track standards.*

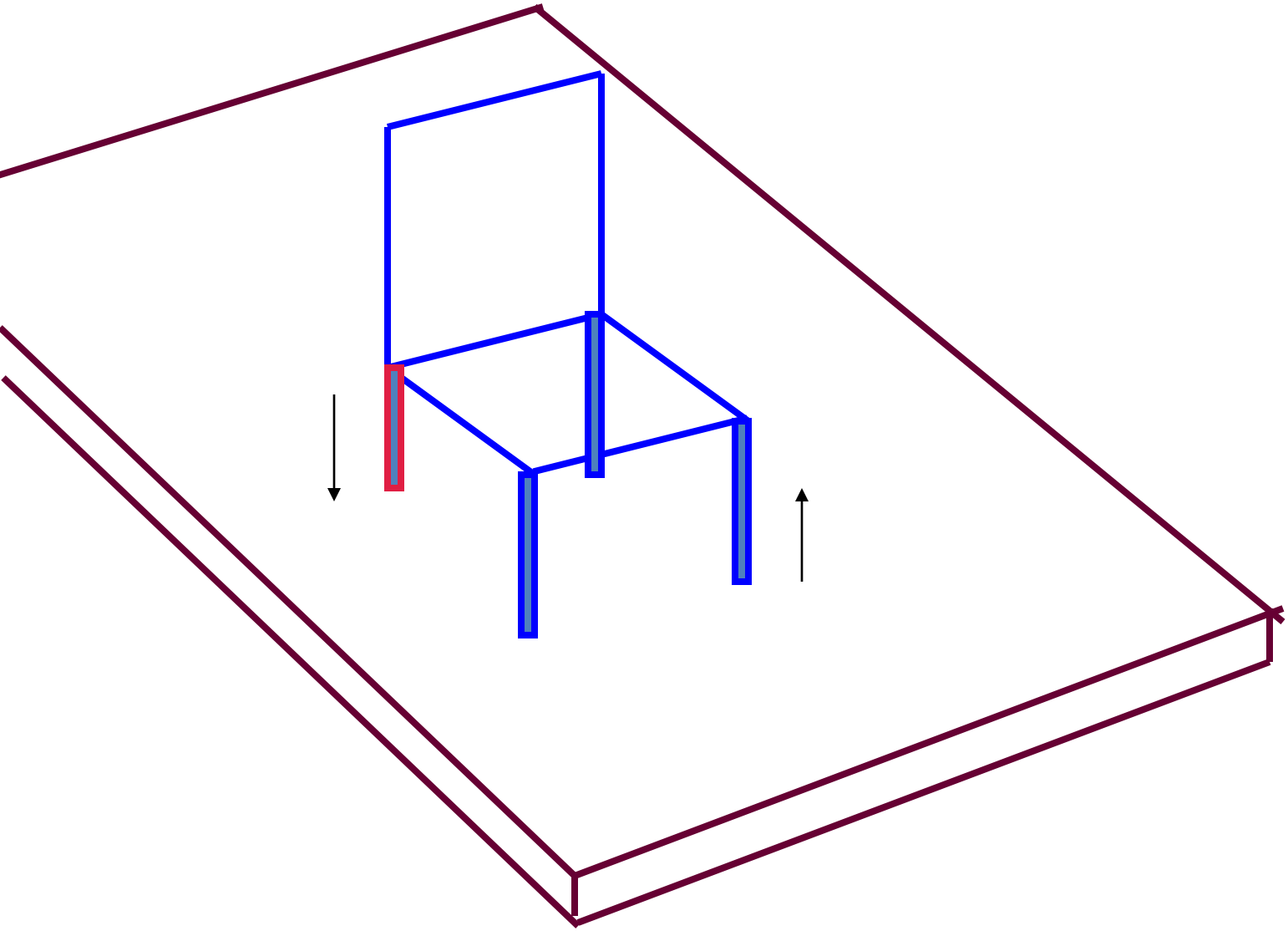


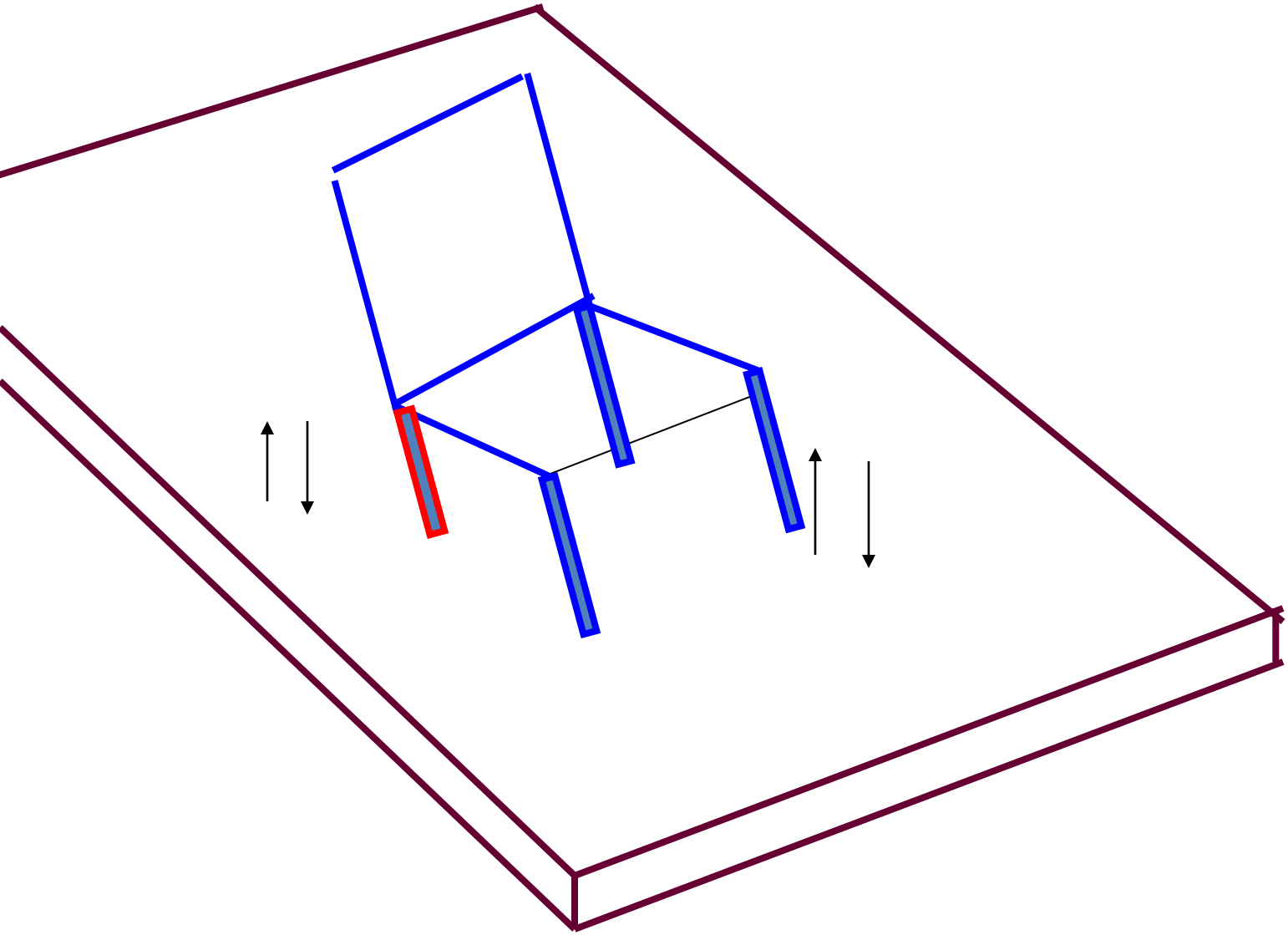




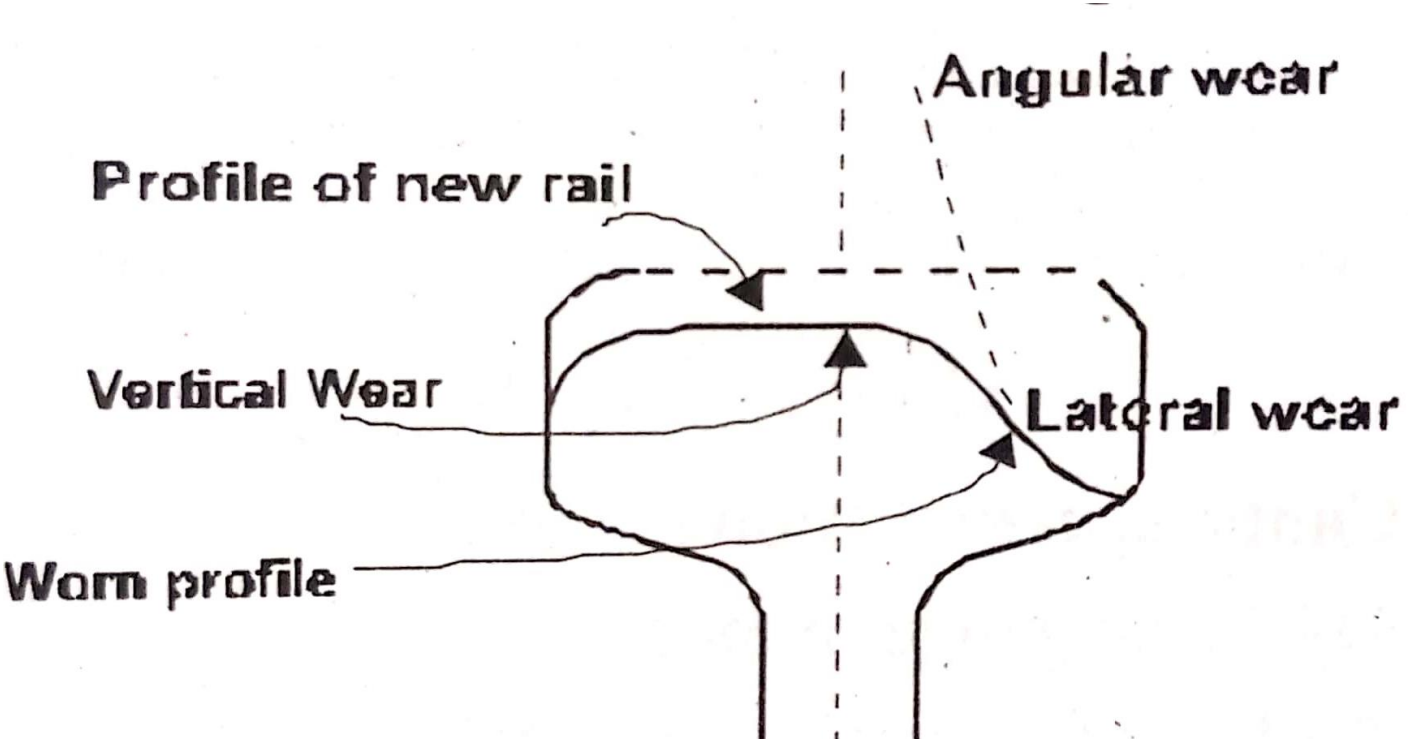








Rail Wear


Angular wear
Profile of new rail
Vertical Wear
Lateral wear
Worn profile

Vertical Wear: Measure the rail height at the centre of rail (normally using calipers or profiling)

Gauge	Rail section	Limit
BROAD GAUGE	60 KG/M	13 mm
	52 KG/M	8 mm

Lateral Wear: (Measured 13 to 15 mm below the rail top table)

Section	Gauge	Category of track	Limit of lateral wear
Curves	B.G	A & B	8 mm.
		C & D	10 mm
Straight	B.G	A & B	6 mm
		C & D	8 mm

Excessive lateral wear:

- Increases the play between rail and wheel.
- Increases the wheel hunting.
- Increases the angularity
- Increases the oscillations.

Excessive angular wear:

- The outer rail of the curve (sharp) and turn out is subjected to angular wear
- This will act as a ramp and cause the wheel flange to mount over the table.
- In this case clear mount mark will not be available.

Creep:

Creep is the longitudinal displacement of track, caused by various factors

- Rails not secured properly to the sleeper.
- Insufficient ballast which yields to the movement of sleeper during wheel movement.
- Badly maintained rail joints.
- Rails lighter than the prescribed type for the particular section of track.

- Improper expansion gap.
- Decay of sleepers.
- Uneven spacing of sleepers.
- Improper drainage.
- Loose and uneven packing .
- Rail seat worn out in the metal sleepers.

The creep in the track

i). Causes the sleepers to go out of square,

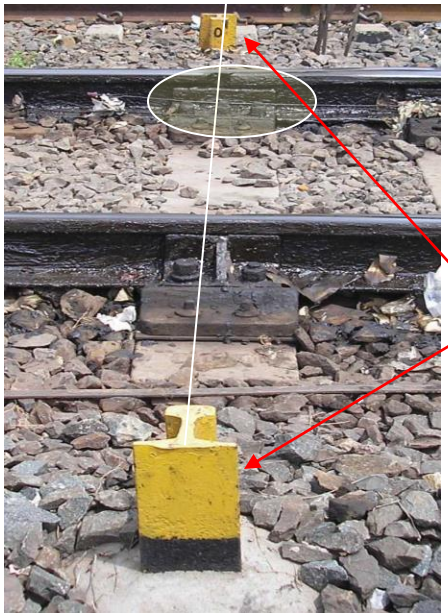
ii). Distorts the gauge,

iii). Causes shearing and breaking of spikes,

bolts and fishplates and

iv) Buckling of the track.

Switch expansion joint (SEJ)



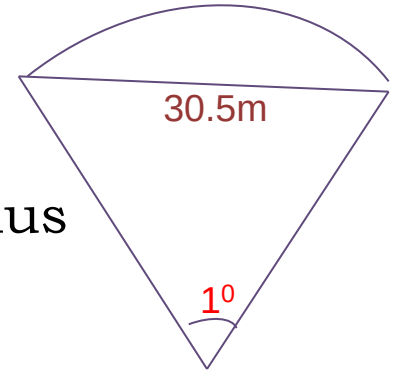
Method of measuring the creep

Creep in excess of 150 mm shall not be permitted. Ref.Para 242(6) of IRPWM

Curve

The angle subtended at the centre

by a chord of 30.5 m is the degree of the curve.



1° Curve is = $\frac{360*30.5}{2\,\Pi}$ = 1750 m radius

2° Curve has a radius of = 1750/2 = 875 m and so on

RH curve

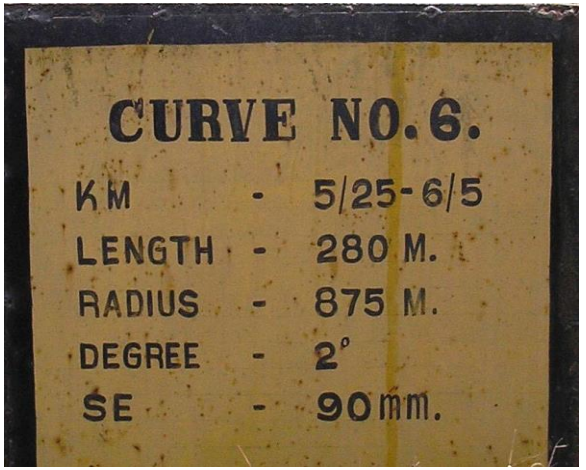
LH curve

Curve indication post

Curve shall be described invariably by the radius in meters.

The maximum degree of curvature on BG is 10^0

The maximum degree of curvature on MG is 16^0



Versine

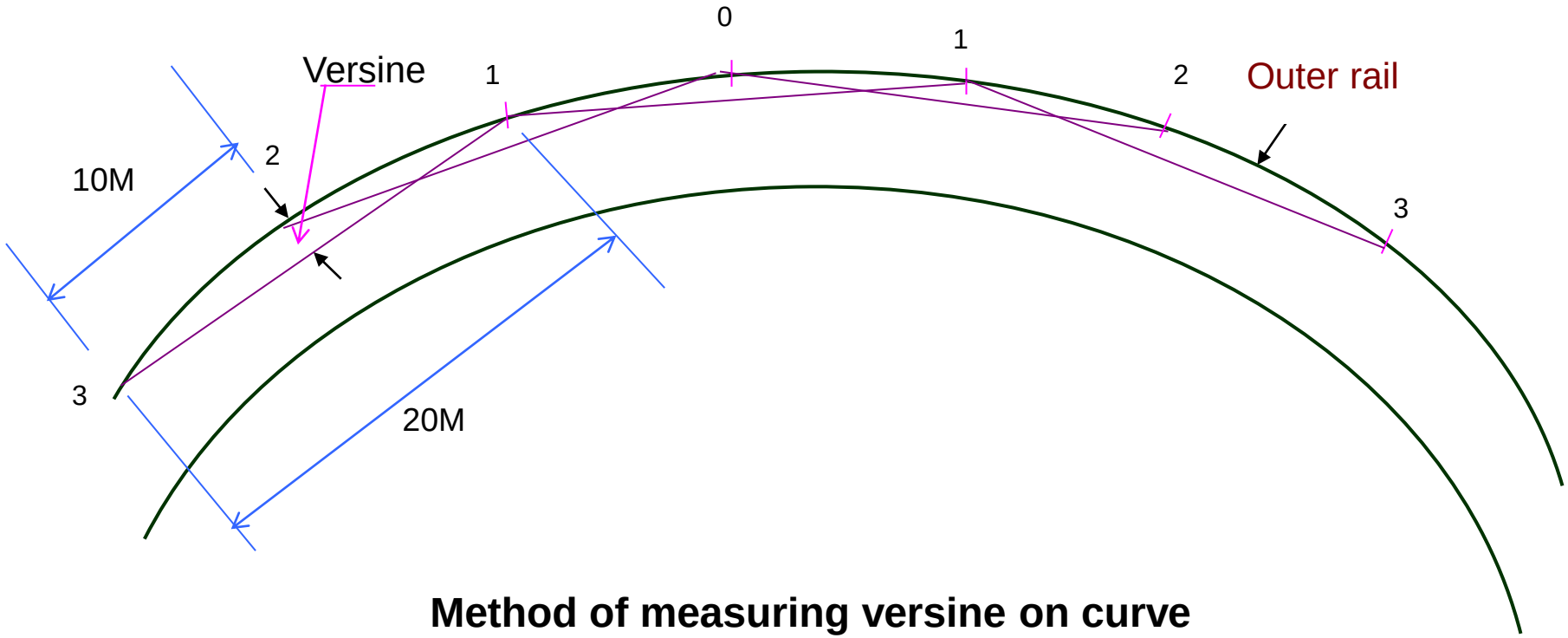
Radius of the curve is determined by measuring the versine on a chord of known length from the equation.

$$R = \frac{125\ C^{2}}{V}$$

R= Radius

C= Chord length in meter

V= Versine in mm



Method of measuring versine on curve

Para 401 (3).

- For measuring versines of a curve, 20 m overlapping chords should normally be used with stations at 10 m intervals.
- For checking radius of turn-out and turn-in curves, overlapping chord of 6 m should be used and the versine measuring should be located at every 3 m.

RANGE	LIMITS OF STATION TO STATION VARIATION
120 km/h and above	10 mm or 25% of the average versine on circular curve, whichever is more.
Below 120 km/h and up to 80 km/h	15 mm or 25% of the average versine on circular curve, whichever is more.
Below 80 km/h and up to 50 km/h	40 mm or 25% of the average versine on circular curve, whichever is more.

Super Elevation:

Cant or super elevation is the amount by which one rail is raised above the other rail.

- Outer rail of the curve is raised above the inner rail - +ve cant or SE
- Inner rail of the curve is raised above the outer rail- - ve cant or se

SE or Cant is $C = \frac{GV^2}{127R}$

C= Cant or SE in mm

G= Dynamic gauge in mm

R= Radius of the curve

V= Speed

Max Cant = 165 mm in BG for group ABC

Max Cant= 140 mm in BG for group D&E

Super Elevation:

Max Cant = 165 mm in BG for group ABC

140 mm in BG for group D&E

Cant deficiency – Maximum value of cant deficiency –

For speeds in excess of 100 km.p.h on Groups ‘A’ and ‘B’ routes for nominated rolling stocks and routes with permission of Chief Engineer … 100 mm

For Broad Gauge routes not covered by the above … 75 mm

Cant Excess – Maximum values of cant excess-

On Broad Gauge cant excess should not be allowed to exceed 75 mm.

Marking on the inner web of the outer rail

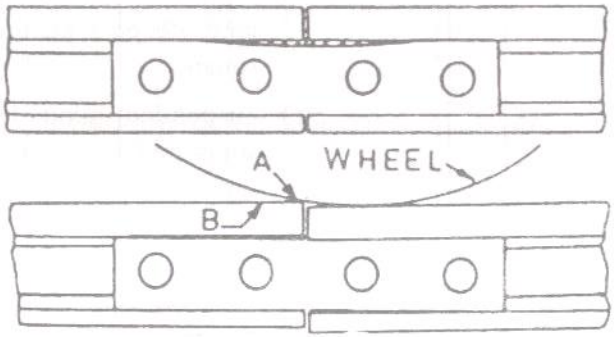
1 indicates station number.

V 12 indicates the versine at this station

SE 15 indicates the super elevation at this station

RAIL ENDS

(a) *Battering:* Batter is a wear on the rail table.



Wear at Rail Joint

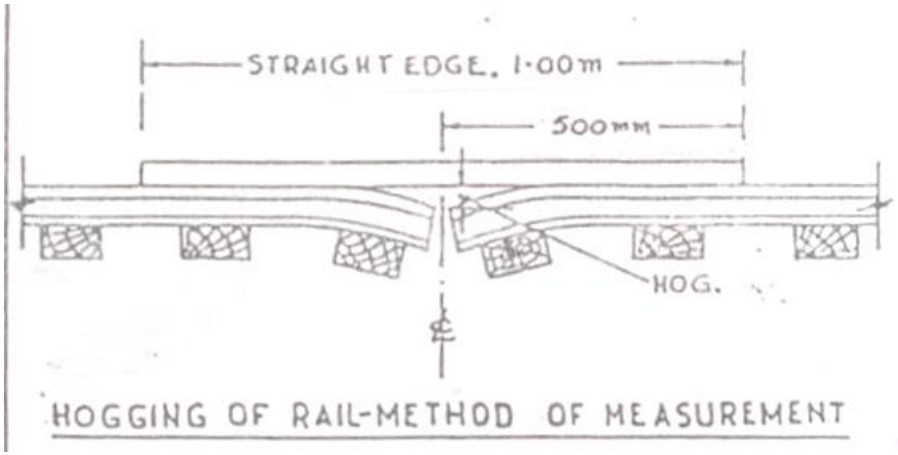
it disturbs the packing below the joint sleepers. The situation is much worse with excessive expansion gap and bad maintenance of joint assembly fittings.

Gap survey

measured for each rail by a steeped feeler gauge when the rail temperature is between 15^{o} and 45^{o}C

REcommended Gap

Rail temperature at the time of measurement	**Range of expansion gap in mm**
0 to 10^{o} C	12 to 8
10 to 25^{o} C	10 to 6
25 to 40^{o} C	8 to 4
40 to 55^{o} C	6 to 2
55 to 70^{o} C	4 to 0
Above 70^{o} C	0



Hog

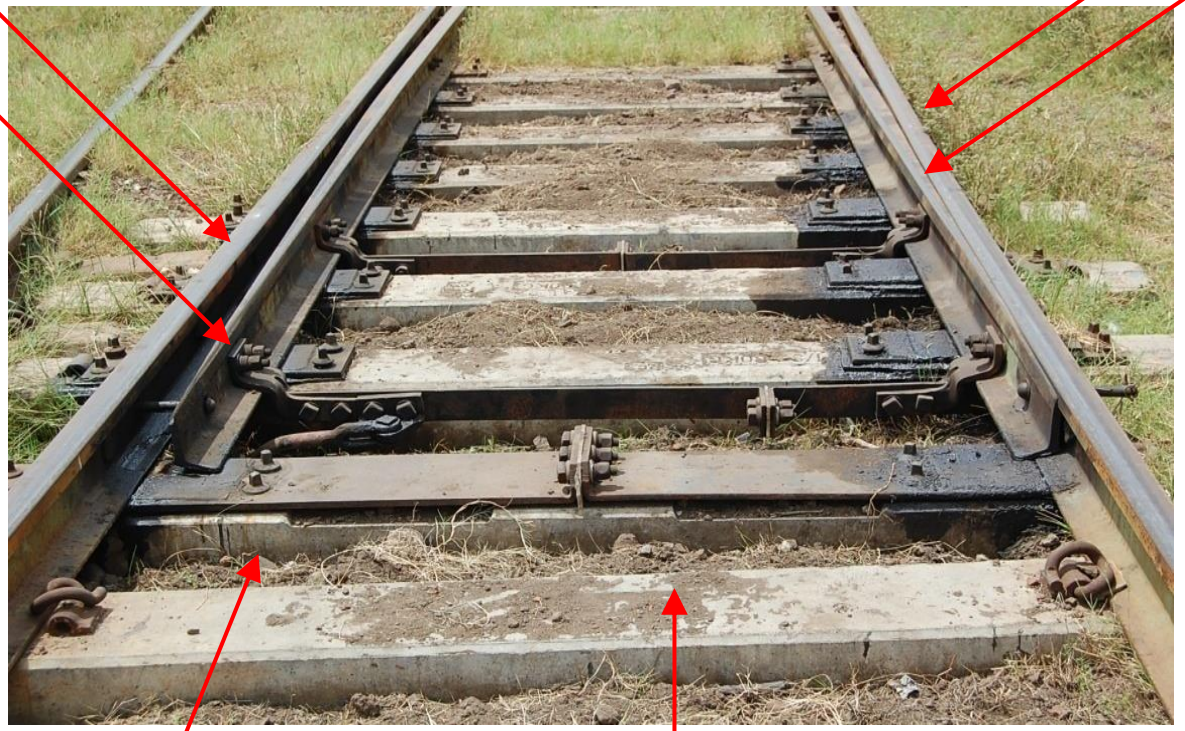
- Hog is a permanent vertical bend/ set in the rail
- caused mainly due to bad maintenance of joints. para 249(5) of IRPWM

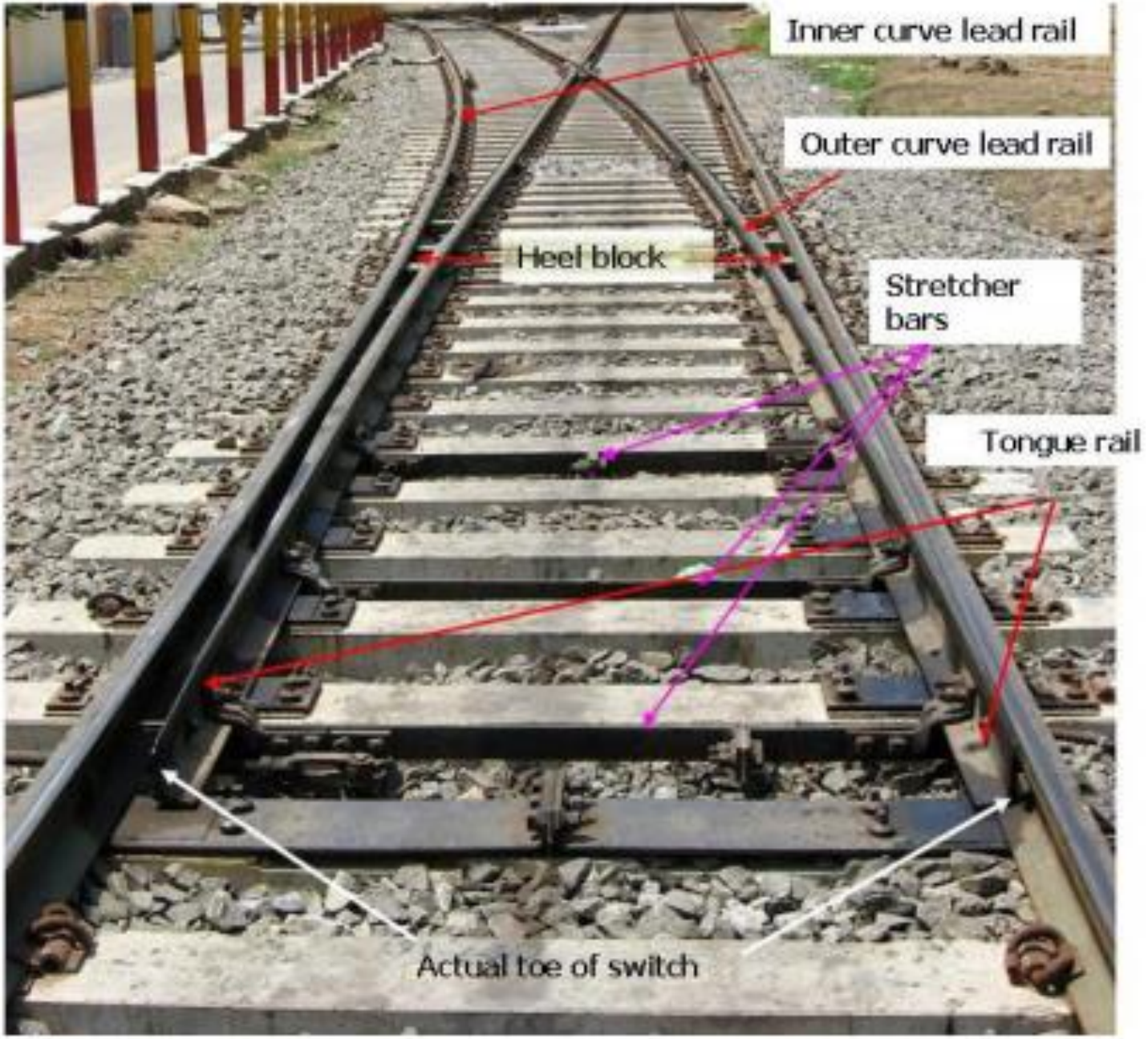
Points & crossings

1.Points and crossings are designed for

- switching trains from one road to another.
- This consists of a pair of tongue rails called the switch, operated by lever located adjacent to the point or from a cabin.

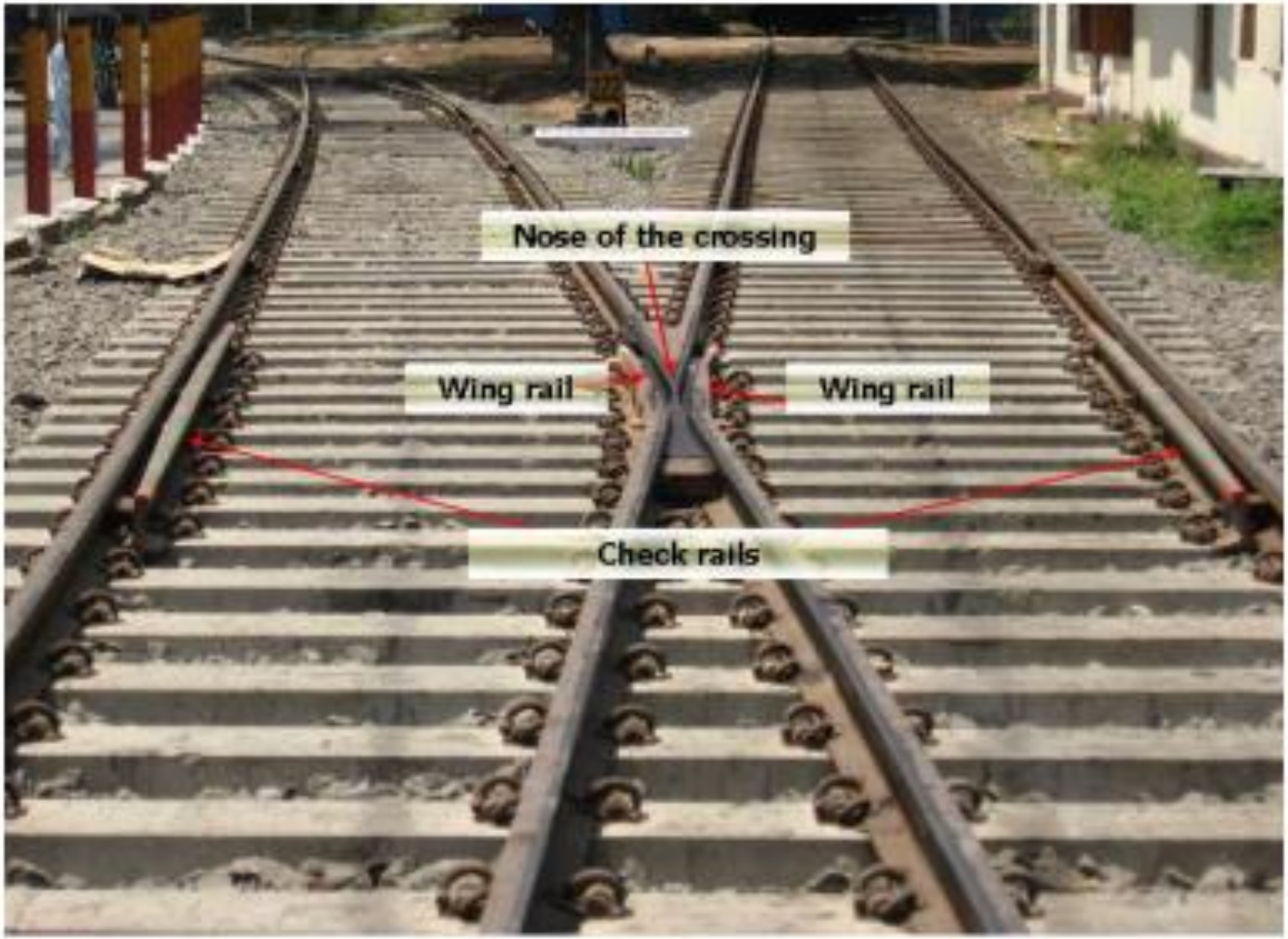
Points


RH Stock rail
LH Stock rail
RH Tongue rail
LH Tongue rail
PSC sleepers for points
Facing side of Points

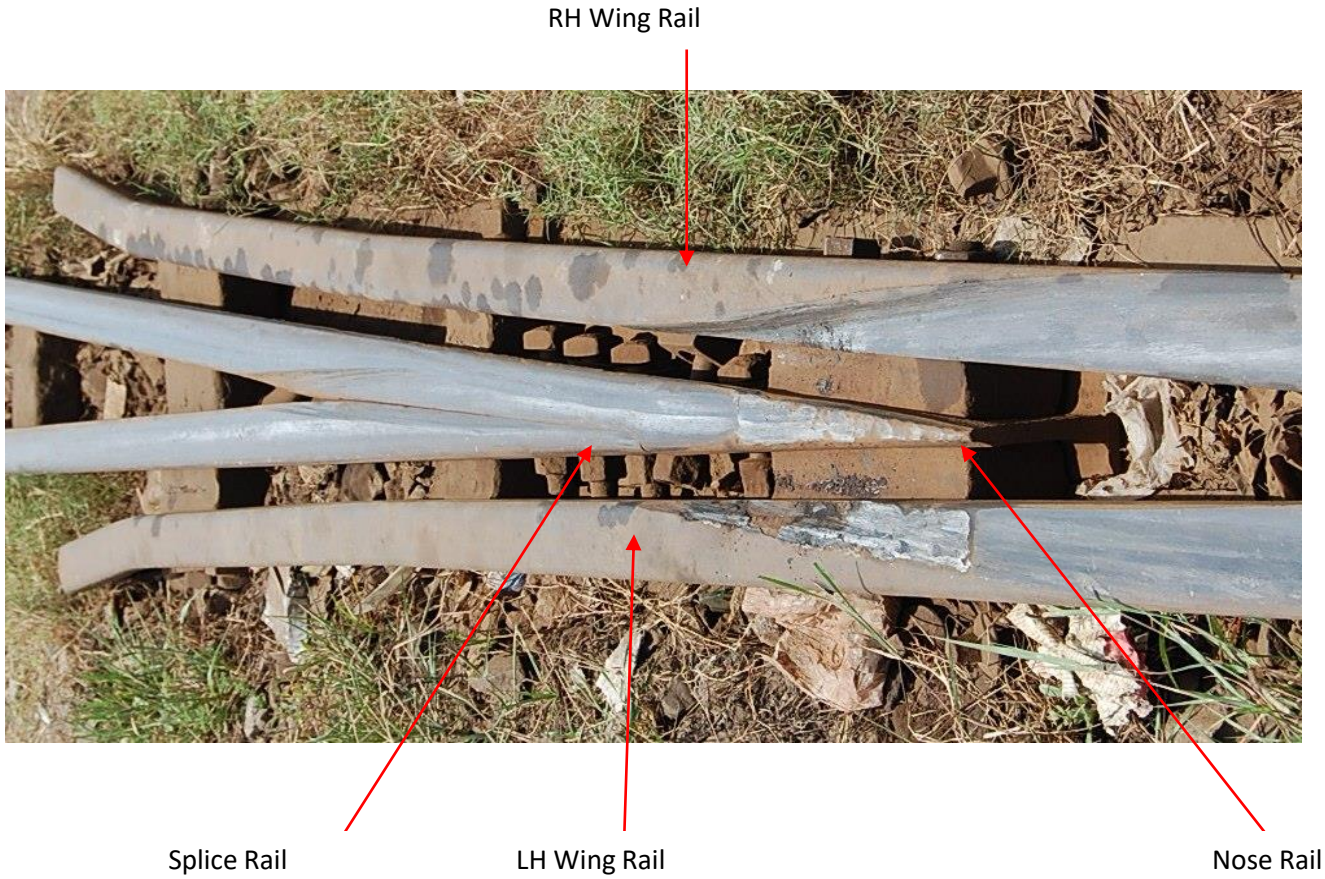

Inner curve lead rail
Outer curve lead rail
Heel block
Stretcher bars
Tongue rail
Actual toe of switch

POINTS

CROSSINGS

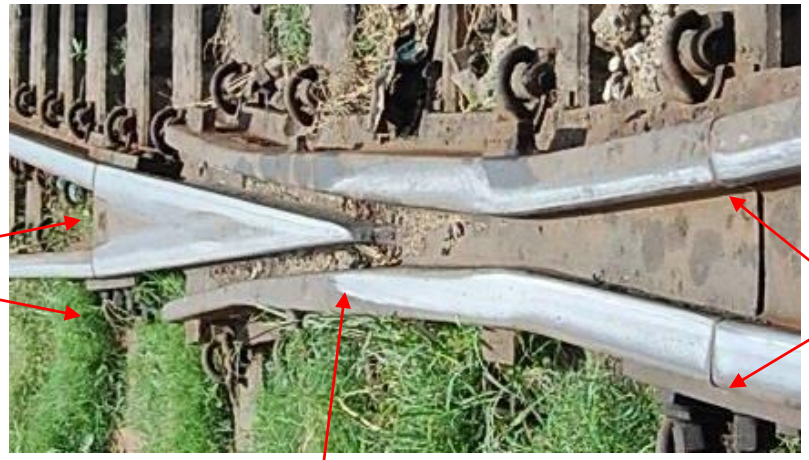


Crossing



Conventional crossing (or) Built up crossing

The portion from the heel of the switch to the nose of the crossing



Cast manganese Steel (CMS) Crossings

Check rail at the nose of crossing

In points and crossings, the following aspects should be checked and recorded.

a. Height of the tip of the switch from the top of the stock rail table.

b. The extent of breakage of the tongue rail from the tip.

c. The thickness of the tongue rail.

d. Nature of the breakage, old or new.

e. In locally operated points, whether the point is cottered.

f. The gap between the tongue rail and stock rail, in closed position.

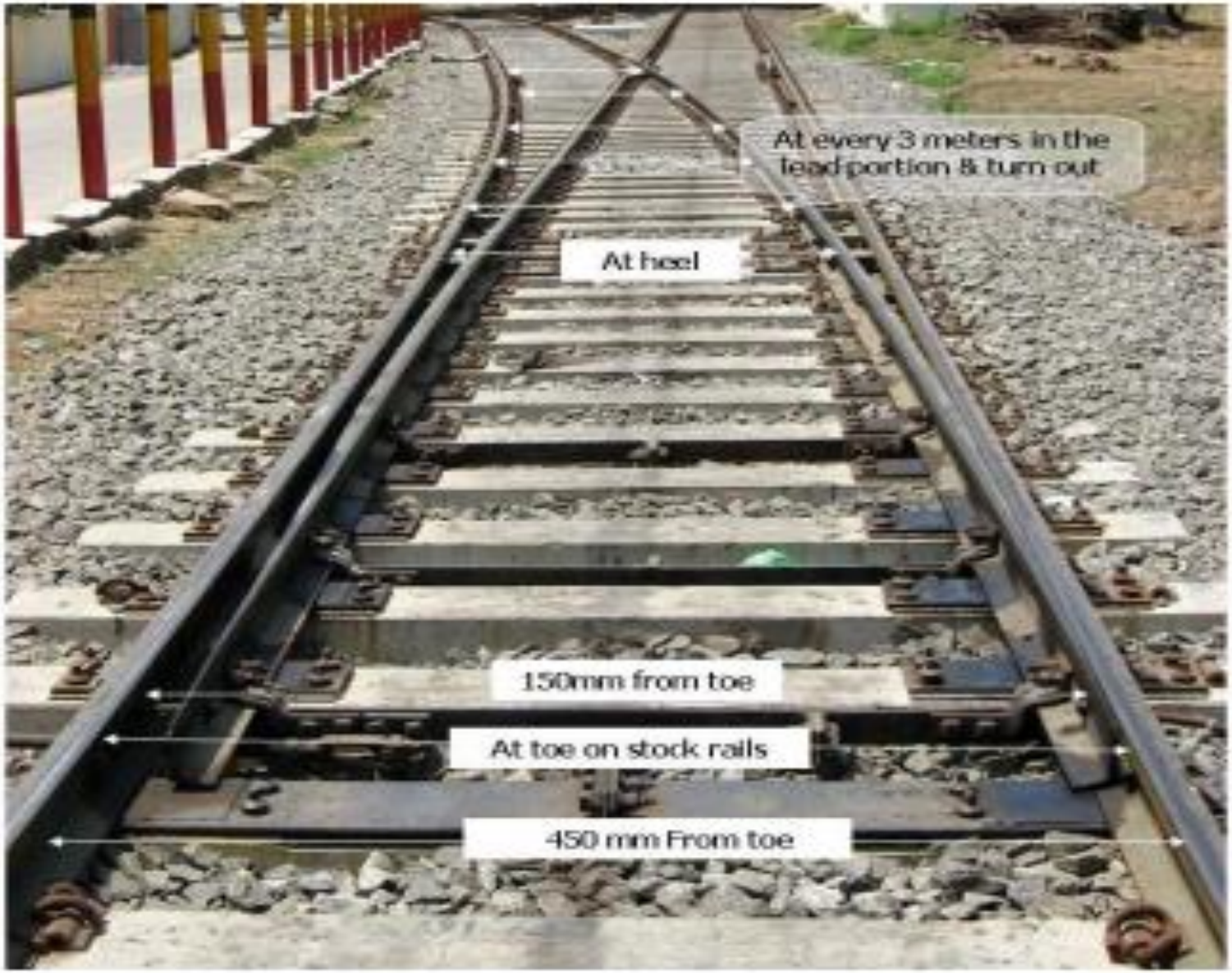
g. The damage to the stretcher bar.

h. The nature of breakage of the tongue rail-

Whether the breakage is outward or inward. When there is a gap between the stock rail and tongue rail the tip of the tongue bends inwards and ultimately breaks.

i. If the damage is caused due to defective wheel flange, the tip of the tongue rail bends outward and breaks.

Locations where gauge & cross levels are measured on Points & crossings




1 metre from nose
At Nose
1 metre from nose

'Go-No go' gauge for measuring wing rail, check-rail clearance

Measuring the wear at the nose of the rail

Measuring the throw of switch


Thickness of the
toe of switch


Height of tip of switch from
stock rail table

The relevant paragraphs pertaining to points and crossings are reproduced from the IRPWM Para 237

- The gauge shall be uniform except at a point just ahead of the toe of switch, where it will be slightly slack enough to house the tip of the tongue rail.
- The clearance at the toe, heel of switch, at check rail and wing rail must be maintained within the tolerances .
- Packing under the sleepers must not be loose/ defective especially under the crossings and the switch.

- The chairs, fastenings and other fittings must be properly secured.
- The points and crossings assembly should be in good condition and in alignment with the rest of the track without kinks.
- Adequate creep anchors should be provided to arrest creep.
- Creep posts should be erected at all inter-locked facing points opposite the toe switch.
- creep should not be allowed to exceed permissible limits.

Rail fracture

- Fractured surface is old or new,
- any portion of the fractured rail is missing,
- point of mount and / or point of drop is ahead of the fracture or in rear of the fracture.

In case of fracture,

- The wear of the rail has to be recorded.,
- The profile should be taken as close to the fracture as possible, and
- The loss of weight should also be found out.

(Ref para 6 (2) (b))*IRPWM Para 302.1 (b)*

BROAD GAUGE	52 Kg.	6.00 %
	90 R.	5.00 %
METRE GAUGE	75 R.	4.20 %
	60 R	3.25 %

Packing of sleepers

The aim of packing is to

- ✓ have each sleeper firmly and uniformly packed
- ✓ ensure that the rails are at their correct relative levels on the straight track
- ✓ the required cant on curves
- ✓ no sleeper has any void between it and its bed.

For good drainage periodical screening of ballast is essential.

Fouling Marks - (1) Fouling marks should be distinctly visible and difficult to remove.

(2) These should be fixed at the point at which the spacing between the tracks, begin to reduce to less than the minimum as laid down in the schedule of dimensions.

There should be no junction fish plates at stock rail joints or at the heel of crossings. At least one rail on either side of the Points and Crossings should have the same section as the Points and Crossings assembly rail section.